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Editorial

Providing alternative livelihoods to fishers may have a slightly different meaning in Oceania than in other parts of the world. As Sharp and Blanc, and Adams explain in their articles about small-scale fisheries (p. 6 and p. 37), for Pacific Islanders, fishing is not “an activity of last resort” to provide a livelihood, and in most Pacific Islands, fishers are not among “the poorest of the poor”, but are often specialists carrying certain inherited rights that give them a respected status.

Therefore, in the hope of reducing fishing pressure on reef or coastal resources, one can hardly ask a fisher to become a handicraft-maker, a gardener or a hotel employee. Even aquaculture has probably been more attractive to farmers or business people than to fishers in Oceania. Speaking of aquaculture, don't miss the articles in this issue on lobster farming in New Caledonia (p. 21) and the production of *Platax* in Tahiti (p. 23).

Alternative livelihoods for fishers must have a link to fisheries, either in activities where fishing skills are recognised and valued — such as being a sportfishing guide for tourists — or in capture-based fishing activities targeting species that are not (yet) under pressure.

Diamond and other “giant” squids may become one of these alternative fisheries. An exploratory deep-sea fishing trip took place in waters off New Caledonia in August 2012. Dropping lures to 500-m depths in waters where it had never been done before and hauling in several diamond squids of close to 20 kg each must have been really exciting (see article on p. 2).

It is not expected that all small-scale fishers will quickly switch to this new resource. Markets for diamond squid will probably be exclusively local at first, as its value on the world market is currently too low to consider exporting it from the Pacific Islands, and the resource is known to be seasonal and relatively fragile. It will, therefore, need to be closely managed, probably by limiting the number of entrants. But, it may provide an additional possibility for diversification, along with targeting small pelagic species with a *bagan* or bigger pelagic species around fish aggregating devices (FADs).

Even for small-scale fisheries, most of the new opportunities seem to arise away from reefs and coastal areas... “Go offshore, young fisherman!”

Aymeric Desurmont

Fisheries Information Officer (aymericd@spc.int)

Masterfishermen talk! Ryoichi Kawasaki, of Japan, shares his expertise of diamond squid fishing with William Sokimi, of Fiji (image: Manu Ducrocq).



Exploratory squid fishing in New Caledonia: nothing rough about these diamonds!



William Sokimi holds one of the very first diamond squid caught in New Caledonia waters (image: Manu Ducrocq).

In August 2012, for the purposes of diversifying coastal fishery activities, the SPC Nearshore Fisheries Development Section, in conjunction with the New Caledonia Merchant Navy and Sea Fishery Department (SMMPM) and the ZoNéCo Programme, using funding from the French Development Agency (AFD), carried out a deep-sea fishing trip in waters off New Caledonia. The aim of the trip was to confirm the presence of commercially viable “giant” squid stocks and also to identify possible alternative coastal marine resource development opportunities.

Initially scheduled for the 2011 cool season, this project had been postponed for lack of funding. AFD's financial support and the availability of the SMMPM's research vessel *Amborella* made the idea viable, as did the presence of Masterfisherman Ryoichi Kawasaki from Okinawa, where this resource has been commercially exploited since the late 1980s (from 15 tonnes in 1989 to more than 2000 tonnes today). Together with SPC Fisheries Development Officer William Sokimi, the *Amborella* crew conducted two consecutive fishing trips between 21 and 31 August 2012, over a total of eight fishing days, setting vertical drifting lines 500 m in length, each fitted with four jigs, at depths of 1500 to 2000 m. The results far exceeded our hopes, because no less than 70 squid, amounting to a total weight of 785 kg (average weight 11.2 kg), were caught! Two species of commercially exploitable “giant” squid therefore occur in New Caledonia and apparently in major quantities: the

diamond squid (*Thysanoteuthis rhombus*) — or *sei-icko*, as it is known in Okinawa, where it is exported to the main islands of Japan to be consumed raw as sashimi or sushi — (35 specimens caught, with an average weight of 18 kg) and another species, the neon flying squid (*Ommastrephes bartramii*), smaller in size and with lower commercial value (35 specimens caught, average weight 4.6 kg). The most impressive catch, a superb diamond squid, weighed 21 kg and had a mantle length of 88 cm. This fishing trip, out beyond the southern and western lagoons of New Caledonia, therefore confirmed the presence of a commercially valuable giant squid resource, which is as yet totally unexploited.

Even if the price paid for diamond squid to Japanese fishers appears not to be high enough to consider exporting it from the Pacific Islands to Japan, it does seem quite feasible to develop this resource as part of efforts

to diversify coastal fishing, by targeting local markets and restaurants. This was the goal that the ZoNéCo Programme had already adopted for next year by commissioning a study to further capitalise on the results of the 2012 fishing expedition. The goal will be to conduct a more detailed evaluation of the presence of offshore squid in the New Caledonian EEZ (several fishing trips would be carried out around the main island, but also around the Loyalty Islands). At the same time as the resource assessment work, a small number of coastal fishers will be trained in fishing techniques and on-board catch processing and the local market will be tested for commercial potential.



The diamond squid's (left) mantle length can reach 100 cm; the mantle length of the neon flying squid (right) doesn't exceed 45 cm (images: Manu Ducrocq).

Contrary to most cephalopods, the diamond squid has the special characteristic of living as a couple. This therefore is a fragile resource liable to shrink rapidly if overfished. The development of a management plan for this resource will therefore be the final stage before beginning commercial exploitation of diamond squid in New Caledonia. Through our contacts in Okinawa, SPC will facilitate the implementation of the economic zone project for New Caledonia. It will also be available to conduct experimental squid fishing trips in other countries of the region.

For more information:

Michel Blanc

Nearshore Fisheries Development Adviser, SPC
(MichelBl@spc.int)

Manu Ducrocq

Fisheries Scientist, ZoNéCo
(zoneco@lagoon.nc)



A typical squid fishing boat from Okinawa (image: M. Blanc) and the lures and light used on each dropline (image: W. Sokimi).



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Improving biological knowledge of deepwater snapper in the Pacific

Deepwater snapper are an important fisheries resource in several Pacific Island countries, where they support important domestic and export markets. Observations of localised depletions in some fisheries have raised concerns about the sustainability of current fishing rates. However, quantitative assessments of deepwater stocks in the Pacific region have been limited by the lack of adequate biological and fisheries data. SPC's Oceanic Fisheries Programme (OFP) is working on several fronts to improve understanding of the biology of deepwater snapper and other deepwater species in the region. New biological information will be used to underpin improved assessments and allow sustainable development of deepwater snapper in Pacific Island countries.

It is generally assumed that deepwater snapper are long-lived, slow-growing and late to mature, making them vulnerable to overfishing. However, there is surprisingly little information on the biology of most deepwater species to verify this assumption. The SPC OFP is implementing two biological sampling strategies to obtain detailed information on age, growth rates, mortality rates, maturity schedules and stock structure of deepwater snapper throughout the region.

The first approach is to conduct dedicated research cruises in several countries on remote seamounts that have received little historical fishing pressure. Biological samples from these cruises will provide a picture of what the biology of relatively unexploited populations looks like. The second approach is to collect biological samples from fishers after they land their catch in port. These samples allow estimation of what the biology of an exploited population looks like. Researchers can then compare the unexploited exploited populations to determine the impact of fishing.

The specific biological samples being collected include otoliths, gonads and fin clips (Fig. 1). Like trees, otoliths have distinct growth rings that can be counted to estimate

the age of the fish. Growth rates can then be determined by relating fish age to fish size. Gonads are used by scientists to determine the sex of fish and the stage of reproductive development (e.g. immature, mature, spawning), and to estimate fecundity for females (Fig. 2). This information is important for fisheries management as it makes it possible to determine the proportion of the population that is reproductively active, which is required to estimate the ecological sustainability of the fishery. DNA from fin clips will be used to examine the genetic variability in deepwater snapper populations across the Pacific and to identify management units in Pacific Island countries.

The SPC OFP is also collaborating with Dr Kim Andrews, a geneticist at the Hawai'i Institute of Marine Biology, University of Hawai'i, who has recently discovered that one of the key target species in the deepwater snapper fisheries, the ruby snapper (*Etelis carbunculus*), may actually consist of two separate species (*E. carbunculus* and *E. marshi*) (Fig. 3). From the samples collected from the fishery in New Caledonia, *E. carbunculus* range in size from 28 to 115 cm fork length (FL), but *E. marshi* only range from 25 to 35 cm FL. The large difference in maximum size suggests that growth rates and maturity schedules are also likely to be different between the two species.

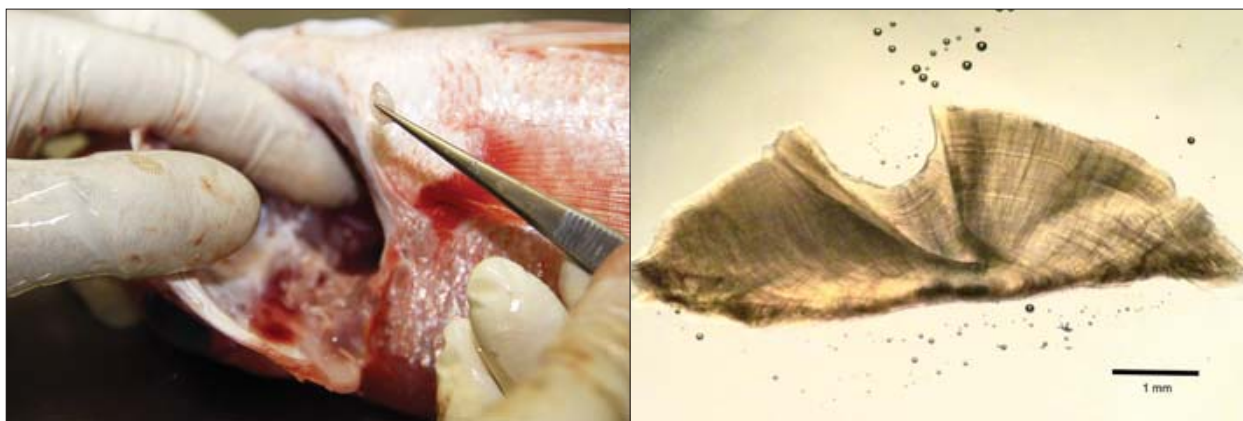


Figure 1.

Left: an otolith removed from a ruby snapper (*Etelis carbunculus*).
Right: a sectioned otolith from a ruby snapper viewed under a microscope.

Fin clips collected from individuals caught in New Caledonia have been sent to the laboratory at the University of Hawai'i for analysis, and morphometric measurements and photographs have been taken from each individual. Preliminary results have shown that approximately 15% of the ruby snapper sampled in New Caledonia were actually *E. marshi*. By comparing the results from the genetic analysis with images and measurements, SPC OFP scientists hope to identify reliable features that can be used to distinguish between the two species in the field. At this stage, SPC scientists have identified one consistent difference between the two species. All of the *E. carbunculus* collected so far have a small black margin on the upper lobe of the caudal fin (see white circle in Fig. 3); whereas all of the *E. marshi* do not have this feature (Fig. 3).

It will be important that these species are identified correctly in the catch records from deepwater fisheries because species with different biology are likely to respond differently to fishing pressure. The SPC OFP will be working closely with the SPC Fisheries Information Section to update the species identification booklet for deepwater species as necessary.



Figure 2. Removing the gonads from an immature ruby snapper (*Etelis carbunculus*).

For more information:

Ashley Williams

Deepwater Snapper Scientist, SPC
(AshleyW@spc.int)

Simon Nicol

Principal Fisheries Scientist, SPC
(SimonN@spc.int)



Figure 3.

Two species currently described as a single species (*Etelis carbunculus*)
A: Ruby snapper (*Etelis carbunculus*); B: New species (proposed: *Etelis marshi*).

Securing sustainable small-scale fisheries

Small-scale fisheries (SSF) are of significant importance in the Pacific. Industrial tuna fisheries tend to attract more attention than SSF, however SSF make a larger contribution to gross domestic product (GDP) than all other capture-based fishing and aquaculture production sectors in 15 of the 22 Pacific Island countries and territories (PICTs) (Gillett 2009).

The Food and Agriculture Organization of the United Nations (FAO) and the Secretariat of the Pacific Community (SPC) recently co-hosted the Pacific Regional Consultation on the development of Guidelines for Securing Sustainable Small-Scale Fisheries. The guidelines seek to enhance the contribution of SSF to poverty alleviation, food security and economic growth. They are intended to support the enhancement of the sector's already important role and to contribute towards the eradication of hunger and poverty (FAO 2012).

What are small-scale fisheries?

FAO (2005) defines SSF as traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amounts of capital and energy, relatively small fishing vessels (if any), making short fishing trips that are close to shore and using fish mainly for local consumption. In practice, the definition varies between countries. SSF can be subsistence or commercial fisheries, providing fish for local consumption or export.

For this paper, we adopt the definition of SSF (also called artisanal fisheries) as including capture-based subsistence and commercial coastal and freshwater fishing.

The importance of small-scale fisheries

SSF generate income, provide food and make an important contribution to economic development. They employ over 90 per cent of the world's capture fishers and fish workers, about half of whom are women (FAO 2012). In addition to full- and part-time fishers and fish workers, occasional fishing often provides vital supplements to other livelihood activities in times of difficulties or as a recurrent side-line activity.

SSF in the Pacific are of great importance to the economies of all PICTs. They are an important source of livelihood, food security, employment and income, economic growth, recreation and culture.

Figure 1 shows the breakdown of the fisheries sector's contribution to the gross domestic product (GDP) of the combined economies of the Pacific.

The significance of SSF to the aggregated economies of the Pacific Islands is well demonstrated in Figure 1. SSF accounts for 53% of fisheries' total contribution to GDP, which significantly outweighs the contribution from locally based industrial fleets (35%) and aquaculture (12%). Note that these figures exclude post-harvest activities.

SSF is the most important fishing sector, in terms of value added to the domestic economy, in 15 of the 22 PICTs. Figure 2A provides a breakdown of the contribution of different fisheries sectors to GDP by country.

Figures 2A and 2B display the importance of SSF to the economies of the 22 PICTs, with SSF contributing a larger proportion to GDP than any other capture-based fishing or aquaculture production sector in 70% of PICTs. Again, these figures exclude post-harvest activities.

Figure 3 presents the makeup of SSF by capture-based subsistence, coastal commercial and freshwater fisheries, which gives an indication of what subsector makes the most significant economic contribution. In a majority of cases, the largest subsector contributor to GDP is subsistence — fishing for household consumption — which is often undervalued because it is difficult to measure.

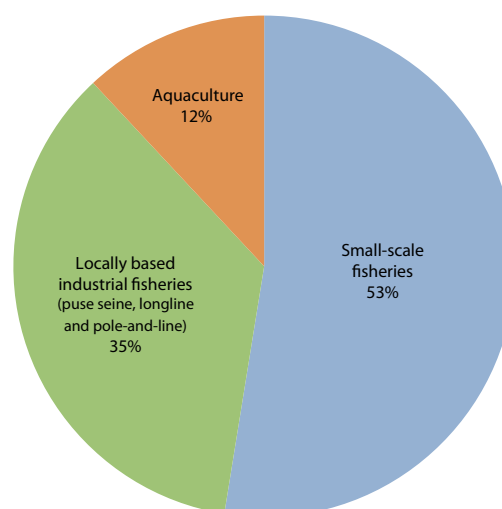


Figure 1. Contribution by fisheries sector to GDP of all PICTs (2007). Source: Gillett 2009.

SPC ACTIVITIES

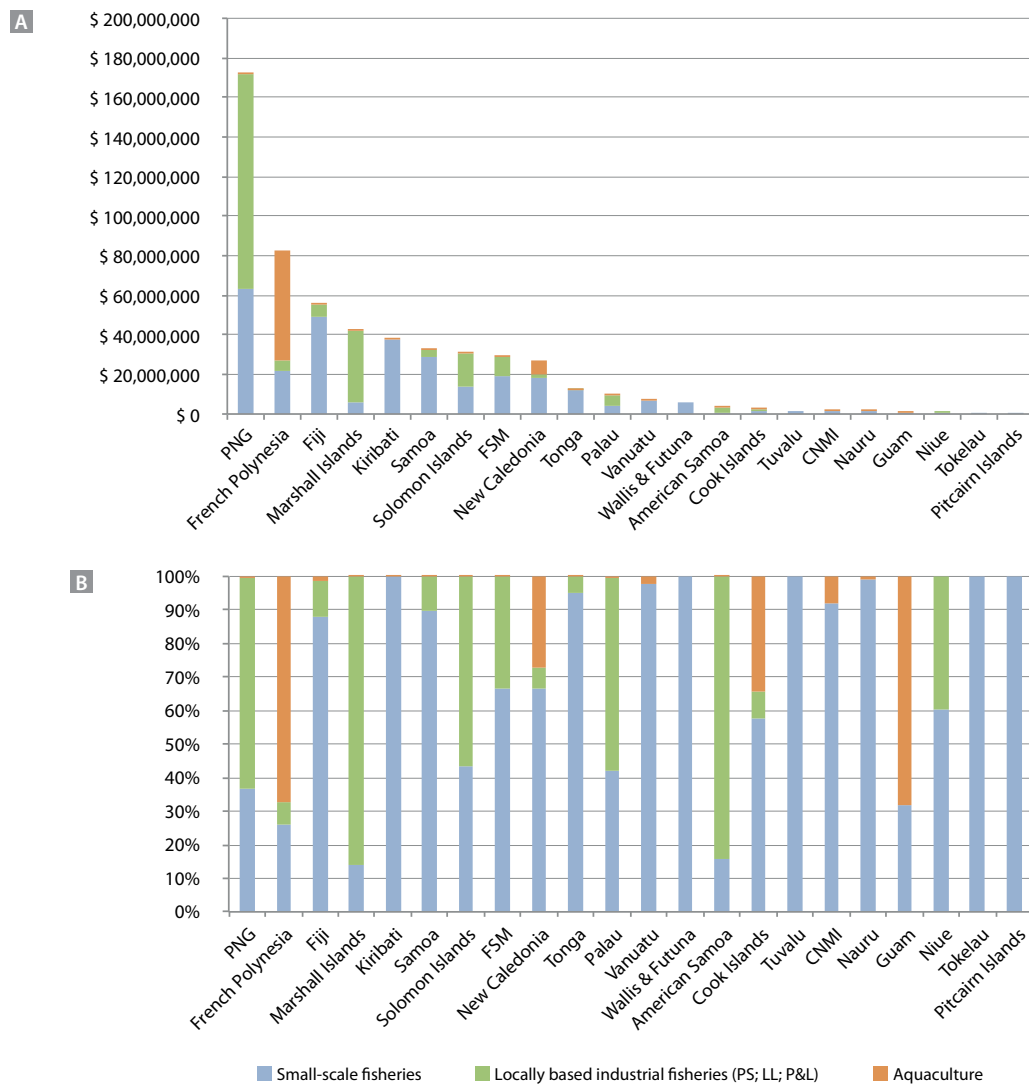


Figure 2. Composition of fisheries sector's contribution to GDP by country (2007).

Source: Gillett (2009).

PNG = Papua New Guinea; FSM = Federated States of Micronesia;

CNMI = Commonwealth of the Northern Mariana Islands;

PS = purse-seine; LL = longline; P&L = pole-and-line.

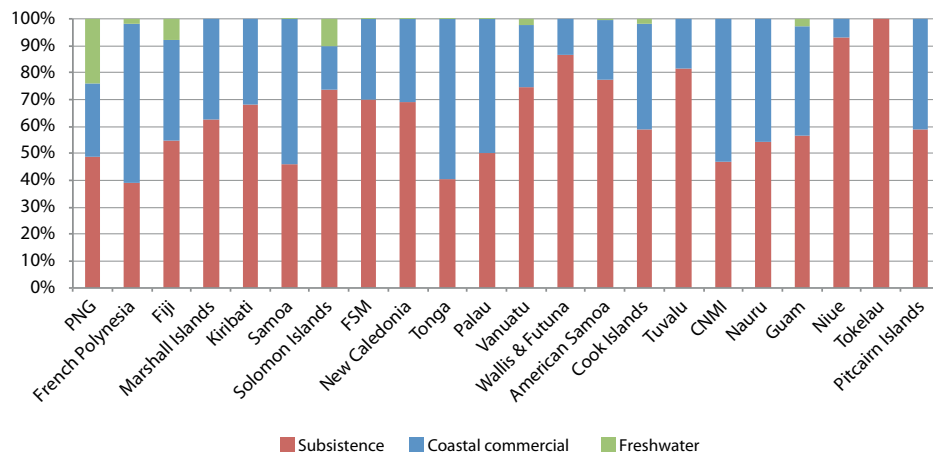


Figure 3. Composition of small-scale fisheries subsectors contribution to GDP by country (2007).

Source: Gillett 2009.

Batty (2012)¹ makes reference to the region's high dependence on fish for food with per capita fish consumption in every PICT being above the global average, and in some cases, amongst the highest in the world. He goes on to say that there are very high levels of participation in fishing in the region, with studies showing that nearly every family residing in a coastal village has someone involved in fishing.

Given the lack of alternative economic activities, the Pacific has a high dependence on SSF and the *Guidelines for Sustainable Small-Scale Fisheries* will be an important tool to support the enhancement, governance and development of the sector.

The Pacific Islands Regional Consultation on the development of Guidelines for Securing Sustainable Small-Scale Fisheries

The 29th Session of the FAO Committee on Fisheries (COFI) recommended that an international instrument, in the form of guidelines, be developed to complement the Code of Conduct for Responsible Fisheries. The Guidelines for Securing Sustainable Small-Scale Fisheries are being developed through a consultative process involving governments, regional organisations, civil society organisations, and small-scale fishers, fish workers and their communities. The negotiated final draft guidelines are to be presented for adoption to the 31st Session of COFI in July 2014.

Accordingly, FAO is currently facilitating a number of activities that will provide important inputs into the guidelines development process and the design of the final instrument. As part of this process, a consultative workshop for the countries of the Pacific region was convened in Noumea, New Caledonia, on 12–14 June 2012: the *Pacific Regional Consultation on the development of Guidelines for Securing Sustainable Small-Scale Fisheries*. The event was hosted by SPC with the support of FAO.

Participation and scope

The consultation convened 31 government, industry and civil society representatives from 16 PICTs,² as well as two representatives from Timor Leste. Together with resource persons, the consultation brought together some 53 participants.

The meeting allowed for the sharing of policies and practices in support of small-scale fisheries in the region and thereby contributed to the development of the guidelines.

Objective and expected outputs

The objective of the consultation was to support the development of the guidelines by providing inputs and advice, both with regard to good policies and practices in the region and with respect to overall principles and

contents. The guidelines should become an integral part of ongoing governance and development processes in support of small-scale fisheries and the consultation promoted integration and cross-linkages between the guidelines, regional policy and action.

Outcome of the consultation

The consultation was structured around plenary presentations, discussions and working group sessions.

Participants stressed the importance of small-scale fisheries in the region as a contributor to poverty alleviation, food and nutrition security, and socio-economic development, and emphasised that the guidelines will be an important tool for securing sustainable small-scale fisheries governance and development.

Two working group sessions discussed three topics in parallel; the outcomes are summarised below:

Session 1: Responsible fisheries and sustainable development

1.1 Governance of rights, resource management and stewardship

- Customary right systems are a fundamental part of the fisheries governance system in the region and, in some cases, these rights have been enshrined in legislation to regulate use and management of resources.

¹ Batty M. 2012. Opening remarks to the Consultation on the development of Guidelines for Securing Sustainable Small-Scale Fisheries. 12 June 2012, Noumea: Secretariat of the Pacific Community.

² American Samoa, Cook Islands, Fiji, French Polynesia, Kiribati, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna.

- The concept of “community” is associated with the livelihood dimension of the fishery and community rules are still very strong and respected.
- Two-way communication at all levels of governance and between resource users and fisheries administrations is essential to ensure sustainable fisheries management.
- Government has a role to play in providing infrastructure and enabling enforcement and compliance with certain obligations (e.g. sea safety equipment).
- The region has readily embraced the ecosystem approach to fisheries management and its principles are being applied in community-based management frameworks.

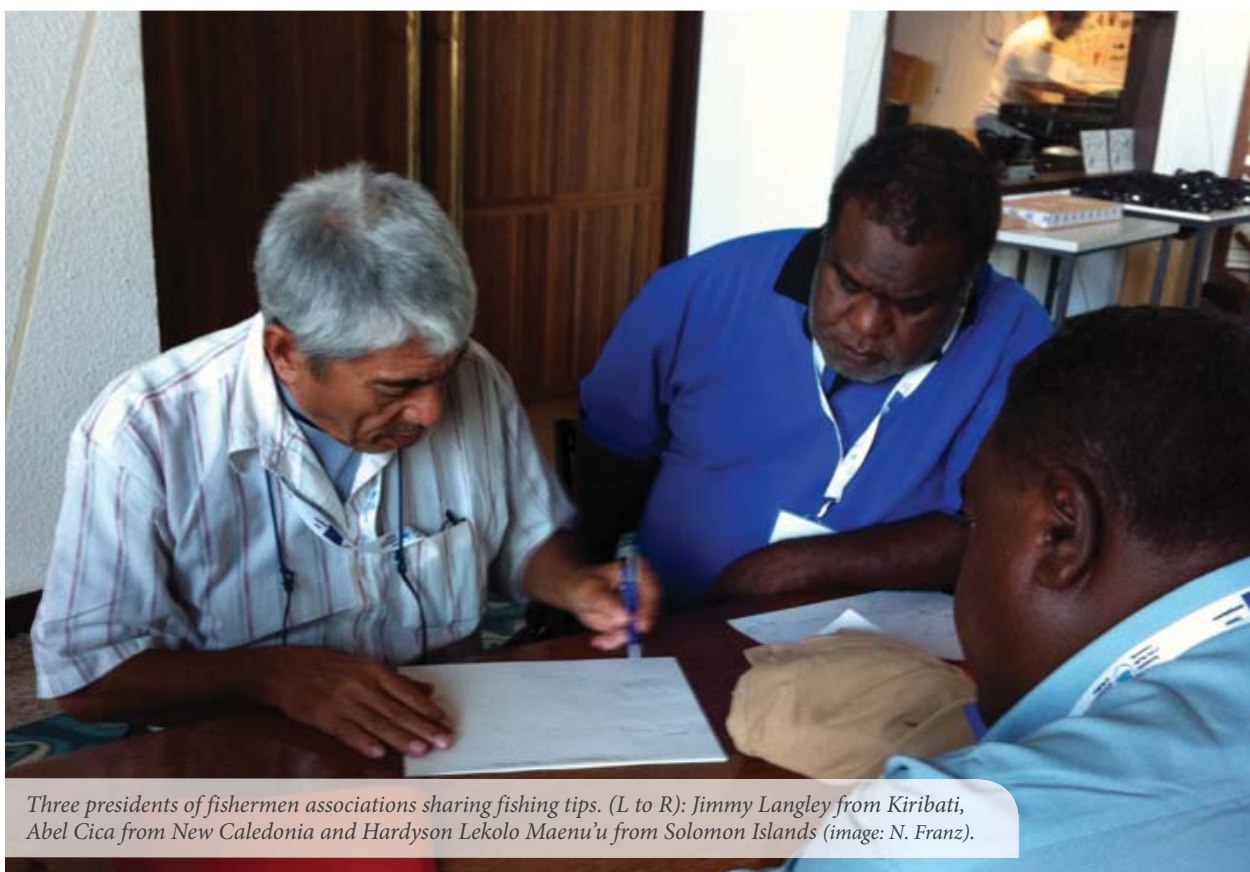
1.2 Social development and gender equality and equity

- In the Pacific region, fishing communities are well integrated and fishing is not considered a “last resort” activity, as it is in many other parts of the world.
- Mechanisms to protect SSF from external shocks should be explored, promoted and implemented (e.g. insurance schemes, disaster risk management and climate change proofing).

- The role of women and their participation in decision-making should be encouraged and supported.
- There is a need to promote the development of financial services that are tailored to SSF.

1.3 Post-harvest and value chains, decent work and employment

- Fishing is a respected and acknowledged profession in the region, not an activity of last resort.
- Fishermen associations, in collaboration with government and regional organisations, should play a proactive role in the commercialisation and marketing of fish that must include promotion of good food safety measures.
- There is a need to promote a “sea safety culture” in the capture sector.
- Elimination of child labour in SSF is important, although child labour is generally absent from SSF in the Pacific.
- Further consideration must be given to the transfer of generational knowledge given the cultural significance of SSF in the region.
- SSF stakeholders should enhance post-harvest technology transfer and seek the opening of new markets.



Three presidents of fishermen associations sharing fishing tips. (L to R): Jimmy Langley from Kiribati, Abel Cica from New Caledonia and Hardyson Lekolo Maenu'u from Solomon Islands (image: N. Franz).

Session 2: Ensuring an enabling environment and supporting implementation

2.1. Policy coherence, institutional coordination and collaboration

- There is a need to encourage the development of policies to protect SSF livelihoods, promote income opportunities and emphasise the socio-economic and cultural importance of SSF.
- SSF actors should develop and/or strengthen SSF associations/cooperatives to contribute to the sustainable management of the resources and strengthen their voice in decision-making.
- It is important to ensure that there is necessary support and capacity to effectively manage and enforce policies at appropriate level.
- The SSF guidelines should make stronger reference to subnational planning processes and legislation.

2.2. Research, information and capacity development

- The role of associations and bottom up-approaches to information and capacity development need to be highlighted.
- Stakeholders must be proactive to ensure that adequate training is tailored to their needs.
- It is important to emphasise and promote the use of technology and alternative methods for information dissemination and capacity development, including the use of mobile phones and the Internet.
- The guidelines should specify the need to create a variety of dissemination channels, including information sharing between non-government stakeholders and the use of training attachments and tutor exchanges between countries.
- Research, information and capacity development should be more prominent in the guidelines, as they are the basis for good management and development plans for SSF.

2.3. Implementation support and monitoring

- It is important to develop an efficient system for monitoring at the international level that avoids over-burdening countries with reporting requirements — regional organisations could play a role in facilitating this.

- Funding opportunities can be explored by building on the different issues included in the SSF guidelines.
- There is a need to identify priorities within the SSF guidelines and define milestones and time frames to achieve them.
- Regional platforms exist (e.g. island councils, Pacific Islands Forum Government Heads, Forum Fisheries Committee Ministers Meeting, SPC Heads of Fisheries Meeting) and should be used to build awareness and political support for the SSF guidelines; SPC can play a role in this process.

Acknowledgements

Acknowledgement is given to SPC and all the people responsible for the organisation of the consultation and to FAO for funding and facilitating the process. Finally, acknowledgement is given to the participants who provided their views and knowledge to ensure that Pacific Island SSF are well represented in the guidelines.

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For more information:

Michael Sharp
Fisheries Development Officer (Economics), SPC
(MichaelS@spc.int)

Michel Blanc
Nearshore Fisheries Development Adviser, SPC
(MichelBl@spc.int)

SPC SciCoFish project aims to improve collection of reef fisheries scientific data to support management

The new SPC Scientific Support for the Management of Coastal and Oceanic Fisheries in the Pacific Islands Region (SciCoFish) project funded by the European Union, first implemented in 2011, has taken up the challenge to assess coastal living marine resources, management systems and resource status to inform management. A regional workshop was held in Fiji in April 2011 to discuss the basic monitoring needs for Pacific Island countries and territories to effectively manage their coastal fisheries resources and identify gaps in scientific information on fisheries accessible to countries. The workshop identified the development of standardised and effective data collection and monitoring methodologies as a priority.

A creel and market survey can provide most of the basic information needed to get a good understanding of the status of a fishery and its evolution if the survey is done over the long term. More importantly, it can also be designed to answer the most common or the most important management questions. A draft simple Creel and Market Survey Manual was completed in March 2012. It provides step-by-step instructions on how to plan, design and implement a statistically valid survey and how to enter and analyse data to support management, including using pre-written queries to derive useful information. To add flexibility to the method, we took the approach of “slicing” the data and the sampling into minimum units repeatable over time and/or over several sites to increase coverage. This creel and market survey method is being trialled in Nauru, Tonga and Federated States of Micronesia (FSM), and will then be made available to other SPC member countries.

The SciCoFish Finfish Fisheries Scientist visited the first trial country, Nauru, from 29 May to 20 June 2012. During the visit, six fisheries officers from the Nauru Fisheries and Marine Resources Authority were introduced to and trained on the creel and market survey method. The training consisted of lectures on what creel and market surveys are, how sampling is designed, how sites are selected and how surveys are effectively planned and conducted. Management questions were also discussed, including the data and information needed for management purposes. Practical hands-on training was also provided on how to identify fish using meristic characters and the

catch data that need to be collected. The data from the pilot survey conducted during the first week of the visit were then used to train the local officers on data entry using the database and on survey design optimisation. The last two weeks were spent on conducting the main survey using the methodology elaborated after the pilot survey. The survey site for the main survey conducted in Nauru included villages from Boe to Nibok. The Nauru Fisheries and Marine Resources Authority aims to do three more surveys to cover the rest of the island before the end of the year.

What is a creel¹ and market survey?

A **creel survey**, sometimes called a fishermen survey or a beach survey, is the collection of information on the catch obtained directly from fishers at the landing sites. This type of survey produces the most comprehensive data on catch and fishing effort, and usually allows for the sampling of large quantities of fish at relatively few landing sites. The information collected can include biological information on finfish and invertebrate species caught (including their size and/or weight), fishing gear used, amount of effort (fishers, hours), cost of the fishing operation (fuel, ice, etc.), and income received if the fish is sold at the landing site.

Creel surveys are often used to estimate the condition of the fished resource. However, some characteristics measured during a creel survey (such as fish size) may not be representative of the actual resource as the fishing strategy influences (filters) the sampling: e.g. fishers may target specific species or a set range of fish sizes. Therefore, creel surveys are a “fisheries-dependent” form of sampling.

A **market survey** is the collection of information on catch being sold or traded through a fish market, stall or shop. It is generally not well adapted to the evaluation of the condition of the resource as data are even more filtered than those obtained in creel surveys. In many markets, part of the catch is processed (salted, smoked, cut in pieces, or combined with other food products), making it difficult to relate catch sold and wild populations. As in creel surveys, the information collected can include biological information.

Market surveys provide a way to verify and validate the data collected in creel surveys, particularly on the value of the catch. They also give a broader view of the fishery than creel surveys, as it is almost impossible to survey all fishers at all landing sites.

¹ Creel is an Irish word for a type of small wicker basket mainly used by anglers to hold their catch.



*Left: Collecting data from fishermen when they land their catch during a creel survey in Nauru.
Right: Training on the collection of biological data of reef fish in the Marshall Islands (images: B. Yeeting).*

The second trial was organised in Tonga on 6–17 August 2012 for six local fisheries officers. Two of them came from the outer islands of Ha’apai and Vava’u. Although Tonga is much bigger than Nauru, the survey method was flexible enough to allow for selection of an appropriate site where the survey could be done within the time available. The creel survey site was on the eastern side of Tongatapu, from Navutoka to Manuka Village.

The trials in Nauru and Tonga have focused on creel surveys. For the FSM trial, planned for the second half of September 2012, we will focus on the market survey method.

Parallel to the creel and market survey work, we collected biological data to provide a better understanding of the biology of selected important reef fish species. The SciCoFish Fisheries Scientist visited Kiribati from 7 to 17 May 2012 and trained five fisheries officers. The training included lectures to explain basic fisheries biology and the importance of biological information such as length–weight relationship, age and growth of fish, maturity stage and gonadal index for the management of fisheries. Hands-on training was also provided on identification of fish using meristic characters, sexing fish, and the extraction of gonads and otoliths. Assistance on biological monitoring programme design and species selection was also provided. This work in Kiribati followed similar work done in Marshall Islands (3–13 July 2012), where four fisheries officers were trained, and in Nauru (during the creel and market survey visit), where six officers were trained. FSM will receive biological sampling training in September 2012.

It was interesting to note several positive remarks from the countries that participated in the training for these data collection activities.

“The information will be a great help to explain growth of fish and the reasons for setting size limits to fishing communities,” said Delvin from Nauru.

Vilimo from Tonga commented, “We should have collected this data a long time ago. The creel and market survey data will help us verify the status of our fishery... the biological information is exactly what we need to know to set up new or refine existing management regulations,” while Silika from Vavau said, “This will be very useful for monitoring our Special Management Areas with the communities.”

“We have always wanted to find a practical way of determining spawning aggregation times for some of our important food fish species so that we can start protecting them. Gonadal index will provide a simple and inexpensive way to start working on this,” said Fisheries Research Assistant Aranteiti from Kiribati.

To support these data collection activities, SPC has provided some basic data collection equipment such as weighing scales, measuring boards, dissecting kits and sample containers. Furthermore, SPC is organising attachment training for Pacific Island fisheries officers on the analysis of creel and market survey data and on the processing of otoliths for determining aging. In collaboration with the French Institute of Research for Development (IRD), a first workshop on this subject was conducted in the second half of August 2012 in Noumea.

For more information:

Being Yeeting
Fisheries Scientist (Finfish), SPC
(BeingY@spc.int)

New LearnFishID module developed for sea cucumber species

Sea cucumber species identification is a recurrent problem faced in the sea cucumber fishery. Colouration and form are the most commonly used features in identifying species, but some species have several different colouration patterns, and some can change their shape according to external factors such as induced stress or the topography of the bottom.

Sea cucumber species such as sandfish, golden sandfish, white teatfish, black teatfish, brown sandfish, curryfish, blackfish, surf redfish, stonefish, elephant trunkfish, tigerfish, chalkfish, peanut fish and lollyfish all display differences in colouration of their outer skin layer from young age to maturity, or according to habitat conditions and geographical locations, contributing to identification difficulties. And when they are gutted, boiled and roasted, then preserved through drying, smoking or freezing, they become very different from the live form, which creates another identification challenge. Many guidebooks, posters and identification cards have been produced to help with sea cucumber identification.¹ But most relate to the most common commercial species and do not include all the variations of colour and form that can be encountered in the field.

For more information:

Franck Magron

Reef Fisheries Information Manager, SPC
(FranckM@spc.int)

Kalo Pakoa

Fisheries Scientist (Invertebrates)
(KaloP@spc.int)

LearnFishID sea cucumber module

The LearnFishID sea cucumber module is a Web-based species identification system that can be used to learn to identify 20 different tropical sea cucumber species. It is accessible from the SPC website at: <http://www.spc.int/CoastalFisheries/learnfishid/main/seacucumbers>.

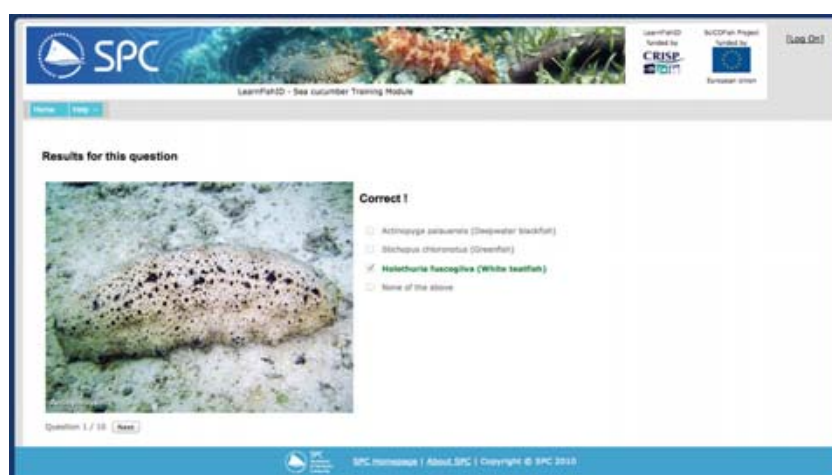
The module contains photographs of 28 species of sea cucumbers taken in 17 Pacific Island countries. The number of species was set at 28 based on the sea cucumber iconography that was available at SPC.

The module allows users to test their identification skills using pictures through multiple choice type questions. Three different skill levels are available — beginner, advanced and expert — allowing users to follow a progressive pattern in their learning. A score is given at the end of each session, enabling users to see how well or how poorly they perform with sea cucumber identification.

In the near future, the module will give the possibility for registered users to contribute photos, which will be verified by a panel of experts before being included in the database. Improvements in this module will depend on feedback from users and contributors.

So, please try it and let us know if this tool deserves to be further developed.

Adult white teatfish are easy to identify. Not all sea cucumber species are... give it a try at: www.spc.int/CoastalFisheries/learnfishid/main/seacucumbers



¹ See for example SPC's Pacific Island sea cucumber and beche-de-mer identification cards (available at: http://www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Anon_04_ID_BDM.pdf)

New underwater writing slate eases survey work

Many types of underwater recording devices have been developed over the years, but waterproof paper and a mounting board remain the most commonly used and reliable recording devices in marine surveys. Data-sheets can be photocopied onto waterproof paper and the diver simply needs to fill in the boxes while moving along underwater. Once completely filled, the sheet is taken out and replaced with a new one. But keeping the record sheet firmly on the mounting board is a challenge for surveyors.

Paper clips, rubber bands and masking tapes are used to hold record sheets in place; however this has not solved the problem of record sheets falling out due to broken rubber bands or falling paper clips when moving against even the slightest current. When handling additional equipment such as a measuring tape or an underwater camera, keeping the sheets in place can become difficult, time consuming and even risky, especially when a surveyor must try to catch loose pages on ascending from a deep dive.

A new underwater slate

A new underwater mounting slate combines waterproof paper and a writing slate in one unit. Originally developed by Kim Friedman, the new slate made of PVC foam (www.foamalite.ie) has two main parts, a mount and cover held together by hinges and a lock to open and close the slate to place and retrieve sheets. The lid is attached with a steel ruler, and a pencil and safety line are tethered to it. The PVC foam material provides an extra writing surface in addition to the record sheet for recording eventual additional information. Flexible and durable PVC material is easy to work with and hard to break in comparison to rigid boards. Despite the weight of hinges and screws the slate is positively buoyant – it stays afloat on the surface if accidentally dropped overboard, and if lost underwater it



Using the slate to measure sea cucumbers and record data during field work in Fiji (image: K. Pakoa).

ends up at the surface with record sheet intact, allowing recovery of data. The new slate uses one-sided A4 forms, such as the invertebrate record sheet. Several sheets can be held in the slate, but a maximum of three sheets is recommended for underwater recording.

Distribution

So far, the new slates have been provided to the Tonga Ministry of Fisheries, Marshall Islands Marine Resources Authority, Vanuatu Fisheries Department, Solomon Islands Ministry of Fisheries and Marine Resources, Tuvalu Ministry of Natural Resources, Samoa Ministry of Agriculture and Fisheries and Papua New Guinea National Fisheries Authority. More slates will be distributed this year to the Fiji Department of Fisheries and partner non-governmental organisations, the Cook Islands Ministry of Marine Resources and the Palau Bureau of Marine Resources. The slates are produced by SPC's Coastal Fisheries Science and Management Section under the European Union-funded Scientific Support for the Management of Coastal and Oceanic Fisheries in the Pacific Islands Region (SciCOFish) project.



For more information:

Kalo Pakoa

Fisheries Scientist (Invertebrates), SPC
(KaloP@spc.int)

Ian Bertram

Coastal Fisheries Science and Management
Adviser, SPC
(IanB@spc.int)

Fish inspector training course for Competent Authorities

Protection of public health through food safety is a major concern that has been part of trade negotiations globally. Food safety is seen as one of the technical barriers to trade that needs to be addressed by exporting countries. Failure in food safety can have legal implications and lead to subsequent economic losses. Therefore, food exporters must comply with strict requirements to trade globally.

Pacific Island countries and territories (PICTs) have no exemption should they wish to trade seafood resources globally. The European Union (EU) is a very lucrative market but it has very stringent rules. The only countries currently exporting to EU are Papua New Guinea (PNG), Fiji and Solomon Islands. Each of these countries has an established and functioning Competent Authority that provides official guarantees for export to the EU market. Other PICTs have expressed interest in having access to the EU market, but have yet to establish a Competent Authority.¹ As part of the assistance provided to member countries and territories, the Forum Fisheries Agency (FFA) and SPC have developed a training curriculum, which was delivered for the first time from 7 May to 1 June 2012 in Auckland, New Zealand. The reference materials used were “Strengthening fish and fishery products health conditions in ACP/OCT² countries”, and “EU market access & eco-labelling for fishery and aquaculture products”, both developed by SIPPO³. The curriculum was tailored to suit the training needs of PICTs and it was delivered by two FFA Consultants, Francisco Blaha and Cushla Hogarth, and SPC’s Fisheries Development Officer (Post-Harvest and Exports), Timothy Numilengi. FFA and SPC acknowledge the excellent integrated facilities provided by Auckland Seafood School.

The FFA Devfish2 (Development of Sustainable Tuna Fisheries in Pacific ACP Countries – Phase II) project and the AusAID-funded Food Security Programme of SPC jointly funded the delivery of the training. A total of 17 participants attended, hailing from Cook Islands, Federated States of Micronesia, Fiji, Kiribati, PNG, Solomon Islands and Vanuatu. The training targeted staff of Competent Authorities, fisheries ministries and other government agencies involved in inspections and certification of fish and fishery products for export purposes. The course was designed to meet the growing demand for compliance with technical market access requirements and trade facilitation. The training was quite intensive, with group exercises, presentations, and practical and open book exams. Areas of capacity building included the role of inspectors, establishing an organisation and its operational functions, managing food safety risk, developing and implementing inspection systems, establishing inspection methodologies, reporting, EU



regulations and other legislative requirements relating to market access, various fishing techniques and processing, laboratory testing, product traceability, rapid alert and crisis management. These are fundamentals required by the inspectors to effectively plan, manage and implement the systems in compliance with the market access requirements. The course participants appreciated the new skills and knowledge they gained, which will benefit their respective countries in meeting certain market access conditions.

All participating countries were given the opportunity to review their own systems, which allowed them to identify certain gaps that need to be filled. Some of these gaps will be filled internally, while others require further assistance from SPC and FFA, such as training in the Hazard Analysis and Critical Control Points (HACCP) food safety system, thermal process canning operations, Good Laboratory Practises, organoleptic (sensory) assessment, in-depth HACCP auditing skills, technical assistance on-site for private enterprises, arrangements for laboratory testing and establishment of Competent Authorities.

For more information:

Timothy Numilengi
Fisheries Development Officer (Post-Harvest
and Exports), SPC
(TimothyN@spc.int)

¹ The Competent Authority is the competent official organisation, recognised by the European Commission, which is responsible for the management of official systems of inspections or certification of fish and fishery products to the EU market.

² ACP/OCT: African, Caribbean and Pacific Group of States/Overseas Countries and Territories

³ SIPPO : Swiss Import Promotion Programme

How to prevent dolphin depredation on fish hooked on a trolling line

Cetacean depredation on hook-and-line caught fish has become a frustratingly common occurrence for commercial and artisanal fishermen of the Pacific Islands. Fishers from Nauru, Solomon Islands, Kiribati, Tuvalu, and Cook Islands have recently reported that fish are being stolen by cetaceans from their lines with increased frequency, and this is exasperating them to the point that some of them have been tempted to kill or harm the “culprits” in the hope that it would solve the problem.

In 2002, a workshop on “Cetacean Interactions with Commercial Longline Fisheries in the South Pacific Region: Approaches to Mitigation” was held in Apia, Samoa, to gauge the gravity of the situation and to identify ways of dealing with the problem. A few angry local fishermen were at the stage of requesting mass culling of any cetaceans that roam their fishing grounds, but most agreed to use passive methods to repel cetaceans rather than aggressive physical methods such as detonators, oil slicks and shooting on sight.

A lot of work has already been done on producing cetacean deterrents for different types of fishing gear and this is constantly being updated to match the adaptability of cetaceans to the deterrent devices.¹ Cetaceans are ingenious creatures that quickly catch on to most passive deterrent methods and almost always find ways around them. Research institutions are still trying to perfect deterrent methods that focus mainly on the senses of sight, hearing, smell and taste. To date, several methods such as acoustic pingers, magnets, taint or metallic streamers have been trialled with varied success. Some of the products are available on the market for fishers who have funds to invest in them.

One newly identified type of cetacean depredation behaviour in the Pacific region is depredation on troll-caught fish. Dolphins were identified as being responsible for these depredations. In some countries of the Pacific region, fishers are wary of dolphins when they go trolling, especially around FADs. Once dolphins are spotted the fishers know they only have a 50/50 chance of landing the fish whole because the dolphins pluck the fish off the hooks or take chunks of them as they are being reeled in. The fishers are perplexed at this behaviour. They are used to sharks trying to rip their catch off the hook but not dolphins. The dilemma now is how to outsmart the dolphins to keep them from interfering with their catch without resorting to aggressive deterrent methods.

A stainless steel wire streamer or something similar is a simple but effective tool. This can be snapped on as soon as a strike is confirmed. The streamer should slide down the mainline to the hook and flail around the caught fish, presenting an obstacle to the dolphin and dissuading it from taking the fish. This is usually the cheapest method and the first resort adopted by fishers to fend off dolphins, although the effectiveness of the method depends on how fast the fisher is able to put the device in place.

The streamer can be constructed in many ways, but the general idea is to crimp a 100–200 cm x 7 mm stainless steel wire cable to a carabineer (mountain climber’s snap), or similar device, and unfurl the strands to produce several flailing arms (see diagram). The snap must be smaller than the lure or there must be some sort of stopper to prevent the streamer from falling off the mainline if the fish escapes. Lead sinkers can be added to the strands and a funnel can be rigged just after the snap to help the streamer travel faster down the trolling line. Normally this should do the job but if this is insufficient then several whole wire rope lengths should be used. The trick is to place the streamer on the line as soon as the fish has been hooked so that it gets to the hooked fish before the dolphin. It helps if the vessel is kept moving ahead until the streamer reaches the hook.

This same principle can be applied using a cloth shroud that can be snapped on and slid down the line to cover the fish. Although I haven’t yet been able to verify its efficiency, the shroud idea is there for someone to try.

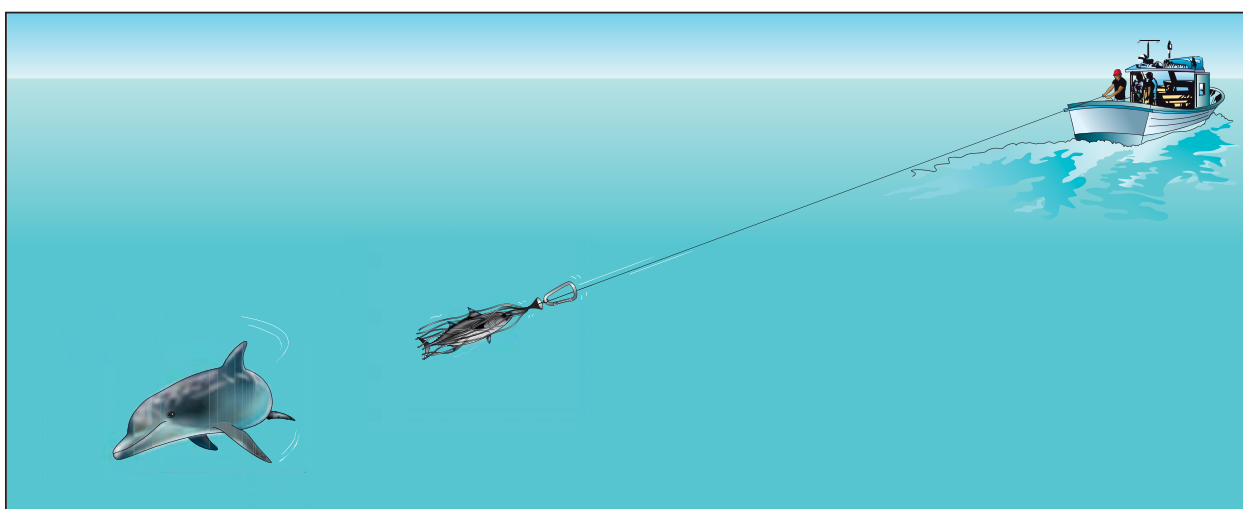
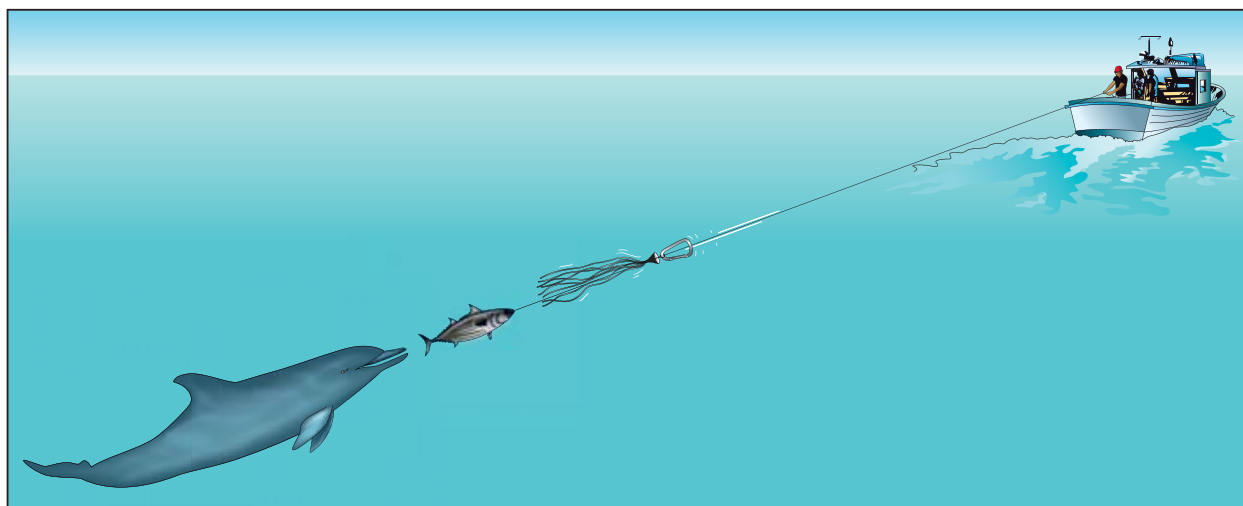
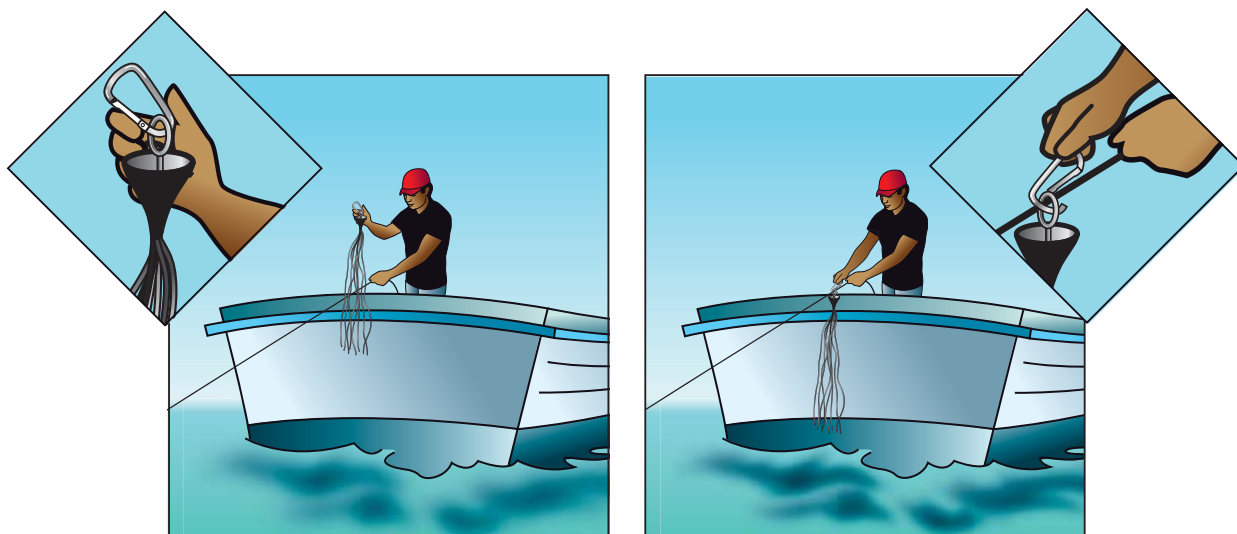
Happy fishing!

For more information:

William Sokimi
Fisheries Development Officer, SPC
WilliamS@spc.int

¹ See for example: McPherson G., Nishida T. 2010. An overview of toothed whale depredation mitigation efforts in the Indo-Pacific region. SPC Fisheries Newsletter 132:31–36. (available at: http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/132/FishNews132_31_McPherson.pdf)

SPC ACTIVITIES



A fish is hooked, the boat keeps steaming ahead, the streamer is snapped on the trolling line (1 and 2); the streamer slides along the trolling line (3) and covers the fish; the dolphin is fended off by the metallic “hairs” (4). Illustrations by Jipé Le-Bars, SPC.

More FADs deployed in four Pacific Islands

Since the beginning of this year several countries around the region have requested assistance from the SPC Nearshore Fisheries Development section to plan and implement their fish aggregating device (FAD) programmes and, in the process, train fisheries officers and selected members from the private sector in FAD-related work.

Kosrae, Federated States of Micronesia

In February 2012, three subsurface FADs were deployed in Kosrae. These FADs were built by Okabe Co., Ltd of Japan and shipped to Kosrae completely constructed with a fibreglass reinforced plastic (FRP) floatation cage containing 12 x 450 mm pressure resistant plastic floats and a mooring rope (Fig. 1). The subsurface FADs were constructed to be deployed in 500 m depth with the floatation cage to settle around 25 m below the surface. After deployment, the settling depths were measured at 20 m, 22 m and 26 m.

The subsurface FADs were deployed off Okat, Saoksa and Utwa districts, using the Division of Fisheries and Marine Resources boat *FV Sinlaku* (Fig. 2). In July, the FADs were reported to be working successfully, producing high catch rates.

A fourth subsurface FAD was deployed in July off Lelu district. This FAD is of a much simpler design with only five oval pressure resistant hard plastic floats strung directly onto the main mooring rope through the centre hole of the floats (Fig. 3). The FAD was deployed on a steep slope; the flotation settled 60 m below the surface instead of the preferred 20 m, but the FAD should still be effective for aggregating fish. The coastline along Lelu district has steep drop-offs so there is very little choice in selecting good FAD deployment sites.

The Okabe caged flotation FAD has strong buoyancy from its 12 x 32 kg buoyancy floats compared to the other FAD with its smaller 5 x 20 kg floats design. This gives the Okabe subsurface FAD the advantage of keeping the mooring taut in strong current, with a small scope for swing. The smaller subsurface design is susceptible to being swayed off the centre point by a strong current, giving it a larger scope; however, it is possible to increase the buoyancy by adding more floats. It should be noted that for deployments in more than 500 m depth it would be better to have the float buoyancy at a minimum of 350 kg. This should give it enough power to support the mooring rope as well as reduce swing scope.

At the end of the project, nine Kosrae Fisheries Division staff had been trained to rig and deploy FADs.

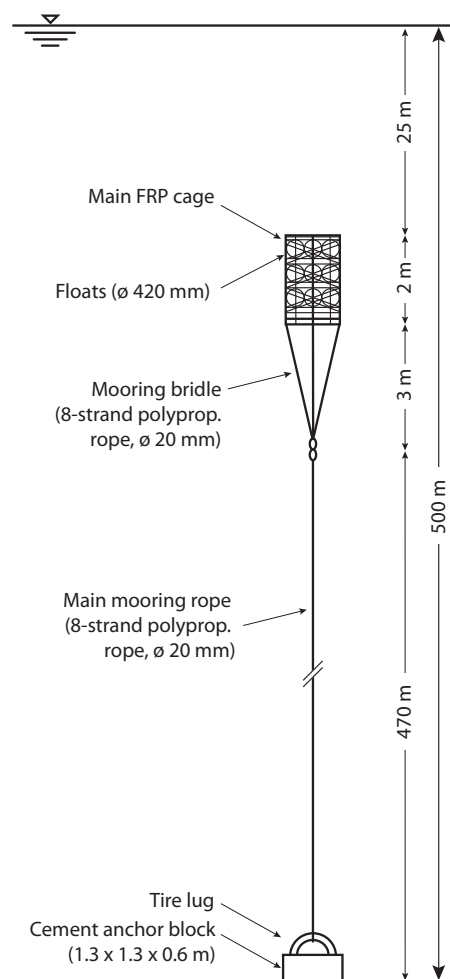


Figure 1. Okabe subsurface FAD design.

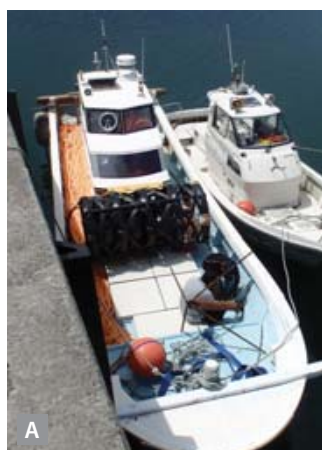


Figure 2. A: Subsurface FAD loaded on the FV Sinlaku and ready for deployment; B: Subsurface FAD floatation cage deployed and on its way down to approximately 25 m below the surface.



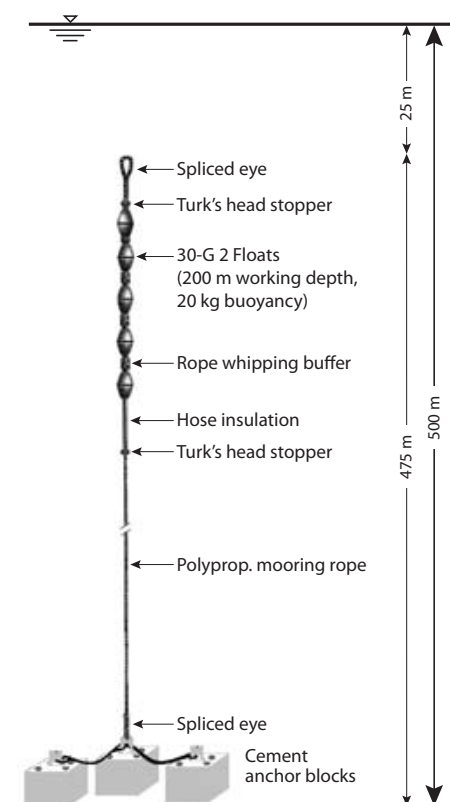


Figure 3. SPC design for subsurface FAD.

Rarotonga, Cook Islands

A FAD development workshop was conducted in Rarotonga in mid-March to train Cook Islands Ministry of Marine Resources fisheries development officers and Cook Islands Fishing Association members on FAD construction and deployment. Eleven participants took part in the workshop, which was conducted over five days and resulted in the rigging and successful deployment of three FADs: a subsurface FAD deployed off Ngatangia in 330 m depth, an offshore Indian Ocean FAD off the Rarotongan Hotel in 1100 m depth (Fig. 4), and a nearshore FAD off Black Rock in 361 m depth.

Before the deployment of the FADs constructed during this workshop, five FADs were already in place from previous deployments. These five FADs were aggregating well and had their “hot” moments at different times during the fishing season. The FADs were located off Panama (spar buoy, 1282 m); Black Rock (offshore Indian Ocean, 1023 m); Matavera (offshore Indian Ocean, 755 m); Kiiiki (offshore Indian ocean 1196 m); and Avarua (nearshore Indian Ocean, 260 m).

Good results achieved at the Avarua nearshore FAD partly explains why the Ministry of Marine Resources had decided to trial another nearshore FAD (at Black Rock) and the nearshore subsurface FAD (at Ngatangia).

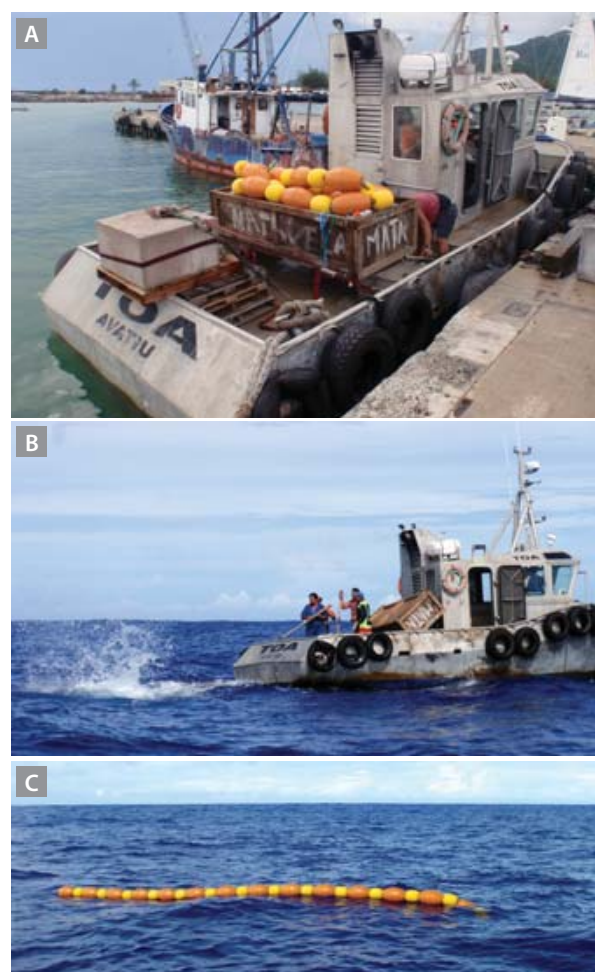


Figure 4. A: Tugboat Toa loaded with an offshore FAD and ready for deployment trip; B: FAD anchor deployed; C: Ngatangia offshore FAD settled and ready to aggregate (all images in this article: W. Sokimi).

Pago Pago, American Samoa

Following the Cook Islands FAD work, another FAD workshop was conducted in Pago Pago, American Samoa. The objectives of this workshop were to rig and deploy two spar buoy FADs (Fig. 5) and to run a FAD awareness programme for the Coastal and Community Fisheries staff of the American Samoa Department of Marine and Wildlife Resources (DMWR). At the same time, a team of new FAD technicians were trained to be the department's FAD crew (Fig. 6).

Twenty DMWR staff participated in the workshop and the two FADs were deployed from the inter-island government shipping vessel *MV Sili* at Site A (deployment depth 840 m) and Site B (deployment depth 1650 m) of the DMWR FAD location list.

Conducting a FAD operation in American Samoa is not as straightforward as on other Pacific Islands. Before any FAD can be rigged, the local US Coast Guard office needs to approve the design and the location where the FADs



Figure 5. Spar buoy used for FADs in American Samoa.



Figure 6. American Samoa DMWR FAD crew.

will be deployed. When submitting the design, all the specifics relating to material, buoyancy, volume, weight and dimensions need to be accounted for. The FAD must also satisfy coastal shipping regulations requiring it to be clearly visible at all times to passing ships; therefore it must have a radar reflector and a light for night-time detection. With regard to this regulation, and in consideration of vandalism problems experienced with previous FADs, the spar buoys are ideal for American Samoa's situation. However, the SPC spar buoy design is expensive to produce and expensive to deploy as the anchor and spar buoy units are bulky and heavy. This requires heavy machinery and a large vessel to carry out the deployment, which can make the cost of deployment equivalent to or higher than the cost of the FAD materials.

Consideration should be given to using smaller and cheaper factory-made navigation or mooring buoys that have the durability and buoyancy required to support the mooring load and weather stress, similar to those used in the New South Wales FAD programme but more robust to support the offshore mooring load.

If a suitable smaller and cheaper spar buoy can be identified, then these spar buoy FADs may be the solution to reduce vandalism on surface FADs in areas where this problem is common. Otherwise, subsurface FADs will have to be the choice if the FADs are to remain moored without being vandalised.

Port Vila and Santo, Vanuatu

The formation of the Vanuatu Fisherman's Association has brought small-scale fishers together to coordinate their fishing efforts better. Associations are formed according to provinces and combined to form the Vanuatu Fishermen's Association.

This coordinated effort led the fishers to work closely with the Vanuatu Department of Fisheries, which assisted them further in their small fishing operations. In order to bolster the catches of small-scale fishers, the Vanuatu Fisheries Department planned a long-term FAD programme to be implemented countrywide in the six provinces of Malampa, Penama, Sanma, Shefa, Tafea and Torba. Representatives from each of these provinces were invited to join the Vanuatu Fisheries Department fisheries development staff in a FAD workshop conducted in July in collaboration with the SPC Nearshore Fisheries Development Section.

The workshop was attended by 18 participants who were trained to rig and deploy subsurface FADs. Vanuatu is vulnerable to frequent cyclones and stormy weather, so most of the surface FADs have short lifespans. Another problem is the high incidence of vandalism on the FADs, so deploying subsurface FADs is seen as another possible way to help ensure longer lifespans.

Two subsurface FADs were constructed and deployed off Pango point and Eratap point on Efate Island, close to Port Vila (Fig. 7), and another two were rigged and deployed off Aeaki Island and Tutuba Island in Santo. The FADs were targeted to settle 20 m below the surface. Three weeks after the deployment the FADs were described as "on fire" as the fishermen were returning with large catches of mahimahi and yellowfin tuna.



Figure 7. Towing the subsurface FAD on a barge to the deployment site.

For more information:

William Sokimi
Fisheries Development Officer, SPC
(WilliamS@spc.int)

Juvenile lobster collection and grow-out for the food market in New Caledonia – a reality!

A number of countries, including Vietnam, the Philippines and Indonesia, have long practiced the collection and grow-out of spiny lobster (Panulirus ornatus) post-larvae (pueruli) for food. Following in their footsteps, New Caledonia's provincial fisheries officers, in close collaboration with the territory's Agency for Economic Development (ADECAL) and SPC's Aquaculture Section, initiated lobster collection and grow-out trials in selected New Caledonian coastal locations in 2009. The first collection trials were carried out during 2010 in Ouano Bay, a well-known lobster settlement area, and yielded very promising initial results.¹

During the 2011 collecting season (March to September), six collection sites were tested. The testing involved a total of eight groups of local fishers as well as the participation of adjacent coastal communities. Four of the sites were located in the Northern Province and two of them in the Southern Province. The fishers involved collected a total of 2137 pueruli, with extremely high collection rates in some settlement sites. At La Foa, for example, collection rates were 20 times higher than typical rates in other regions of the world (e.g. Vietnam or Indonesia). These trials also demonstrated that the lobster collection season in the New Caledonian lagoon is two months longer than in other Pacific and Asian countries.

Initial grow-out experiments and collection methods

“The Aquaculture Society of Ouano” (SAO), a local company based in Ouano Bay and managed by Nadine Sephar, has been in charge of the grow-out experiments. ADECAL, SPC and provincial officers from both provinces have provided the required technical support. The 2137 collected juveniles were stocked in 11 (0.3 m³) submerged cages during the nursery phase (3 months), after which the survivors were transferred to six traditional floating cages (3 x 3 x 3 m or 27 m³ volume) installed at

SAO in Ouano Bay. The animals currently weigh an average 200 g, and the company is expecting them to reach the 400 g commercial size in another three months (for a total rearing period of 12–16 months).

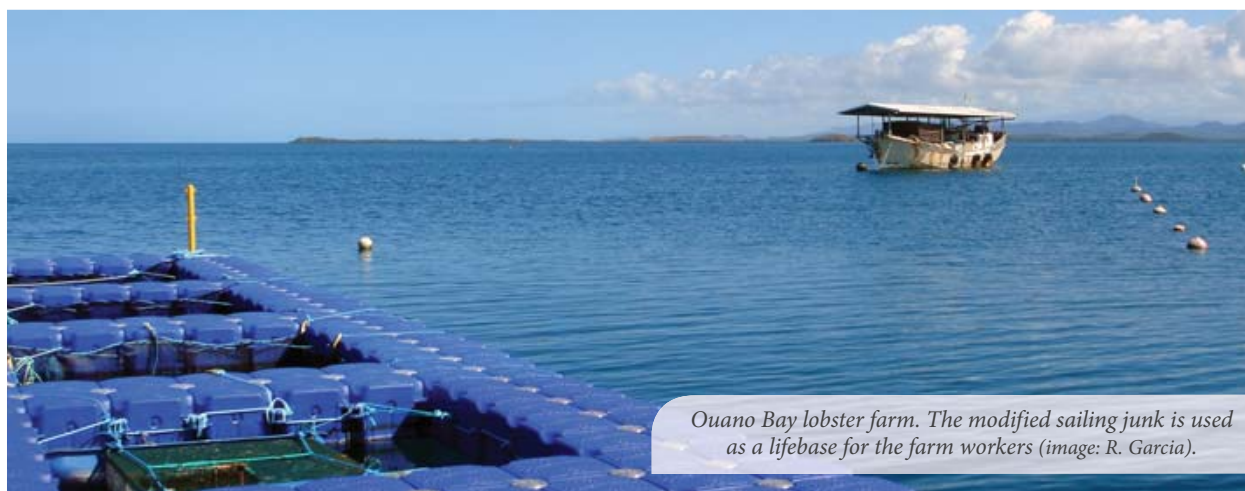
Nadine Sephar has been in charge of the monitoring of a series of different grow-out trials. Most focused on the comparison of different feeding strategies, stocking densities and farming systems on the growth of the animals, to develop a set of better management practices to be used in future aquaculture settings.

Some of the problems encountered during the grow-out phase have been related to:

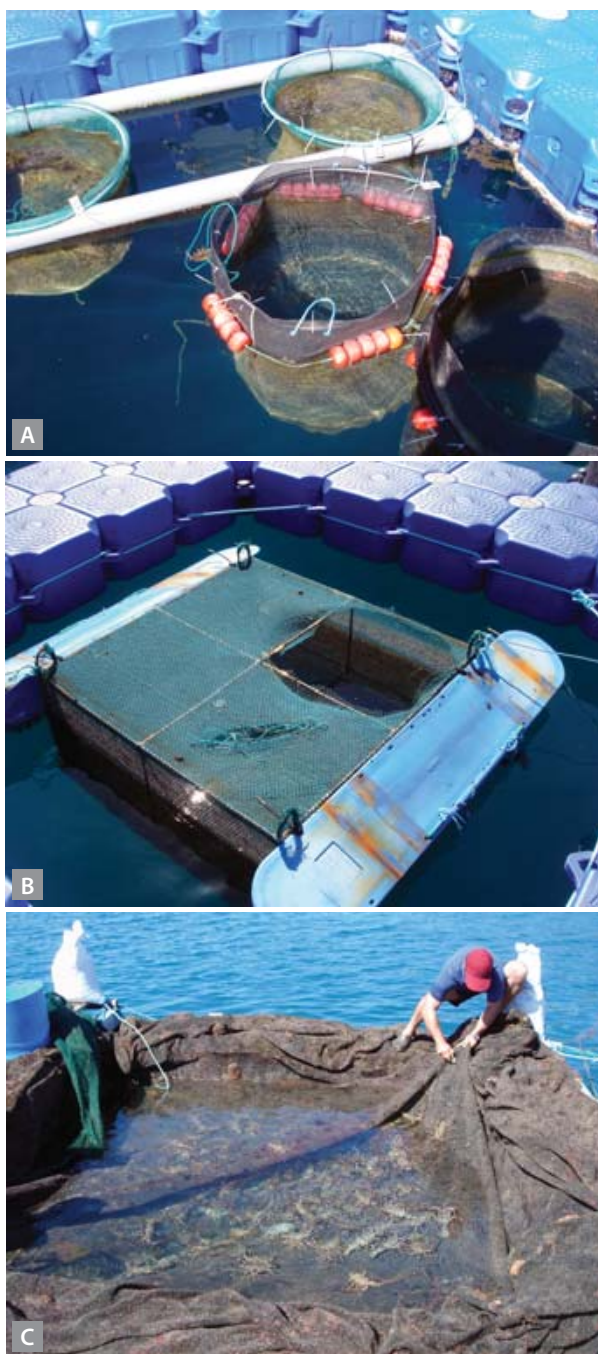
- availability of suitable feeds (i.e., feeds with a high protein content are required during the first 2–3 months);
- maintenance of proper stocking densities; and
- periodic grading of the animals inside the cages to control cannibalism (i.e., slightly larger animals will often eat smaller ones).

The average survival rate of the first round of trials has been around 25%, quite low when compared with other regions (e.g. 40–50% in average in Indonesia and the Philippines).

¹ See article by Antoine Teitelbaum in issue #134 of this newsletter: (http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/134/FishNews134_20_Teitelbaum.pdf).



Ouano Bay lobster farm. The modified sailing junk is used as a lifebase for the farm workers (image: R. Garcia).



A & B: Cages used for the nursery phase (3 months);
C: Hauling the net of a grow-out cage where lobsters
are kept for 12–13 months (images: R. Garcia).

During the first year of juvenile collection, most fishers switched from the classical “onion bag” collectors, which are used in other regions of the world, to the so-called “wooden stick” method (see footnote 1). The latter involves placing pieces of drilled wood or bamboo into the water for the juveniles to use as shelter. In New Caledonia, wooden sticks were shown to have higher recruitment rates (3.5 times more recruitment than traditional “onion bags”). According to fishers involved in collection, initial recruitment may take longer when using new wooden sticks, because the process of “biofouling”

(i.e., accumulation of algae and other natural matter) is slower than with onion bags. However, once a thin algae layer covers the wooden sticks, recruitment rates seem to be much higher. Moreover, fishers say that the sticks are easier to deploy, monitor and clean (they require less manipulation time), and that they last longer. They are also made of locally available materials.

SPC involvement

As part of the SPC–New Caledonia joint country strategy, SPC’s Aquaculture Section has facilitated the exchange of information and experiences between the Lombok Mariculture Centre, in Indonesia, and the New Caledonia fishers and farmers involved in lobster collection and production. A hands-on training and knowledge transfer between the Lombok Mariculture Centre and the New Caledonian stakeholders is planned for the first week of December in Lombok, with the aim of meeting some of the current knowledge needs.

Conclusions and future plans

This first year of juvenile lobster collection and grow-out has allowed local fishers to identify the most suitable collection sites and the most efficient, locally-adapted, and environmentally-friendly collection devices. With regard to farming systems, the first trials have shown that stocking densities should be established by cage surface and not by cage volume. Furthermore, adequate feeding strategies and regular grading of caged animals are key factors to a successful grow-out operation.

Current plans for the Ouano facility for the remainder of 2012 include the testing of eight new collection sites (including two new sites located in the Loyalty Islands). Grow-out trials will continue, taking into account lessons learnt on farming strategies and high protein feeds. Growth and feed conversion efficiency results will then be compared to those obtained from earlier experiments.

For more information:

Manuel Ducrocq

Fisheries Scientist, ZoNéCo Project (ADECAL)
(Manuel.Ducrocq@adecal.nc)

Nadine Sephard

Manager, Aquaculture Society of Ouano
(SepharNad@yahoo.fr)

Ruth Garcia

Aquaculture Officer (Mariculture), SPC
(RuthGG@spc.int)

Colette Wabnitz

Fisheries Scientist (Aquarium Trade), SPC
(ColetteW@spc.int)

Producing *Platax* in Tahiti – goals and challenges!

Tahiti Fish Aquaculture (TFA) is the second Platax fish farm set up in French Polynesia since 2011. The farm is located on the Tahiti Peninsula on the island of Tahiti, near the village of Tautira. Thomas Launay, Production Manager and associate of the farm's owner, Eddy Laille, talked to us about his experience.

Platax orbicularis (locally known as *paraha peue*) is a fish that has become scarce in French Polynesia, particularly due to overfishing. It is very popular with the local community because of its taste and the texture of its meat. So it was a perfect candidate for relaunching the virtually non-existent fish farming sector in French Polynesia.

The farm's goal is to produce consistently high-quality local lagoon fish on a regular basis over the long term. This project is an excellent example of responsible and sustainable development, both economically and in terms of the environment, since it integrates and preserves the ecological assets of French Polynesia's lagoons by minimising the effects production has on local aquatic ecosystems.

Since 2011, TFA has been producing *Platax* in floating cages in the lagoon. We have five floating high-density polyethylene cages that are 12 m in diameter and 7 m deep, for a total volume of about 800 m³ each.

The fingerlings come from the territorial hatchery, VAIA, and are put in cages once they weigh about 8 to 10 g, in small 50 to 100 m³ modules (nursery phase). They are then transferred to 800-m³ cages for the grow-out phase. The initial density when they are placed in the cages is about 170 fingerlings per m³, i.e. 1.7 kg per m³, and the final density is about 12.5 kg per m³. So the idea is to grow-out *Platax* in low densities so as to avoid problems related to high fish concentrations, such as opportunistic bacterial and parasite infections, and ensure the production of high-quality fish. The feed we use is extruded "Ombrine Grower", which is produced by the company Legouessant, in Brittany, France. We use it because it has good nutritional characteristics, high digestibility and is made of proteins of plant and marine animal origin. However, we are working on producing local feed, which would be easier to get. The fish are fed two or three times a day, depending on the growth phase. The feed conversion index is currently between 1.5 and 2, for fish raised to a weight of about 1 kg.



Platax orbicularis is considered a delicacy in French Polynesia (image: T. Launay).

Up to now, the major challenge has been the cage construction phase. It was difficult to bring in heavy equipment because there is no road to the site, so all transport had to be by sea. Luckily, the seaway between the village of Tautira and the farm is completely protected by the barrier reef (inside the lagoon), so it is navigable in all weather conditions.

The most critical phase of *Platax* farming is transferring the fingerlings from the nursery to the grow-out cages. The farm has experienced very high mortality (nearly 90%) over our last three cycles. This mortality is probably due to opportunistic bacterial infections, e.g. *Vibrio harveyi* and *Tenacibaculum maritimus*. The phenomenon begins a few days after they are placed in the cages and lasts for at least 30 to 40 days. So our current priority is to work in partnership with territorial and regional research agencies and with other fish farmers in French Polynesia to try to resolve this problem of massive mortality that is a real threat to the future of our farm and, more generally, to the aquaculture industry in French Polynesia.

Aside from that critical phase, TFA does not have any major problems for the moment. Some farms in French Polynesia are bothered by parasites, e.g. *Neobenedenia* sp., and have to institute disinfection protocols. However, this has not been the case for TFA farm so far. Moreover, it would seem that the strategy of raising the fish in low densities is the reason behind these good results in terms of parasites.

To conclude, TFA produced about 2 tonnes of *Platax* in 2011 and hopes to produce about 6 tonnes in 2012. TFA's goal is to produce 40 to 50 tonnes of *Platax* each year in the future.

For more information:

Thomas Launay

Production Manager, TFA Farm
(Thomas.Launay@gmail.com)

Eddy Laille

Owner/Manager, TFA Farm
(tahiti.fish.aqua@gmail.com)

Ruth Garcia

Aquaculture Officer, SPC
(RuthGG@spc.int)



A: The farm five cages are moored inside the lagoon, close to shore. They are protected from oceanic waves by the barrier reef, visible in the background;

B: One of the five 800-m³ cages;

C: *Platax* are individually weighed, vacuum-packed and labelled for the local market.

(Images: T. Launay)

Fishing it up

The state of Nauru reef fisheries

Before going into reef fisheries let's consider tuna for a minute. There are plenty of skipjack tuna in Nauru waters. Oceangoing fishing vessels catch around 50,000 tonnes a year here — a catch that the best scientific minds of the Pacific reckon is fully sustainable — and the income from which contributes in a major way to the Nauru economy.

It's not just foreign consumers and the Nauru government budget that benefits from this healthy tuna resource. Small boats and canoes fishing in the blue water just outside the Nauru reef can bring in plenty of tuna on a good day.

But talk to Nauru fishermen about the fish on the Nauru reef and they turn pessimistic. "Things were better in the old days", they will say. "We used to be able to catch big coral trout and groupers, but nowadays we hardly see them. We used to catch plenty of lobsters. We used to see giant clams".

And unlike some other Pacific Islands, which put the blame on tourists or climate change, Nauru fishermen are clear-sighted about where the problem lies: Too many people fishing in too small an area!

What is the answer? Again, if you ask fishermen, the reply is usually "the Government needs to do something about it".

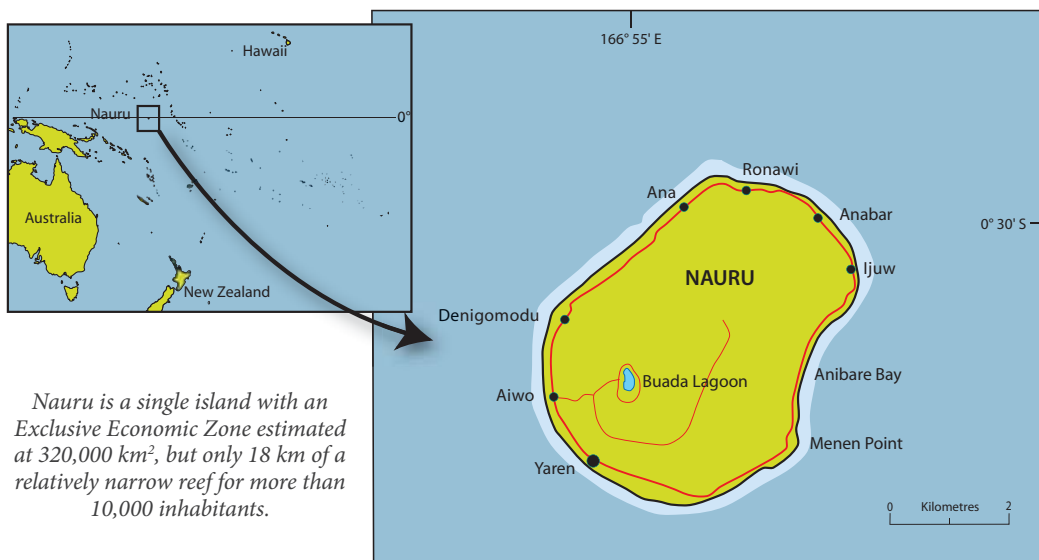
The trouble is, Governments in most Pacific Island countries have problems finding enough money to manage reef fisheries — even reef fisheries which are in much better shape than Nauru's — when that money is urgently needed for national priorities in health, education and public infrastructure.

Why is this? Why do Pacific Islands have one of the best-managed joint tuna fisheries in the world when some of them are struggling with their own reef fisheries?

Pacific Island Governments are able to effectively manage tuna fisheries for three main reasons:

- there are only three or four tuna species to look after (depending on the area) and we already know a lot about their biology;
- the vast majority of tuna is caught by oceangoing vessels that are used to providing comprehensive catch reports, being monitored by independent observers (paid for by the boats themselves), with satellite position locators switched on at all times;
- governments work together: there is a high level of inter-Pacific Island cooperation to control these fisheries, expressed through organisations such as the Nauru Agreement, the Forum Fisheries Agency and the Oceanic Fisheries Programme of the Secretariat of the Pacific Community.

But for reef fisheries covering hundreds of species, involving large numbers of small boats or divers, most of whom are not accustomed or not able to report to government every time they land a catch of fish, with few incentives for regional cooperation, and with little



known about the biology and sustainable levels of fishing for most of these species and, of course, no hope of full “cost recovery” from the fishermen to finance government management, things are much more difficult.

However, despite these region-wide constraints, many Pacific Islands’ reef fisheries are in better shape than Nauru’s because of fisheries management traditions.

In some islands this may be manifested through strong community ownership of exclusive rights to fish, or to control the activities of others on specific areas of reef. In others there are age-old understandings within the community about what kind of fish it is proper to catch in what season, or in what area, or with what kind of fishing gear, coupled with occasional bans on all fishing for a time in certain areas.

In short, these reef fisheries are in better shape because Government does not have the entire responsibility of sustaining these highly diverse, diffuse coastal fisheries, and can rely upon local communities themselves to play a part in looking after their own reef areas – the areas where they have traditionally exercised custodial responsibility.

Nauru used to have such systems, but the various trials and tribulations of the 20th century have caused these traditions to all but disappear. And where there are no longer many traditional understandings to fall back on, it is a risk for anyone who decides to restrict their own fishing when they know there is a good chance that their neighbour will not do the same thing. Especially when food is needed for the family table and paid employment is scarce.

So what is to be done for Nauru’s reef fisheries? The answer most likely lies in government-community collaboration, or “co-management”. Government develops the regulatory framework, provides scientifically-valid information and advice, and some initial help to communities in getting things up and running, whilst communities themselves take charge of many of the day-to-day decisions about how best to restore reef fisheries to sustainable levels of production.

This plan is already in action. The Nauru Fisheries and Marine Resources Authority (NFMRA) has been holding consultations to help communities design management plans for local fisheries, and is currently developing a legal framework for Cabinet consideration, which could allow communities to take part in decisions about their own fisheries or to discuss with other communities and help decide how fisheries which cover more than one district should be managed. The last piece of the puzzle — the government advisory service on reef fishery resources — is now beginning to take shape.

Being Yeeting and Deirdre Brogan from the Secretariat of the Pacific Community are currently in Nauru

helping NFMRA staff to design an artisanal fisheries survey programme, and provide training in operating the programme — survey and measuring techniques, fish identification, and entering, analysing and reporting the information collected.

Nauru fishermen are in for an interesting time, if being interrogated by NFMRA staff every time they land their catch can be called interesting. But it is all in a good cause, and at least the information is being compiled for them instead of needing to be written down and sent in to the regulatory authority by the fishermen themselves, as happens in most other countries.

NFMRA has had an artisanal (small-scale fisheries) data-collection activity running for some years, but it has concentrated on the local boat-based tuna catch to help fulfil Nauru’s international reporting obligations. This is the first time the system has been systematically expanded to cover as many small-scale fisheries as possible, including reef gleaning, spearfishing and night fishing, and with enough coverage to get reasonably accurate results.

As well as helping NFMRA develop its regular reef fisheries monitoring and community fisheries information service, this work will contribute to Nauru’s efforts to monitor the effects of climate change — by identifying changes in reef fish populations and species composition that might be correlated with climate trends — and it will also help pinpoint the fish and invertebrates that are most in need of concentrated attention by communities, and identify the areas that might make the best Marine Protected Areas (MPAs). MPAs have recently been demonstrated to provide greater benefits¹ — in terms of the juvenile fish they contribute to surrounding fishable areas — than the problems they cause by displacing fishermen into those surrounding areas — something that was previously in doubt.

It will even help to make Nauru’s Gross Domestic Product estimates more accurate, by providing regular and more reliable figures on how much fish is landed in Nauru by Nauruans, and what contribution this may have to the local economy.

Deirdre and Being have both been working for SPC for several years, and between them have a vast fund of Pacific Island fisheries experience.

Deirdre, from Ireland, previously worked with observer data-collection programmes aboard fishing vessels, and was the first female observer to work aboard tuna boats in the Pacific Islands region. Although her work is now more land-based, she spends much of her time travelling from country to country helping Pacific Island governments improve their national tuna fishery monitoring.

¹ See : <http://www.sciencedaily.com/releases/2012/05/120524123019.htm>

Being, from Kiribati, has been working on the coastal fisheries side, and has also been just about everywhere. Previously, he concentrated specifically on helping Pacific Island governments and communities in the management of live reef food fish and aquarium fish export industries, but is now covering the entire range of reef fisheries.

So what else can NFMRA do to help Nauru communities from fishing themselves out of reef fish? Nearshore Fish Aggregation Devices are one of the Authority's other tools. FADs help fishermen to target more abundant oceanic fish and still bring home a catch whilst relieving pressure on the vulnerable reef- and bottom-dwelling fish.

Also, NFMRA has applied for an extension of the AusAID-funded Fisheries Management Institutional Strengthening Project (FM-ISP), which has been helping NFMRA for three years to improve its management of the industrial tuna fishery — in particular consolidating the crucial foreign exchange revenue that foreign fishing on Nauru's rich tuna resources generates for the national economy. This revenue has achieved a major and sustainable increase during the lifetime of the project, and now it is time to turn attention to Nauru's beleaguered reef fisheries.

If approved, the FM-ISP extension will help NFMRA to achieve a similar quantum leap in the protection and management of coastal fisheries. If implemented with care, this protection should eventually result in an

increase in reef fishery production, by restoring areas to full productivity. Once a fish resource becomes overfished, increasing the fishing pressure reduces the catch, since the breeding stock becomes too small to replenish the biomass. It may seem paradoxical, but reducing the total amount of fishing, or setting areas aside for total protection, should actually increase the total catch.

This only works for severely overfished resources of course. Reducing fishing on a resource that is not overfished can only reduce the catch. It is NFMRA's job, with the assistance of SPC, to determine which reef resources are in fact severely overfished, and where community and government effort will do the most good, without costing more than the country can afford.

These reef fisheries may not generate millions of dollars for the Nauru economy, but they provide a good part of the nutritional protein that is the bedrock of Nauru's continuing food security.

And, as most Nauruans will admit, they taste better than tuna and other ocean surface fish. We may be able to continue living off abundant sustainable tuna resources, but it will be sad day when we have tasted our last blue-line snapper or black trevally.

Source: Nauru Fisheries and Marine Resources News, 7 June 2012 (<http://nfmra.blogspot.com.au/2012/06/fishing-it-up.html>).



Casting a throw-net in Nauru lagoon (image: A. Vunisea).

Breaking the boom-and-bust cycle

Sea cucumber a lucrative trade?

The Pacific Islands are facing what could be the end of their longest surviving commercial export fishery. Sea cucumber and beche-de-mer (its processed form) is a source of livelihood for many communities but it is being overfished as a result of continuous fishing and lack of effective management by authorities. Communities are now feeling the pain of losing an important income source.

In the Solomon Islands' atoll of Ontong Java, 30 years of continuous fishing has brought the sea cucumber fishery to collapse. With few other sources of cash, people are now enduring hardship.

Beche-de-mer is a luxury food in China where it is called *hai sen* and said to have medicinal and aphrodisiac qualities. High demand for the product has provided a lucrative trade for small businesses throughout the Pacific.

In fact, the importance of sea cucumber as a commercial fishery is often unrecognised. In Fiji, Solomon Islands and New Caledonia for example, the value of sea cucumber exports is equal to around 19 to 32% of the value of tuna catches in their exclusive economic zones.

But years of intensive fishing and ineffective enforcement of management measures have depleted the region's resources. The results of a study of the state of coastal fisheries, carried out by the Secretariat of the Pacific Community (SPC) from 2002 to 2009, are clear — sea cucumber stocks in the Pacific Islands are largely overfished.

While locally managed marine protected areas (MPAs) are helping to protect some breeding populations, the study, which was funded by the European Union, reveals that these managed areas are being increasingly targeted by fishers from within the community.

While subsistence fisheries are often best managed by communities under traditional practices, the sea cucumber fishery is clearly a commercial fishery that requires other management approaches.

History of boom and bust

As long ago as the late 1700s, Pacific Islanders were harvesting, processing and selling sea cucumbers to visiting merchant ships.

A boom-and-bust cycle has long characterised the fishery's history. The most recent boom occurred in the 1980s and 1990s when an increase in demand saw high production and exports.

For this fragile resource, periods of high production cannot last and are rapidly followed by busts when stocks

are so overexploited that the fishery remains dormant while it recovers, often for extended periods.

Today, sea cucumber fisheries in many islands are closed after being overfished. As traders seek to exploit the last remaining stocks, new fisheries are opening up in remote Pacific Island locations, but these opportunities are now rare.

French Polynesia and Cook Islands, where sea cucumber fishing was once unheard of, are now moving into the trade. Export production in French Polynesia has risen from 3 tonnes in 2008 to 125 tonnes in 2011.

The trend is no different for subsistence fishers — they too are finding it hard to get a good catch of sea cucumber to eat or sell at the local market.

What can be done?

Sea cucumber is a commercial fishery best managed under national government control. Countries that have taken the bold move of closing their fisheries are now on the right track.

The next challenge is making sure the closure is effectively enforced. But many countries do not have good management policies. Papua New Guinea and Tonga are exceptions with fishery management plans that have been successfully implemented.

With EU funding, SPC's Coastal Fisheries Section is assisting Marshall Islands, Solomon Islands and Vanuatu to develop national sea cucumber fisheries management plans.

These plans include limiting the number of export licenses, separating export licenses from processing licenses to make monitoring more efficient, enforcing permanent moratoriums and short fishing periods, protecting the rights of local citizens in the allocation of licenses, and providing assistance in improving the quality and price of beche-de-mer products.

SPC is also promoting improvements in resource monitoring through standardising assessment methods. Being able to compare assessments will enable resource managers to share experiences and advice.

Sea cucumber ranching is working in China for a temperate species (*Apostichopus japonicus*) but has yet to succeed for tropical species in the Pacific Islands. Although research is being undertaken, no one has made money from releasing hatchery-raised baby sea cucumbers in the wild.

Therefore the promises of huge profits from farming sea cucumber being promoted by some traders must be taken with a large grain of salt, if not regarded as false.

In some countries, communities have been victimised when such promises have allowed private companies to gain licenses to harvest and export existing wild stocks, resulting in overfishing.

Learning from Tongan experience

The good news is that the region's longest surviving commercial fishery can bounce back strongly if we learn from Tonga's experience.

Tonga closed its sea cucumber fishery in 1997. Eleven years later, it began reaping the benefits — 690 tonnes of beche-de-mer were exported in 2009 and 2010, generating some TOP 12 million (USD 7 million) annually for the local economy — an all-time record for a non-fish fishery export commodity in Tonga.

Tonga's results show that resting a fishery for an extended period is an investment, not a loss. And enforcing good management measures during an open season can bring in substantial revenue and employment.

These results should also reassure the people of Ontong Java in Solomon Islands that by respecting the current ban on harvesting sea cucumber, they can help their fishery recover and, with good management, provide benefits for years to come.

Source: Islands Business Magazine, August 2012.

US and Pacific Islands sign USD 630 Million Tuna Treaty

The United States has announced it has reached an agreement on a financial package with Pacific Island countries that are Parties to the Tuna Treaty. A statement from its Embassy in Suva today said the significant package "exceeds the benchmarks articulated by Pacific Islands Leaders."

Key issues pushed by Pacific Island countries in the negotiations were the fishing opportunities afforded to the U.S. purse-seine fleet in waters under the jurisdiction of the Pacific Island Parties and the overall financial package. On June 22, at the most recent negotiations in New Zealand, the United States and the Pacific Island Parties reached agreement on this critical issue, said the U.S. Embassy statement. The U.S. has now agreed to provide USD 63 million annually to the Pacific Island Parties over the next 10 years, for a total of USD 630 million.

In addition, the U.S. will provide a payment per vessel day that is more than 50 per cent higher than the USD 5000 per day regional benchmark price established by the Parties to the Nauru Agreement (PNA). The U.S. will also pay a 17 per cent return on the value of the fish caught by U.S. vessels licensed under the Treaty under current conditions, which it says exceeds the 10 per cent average rate of return desired by Pacific Island Leaders.

It will also pay fair compensation for fishing opportunities in the waters under the jurisdiction of non-PNA States. "This agreement on the overall financial package is a significant advancement in the negotiations, and creates a strong foundation on which the United States and our Pacific Island partners can continue to build a prosperous and sustainable future for the peoples of the Pacific region."

"The United States looks forward to working with the Pacific Island Parties to address remaining technical issues and to reaching an early agreement to extend the Treaty," said the U.S. statement. Since 1988, the United States' tuna purse-seine fleet has operated in the Western and Central Pacific under the terms of a Treaty with 16 independent States of the Pacific Forum. This mutually beneficial Treaty arrangement has provided unique access to Pacific fisheries for the U.S. tuna fleet and has served as a vehicle for the Pacific Island Parties to receive hundreds of millions of dollars in revenues, U.S. Government economic development funding and assistance with sustainable fisheries management and combating illegal fishing.

The United States is working closely with the Pacific Island Parties to negotiate an extension of this important Treaty beyond the current period, ending in June 2013.

Source: Atuna website (<http://pna.atuna.com/View-Article.asp?ID=11402>).

Tuna fisheries news

Tokelau joins PNA's Vessel Day Scheme

On 1 May 2012, Tokelau signed an agreement with the Parties to the Nauru Agreement (PNA) to join the purse-seine Vessel Day Scheme (VDS). Given Tokelau's small size, remote location and lack of infrastructure, its ability to develop its own large-scale tuna fishing, processing and marketing sectors is constrained. In recognising these limitations, Tokelau intends to focus on maximising the economic benefits associated with being a tuna resource owner, and in doing so, will work alongside PNA members in implementing the VDS. Tokelau currently maintains a bilateral access arrangement with New Zealand's purse-seine fleet (4 vessels). Forty US purse-seine vessels also have access to Tokelau's waters under the US Multilateral Tuna Treaty. The highest recorded purse-seine catch in Tokelau's EEZ during the past ten years was 6000 t (350 purse-seine fishing days) in 2002.

Kiribati renews Fisheries Partnership Agreement with EU

Kiribati and the European Union (EU) have initialled a new protocol to the Fisheries Partnership Agreement (FPA), which provides continued access for four EU purse seiners and six longliners to Kiribati's Exclusive Economic Zone and replaces the current Protocol which is due to expire on 16 September 2012. Under the new Protocol, the annual financial contribution from the EU is € 1,325,000 for a reference tonnage of 15,000 t. This is a considerable increase on the financial contribution

provided under the previous Protocol of € 478,400, however, the reference tonnage has also more than doubled from 6400 t. The number of vessels covered under the new agreement remains the same. A standard feature of Fisheries Partnership Agreements is the earmarking of a certain proportion of the financial contribution for sectoral policy support. € 350,000 of the financial contribution will be used by Kiribati for the promotion of responsible and sustainable fishing in its waters.

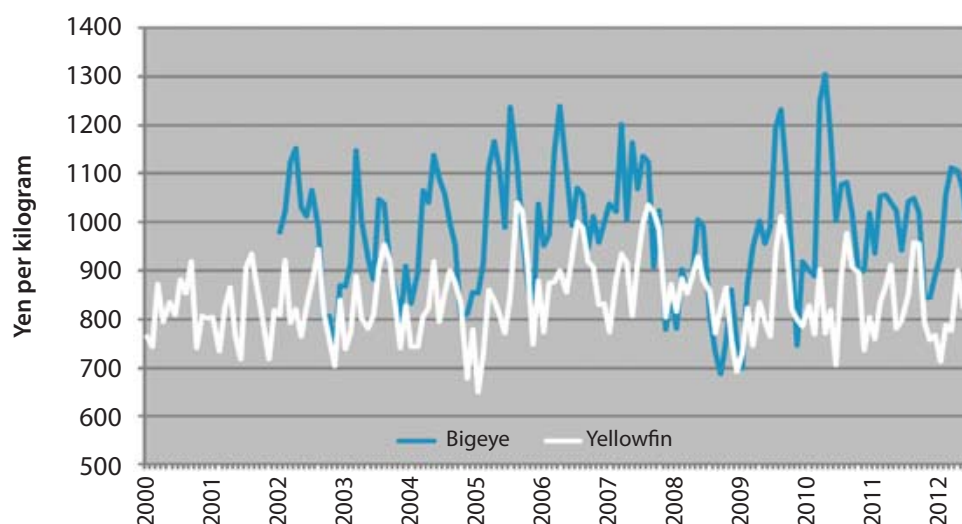
Kiribati was the first Pacific Island country to establish a fishing agreement with the EU (in 2003). Since this time, the EU has also established FPAs with Solomon Islands and the Federated States of Micronesia, however, the fishing opportunities offered under these agreements are far less utilised than those under the Kiribati agreement. While the EU-Kiribati FPA covers both purse-seine and longline vessels, fishing opportunities offered to longline vessels are yet to be taken up. The EU longline fleet operating in the WCPO generally fishes in southern waters and targets swordfish, rather than tuna.

It is currently unclear whether the new Protocol incorporates the Vessel Day Scheme for the purse-seine vessels. The prior Protocol did not include provisions on VDS, hence, unlike other bilateral fishing partners, EU purse-seine vessels have not been subject to a limit on fishing days.

Solomon Islands is also due to renegotiate a new Protocol with the EU in the coming few months.

Source: FFA FISHERIES TRADE NEWS Volume 5: Issue 3, May-June 2012.

Japan fresh sashimi prices (origin Oceania) to June 2012



Source: FFA FISHERIES TRADE NEWS Volume 5: Issue 4, July-August 2012.

Status of pronghorn spiny lobster fishery in Aneityum Island, Vanuatu, and management advice

Kalo Pakoa,^a Rocky Kaku^b and Tony Nimtia^c

^a Secretariat of the Pacific Community; ^b Vanuatu Fisheries Department; ^c Aneityum Island Tourism Project

Abstract

Fishery dependent data is the only information available for management decision-making in the absence of fishery independent resources assessment information. The pronghorn spiny lobster or double-spined rock lobster (*Panulirus penicillatus*) is exploited commercially and is an important source of income for the community of Aneityum Island in Vanuatu. Many years of fishing have led to falling catches in some of the main fishing grounds, and the growing demand for lobsters, mainly due to the increasing number of tourists visiting the island, has led to concerns about the sustainability of the fishery. This assessment supports improvements in the management of the *P. penicillatus* fishery on Aneityum by determining additional measures such as catch quotas by area, per month or by fisher, a closed breeding season and monitoring improvements. Market data collected over an 18-month period between June 2010 and December 2011 were assessed. Close to 100% of lobsters sold (97%) were above the minimum legal harvest sizes of 22 cm total length, with a mean catch size of around 25 cm total length. Larger lobsters command higher prices than smaller ones. Lobster catches increased in 2011 by 17% over the same period in 2010. A total of 12,095 lobsters were sold in 2011 worth AUD 66,135 (equivalent to VUV 6,195,532), and the isolated and difficult-to-access eastern region of the island and the highly populated southern region contributed 65% of the catch in 2011.

Introduction

The pronghorn spiny lobster (*Panulirus penicillatus*) is distributed widely in the Indo-Pacific region, where it is found around islands and islets inhabiting the shallow, rocky subtidal zone (Hearn and Murillo 2008). The species lives in crevices in the surf zone and moves to the reef flat at night to forage on small crabs, gastropods and sea urchins, algae and dead marine animals. The species can be found in groups of up to 20 individuals in submerged caves and tunnels where the group shelters during the day and leaves to forage at night. Adult pronghorn spiny lobsters do not migrate great distances as do other *Panulirus* species, but the long larval stage, which lasts up to eight months, means that larvae can travel long distances by currents, which is responsible for wide dispersal of the species (Chow et al. 2011; Hearn and Murillo 2008). Breeding of this species is monthly year round but peak season is from May to September (Chang et al. 2007).

In Aneityum, commercial fishing of *P. penicillatus* began when the cruise company P&O began visits to the island in the 1980s. Lobster is caught, cooked and sold during cruise visit days, but quality has been an issue. In the late 1990s the company began to enforce strict quality control on cooked lobster being sold to tourists. The Island Tourism Committee then moved to require quality improvements from the local Tourism Committee to make sure the food safety standards of the company were met. Quality control measures have been enforced on fishers since early 2000; these include inspection of live products before cooking to maintain freshness, ban on the sale of

undersize and egg-bearing lobsters and control of cooking and sale. The Vanuatu Fisheries Department assisted the Island Tourism Committee on proper size measurement procedures and advised on the need to set up a marine protected area near the market as a refuge for releasing lobsters confiscated from the market.

Aneityum Island and lobster fishing

Aneityum is the southernmost inhabited island of Vanuatu, halfway between Port Vila and New Caledonia (Fig. 1). The relatively large island is populated by less than a thousand people distributed in three villages of Port Patrick, Umeij and Anelcouhat (Fig. 2), the first being the least populated. Going from one place to the other on the island is done by walking or by boat. Aneityum is one of a few places in the country where reef resources are still in relatively good condition, and this is probably because of the small population and the great distance to outside markets. Ecotourism is the community's main income source. Sale of seafood, handicrafts and services to tourists, in addition to other fees received by the Island Tourism Project, have been the main source of income in recent years. Exact figures of visitor arrivals are not available but daily visits by cruise ships have dramatically increased, from 10 in the 1980s and 1990s to around 40 to 50 visits per year today, resulting in a growing demand for marine resources such as lobster.

Most of the lobster fishing is done by traditional reef owners in their own fishing areas, but a few cases of

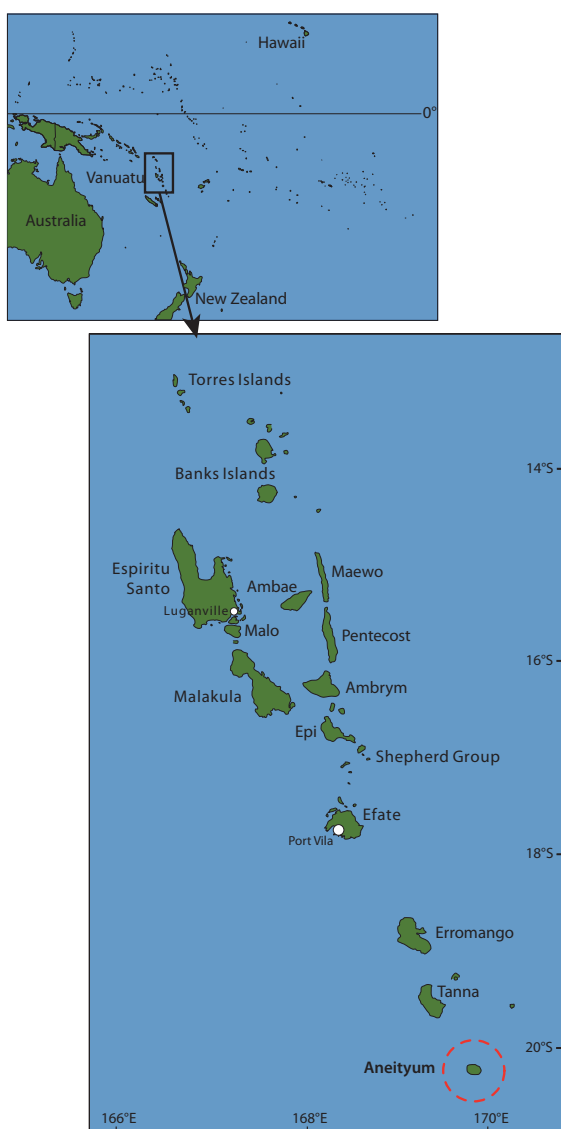


Figure 1. Vanuatu, with Aneityum Island in the south.

poaching by those who do not have their own fishing areas are known to occur. Lobster fishing is done exclusively by men, using free diving and hand collection at night with a torch. The enforcement of the Vanuatu fisheries regulations and new quality control measures have stopped spearfishing for lobster, which was a commonly used technique, enabling fishers to improve the quality of their catch. Empty flour sacks and gloves are used to handle lobsters underwater. Lobsters can be kept for a day or two in submerged wooden cages and brought down to Mystery Island (Fig. 2), where tourists from cruise ships land, the night before or in the early morning of market day.

Green leaves are placed in cages to shade the crustaceans and keep them quiet during transport and holding. The cage is kept wet until cooking. During market day, lobsters are inspected by members of a small committee known as the Mystery Island Marine Protected Area Committee, which functions under the Aneityum Tourism Project to oversee monitoring of marine related tourism activities on the island. Lobsters can also be sold on the island to visitors staying in local guest houses or crews of visiting vessels and yachts, sold at meetings, or used for subsistence or sent to friends and families in Vila by plane.

Resource assessment and management

Four species of lobsters are present in Vanuatu, the painted rock lobster (*Panulirus versicolor*), the bluespot rock lobster (*P. longipes*), the pronghorn spiny lobster (*P. penicillatus*) and the slipper lobster *Parribacus caledonicus* (Bell and Amos 1994). The most important commercial species is the pronghorn spiny lobster *P. penicillatus*. Rock lobsters are nocturnal species and are best assessed at night using timed searches and

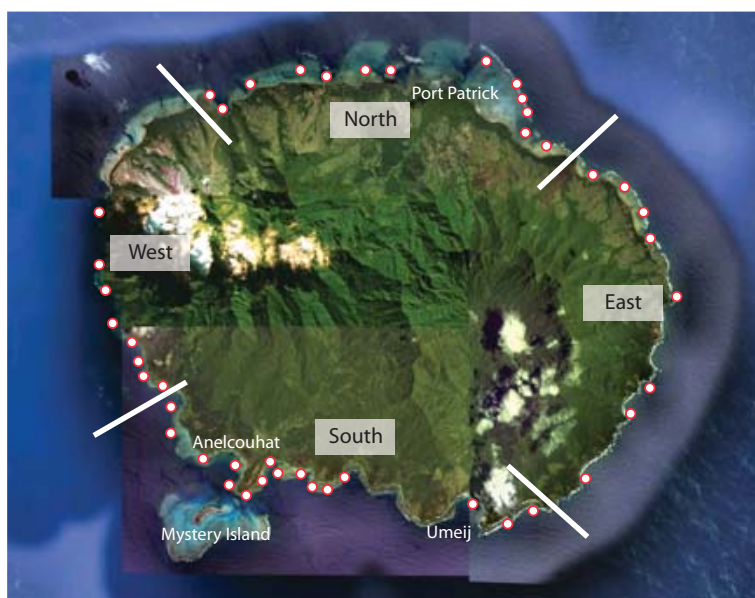


Figure 2.

Aneityum Island, the four regions and lobster fishing grounds (red circles).

Name of each fishing ground:

North region, W-E: Aanagi, Ijepdav, Anpeke, Anekelkap, Inhap, Anwacae, Aname, Anelvehav, Anapet, Anmtanahi, Antau, Anaya, Ihilcou;
South region W-E: Uje, Idupa, Anejijao, Unmajokro, Idavarei, Anisinecen, Anaigue, Analvegec, Nataea, Anadawae, Anatete, Anvigeo, Anwavat, Anpilidae, Idaha, Ahajom;
East region N-S: Iphi, Isinou, Anawonjei, Ijapses, Imtaiga, Idec, Anivat, Igamet;
West region N-S: Etheijap, Umanid, Iyalela, Umaklau, Anawaj, Igowei, Anushul, Ipekra.



Figure 3. Live, boiled and cooked pronghorn spiny lobster for sale at Mystery Island market (images: K. Pakoa).

catch and effort surveys. But night assessment is difficult and rarely conducted by fisheries officers in the Pacific for safety reasons. Furthermore, data collected is not always reliable. Lobster assessment is rarely done in Vanuatu and although the fishery can be important, such as in Aneityum, resources are unknown. Invertebrate resource surveys conducted by the Fisheries Department in 1998 recorded sightings of a relatively large number of pronghorn spiny lobster at Anelcouhat Bay, but the data were not sufficient to understand the status of the resource for the whole island. Monitoring and inspection of lobster sale in Aneityum began 10 years ago, but catch data were not collected by the community for various reasons. Management measures for rock lobster in Vanuatu include a minimum size limit of 22 cm total length for *Panulirus* species and 15 cm for *Parribacus* species, and a ban on the harvest of females with eggs (Fisheries Regulation Order No. 28 of 2009).

This report provides an assessment of the status of pronghorn spiny lobster fishery of Aneityum Island with the goal of improving monitoring and management of the fishery as part of the community's adaptation to climate change under the Aneityum Island Integrated Coastal Management Action Plan.

Method of data collection and analysis

In May 2010, Tony Nimtia was elected as the new member of the Mystery Island Marine Protected Area committee in charge of monitoring and inspection of lobster sale. Catch and market data, including name of fishing ground, name of fisher, length of each lobster, number of egg bearing females and price per specimen have been recorded since June 2010. Records are written on an exercise book and transferred to an Excel spreadsheet at the island's tourism office in Anelcouhat; printed copies are sent to the Fisheries Department. Copies were also sent to SPC Noumea for backup and reporting. Interviews and observations were undertaken with fishers and village elders in Anelcouhat during kava drinking sessions and at the market place during cruise days in March, May and July 2010. Lobsters are sold whole, so production information is presented by number of

lobsters. For the assessment of catch distribution, the island is divided into four regions (North, South, East and West) and catch is recorded for each fishing ground in each region (Fig. 2).

Results of the survey

Species composition of the catch

All the lobster sold on Aneityum is recorded as double-spined or pronghorn spiny lobster (*P. penicillatus*). There is no record of other species being marketed, although they might have been present and recorded as *P. penicillatus*.

Marketing of lobster

Prior to boiling, each lobster is measured and its total length is recorded. Dead and damaged lobsters, under-size animals and egg-bearing females are confiscated and released immediately to sea. Cooking and selling are done by fishers themselves in a designated area under the supervision of the committee (Fig. 3). Each fisher is charged a fee of VT 400 for the use of the marketing facility, and these funds go toward the monitoring programme.

Lobster prices

Lobster is sold whole and the price ranges from AUD 5.00 to AUD 60.00 per piece based on size. The Australian dollar is widely used on the island as the majority of visitors are from Australia.

As indicated in Figure 4, mean price increases with size. The 15 cm to 20 cm sizes, which are under the minimum harvest size requirement, only command a mean price of AUD 9.63, but the price more than doubles for lobster of 22 cm and above. This rapid increase in prices is a good incentive to respect the minimum size requirement of 22 cm, which is based on sexual maturity.

Production quantity and value

A total of 838 lobsters were sold during 11 market days from June to December 2010, which equates to an

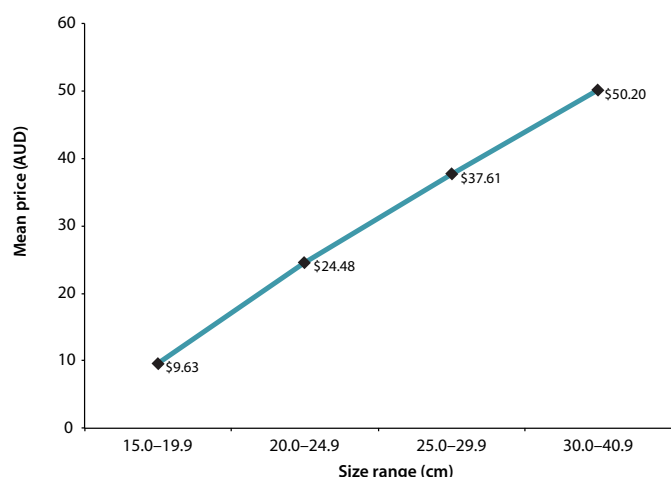


Figure 4. Mean price of lobster in Aneityum according to size.

average of 76 lobsters sold per market day. Data coverage for 2011 was good, covering the 12 months and 33 market days out of the more than 40 cruise visit days for the year (Fig. 5). In these 33 markets days 2125 lobsters were sold. All lobsters for both years were recorded as *P. penicillatus*. Monthly catch varied depending on weather conditions but also on the number of cruise visits arriving directly from Australia, as fishers caught more lobsters before these visits in the expectation of selling them. Monthly production peaked in the middle of the year around May and June but dropped from July to October, with October having the lowest sales; this trend is dictated by tourist arrivals, as July to October are the low season for tourism. The number of lobsters sold from June to December 2011 increased by 17% (334 lobsters) over the same period in 2010.

Income varies with the quantity of lobster produced. In the 6 months of 2010 when lobster sales were recorded, a total income of AUD 26,651.29 (equivalent to VUV 2,496,692 at an exchange rate of AUD 1.00 = VUV 93.68) was made. Total income generated for 2011 was AUD 66,135.06, or an equivalent of VUV 6,195,532. Over the 19-month period during which data were collected, a total income of AUD 92,811.35 or VUV 8,694,567 was generated by this fishery (Fig. 6). Income generated in 2011 increased by 11% compared to the same period in 2010, and this was only due to the increase in production, as prices remained the same.

Size distribution of catch

The size distribution of the catch provides information on compliance with the minimum harvest size regulation. Lobsters sold at Mystery Island ranged from a minimum of 16 cm to a maximum of 40 cm. As Figure 7 shows, the large majority of lobsters sold in 2010 and 2011 were 22 cm and larger, while the quantity of under-size lobsters (<22 cm) remained marginal but doubled between 2010 (1.5%) and 2011 (3%).

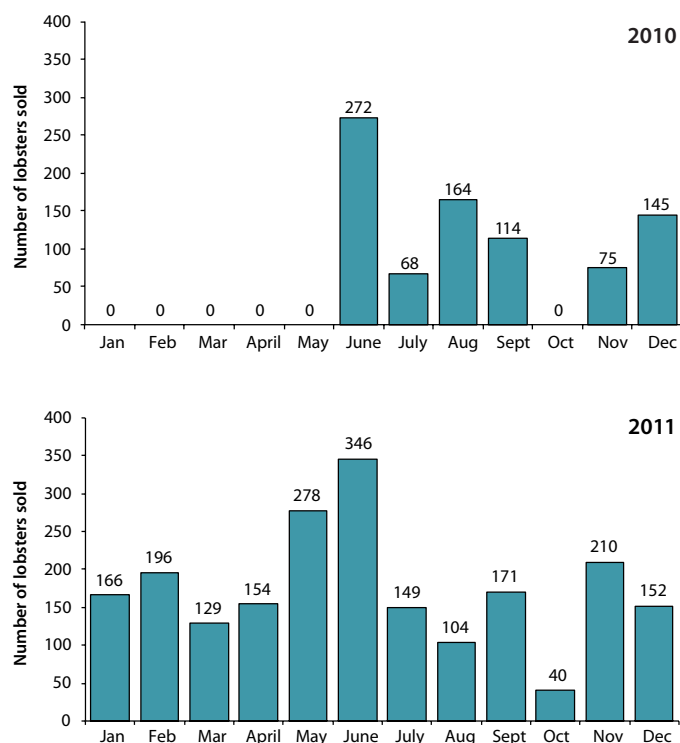


Figure 5. Number of lobsters sold in 2010 and 2011.

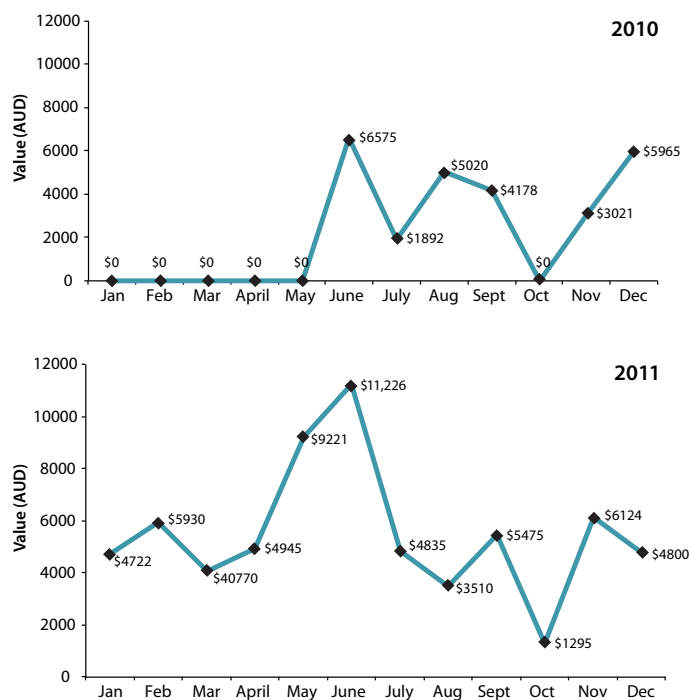


Figure 6. Monthly lobster value in AUD for 2010 and 2011.

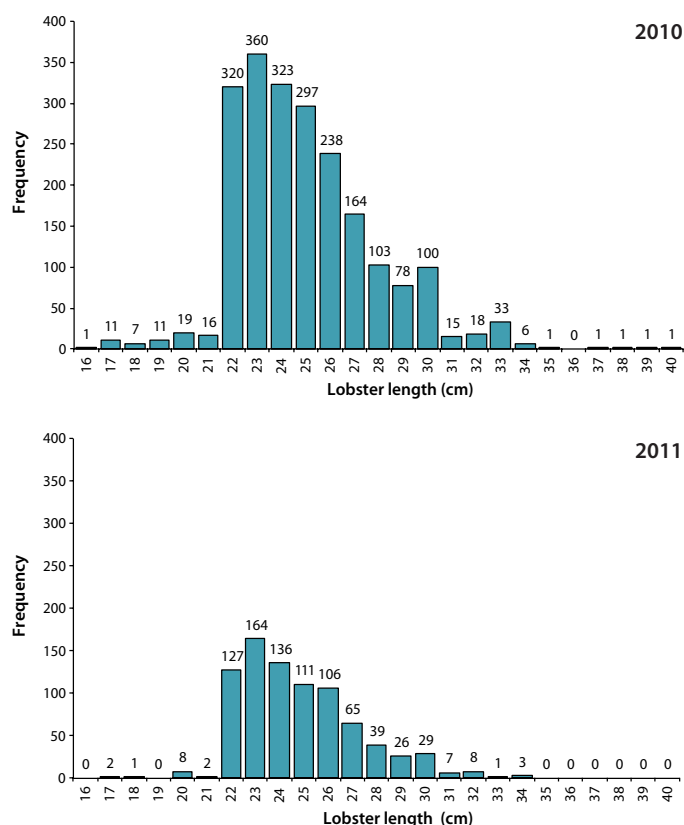


Figure 7. Catch size distribution for lobster sold in Aneityum for June–Dec. 2010 and Jan.–Dec. 2011.

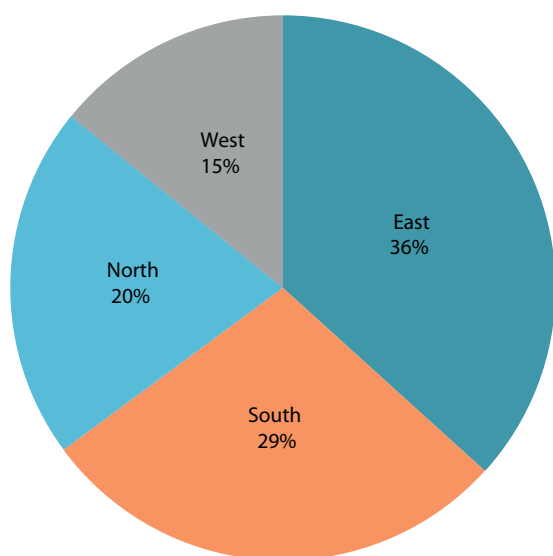


Figure 8. Distribution of Aneityum lobster catch by region, 2011.

Distribution of catch by area

Catch information by area helps fishers and the community to know their resource and take management action. Catch distribution for the four regions for 2011 (Fig. 8), shows that the East and South regions contribute 65% of the total production. The West, South and East are accessed by fishers from Anelcouhat and Umej who are traditional owners in these areas. The East region is uninhabited and accessible by boat only in good weather conditions, which explains why it remains a good fishing ground.

Further assessment of the catch (Fig. 9) showed that production varied by fishing ground. In total, 61 fishers participated in lobster fishing in Aneityum, and the majority of them (62%) were from the South region. Sixteen fishing grounds are accessed by 62% of lobster fishers in Aneityum, or an average of 2.3 fishers per fishing ground, while in all other areas the average is one fisher per fishing ground. In three regions there is one fishing ground that has been clearly more productive than the others; Ahaj in the North, Anavigedo in the South and Iyalela in the West have represented 33%, 48% and 54% of the respective total catches of these regions. For the East region, the main sources of lobster were in three areas — Anawonjei, Imtaiga and Iphi — indicating that good lobster populations can be found in several areas. This could also mean that access to other fishing grounds in the East is restricted by strong waves.

Management advice

- ✓ Inspection of lobster legal harvest size has been effective in Aneityum, but a few undersize lobsters are still being sold. The committee should strengthen its inspection to completely stop the sale of undersize products slipping through the market.
- ✓ All rock lobsters being marketed in Aneityum are recorded as pronghorn spiny lobster (*P. penicillatus*), but it is likely that other species are being sold but not recorded correctly. The Fisheries Department should assist in providing logsheets that include other lobster species names to the Inspection Committee.
- ✓ An increase in production has been noted in 2011 as well as an increase in the sale of egg-bearing females. The community should consider a ban on the export of lobster from the island for personal or commercial use and inspection at the airport and of visiting vessels to protect the island lobster if it is to remain the island's speciality.
- ✓ Data should be collected on sales at mainland markets (such as Bangalow), in shops or in village markets and at fundraising events to improve the total production estimates.

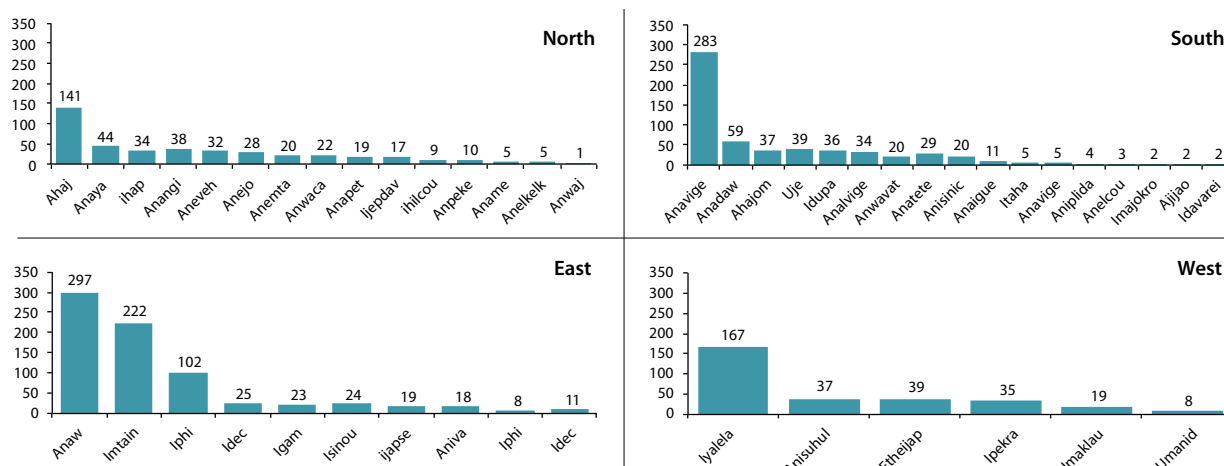


Figure 9. Lobster catch (kg) by fishing ground in the four regions, 2011.

- ✓ The Aneityum Tourism Committee should continue to work with the Fisheries Department to develop educational material on lobster management for fishers and communities.
- ✓ The setting up of the Mystery Island Marine Protected Area is a positive step to improve management of resources like lobster and as a refuge for release of egg-bearing and undersize lobsters. To ensure the future security of the area, the community of Aneityum should look into developing the area into a marine reserve for long-term conservation of resources and as a possible tourist attraction.
- ✓ In addition to the length data being collected, the committee should also collect data on the sex of the lobsters and the time spent fishing by each fisher, and on the number of egg-bearing females and undersize lobsters seized at the market.
- ✓ A seasonal closure of fishing is recommended for Aneityum. *P. penicillatus* and other *Panulirus* species spawn monthly but peak spawning is usually around the summer months — November to April in Vanuatu — when water temperature is high. However, for Aneityum, a closed season could be established during the low tourism season from July to November. More data on egg-bearing lobster would be needed to verify the peak spawning period in Aneityum.
- ✓ Setting catch quota by fisher and by area or by month must now be considered in order to control catches. This measure is already identified in the Draft Aneityum Lobster Fishery Management Plan and needs to be further discussed with the community. A draft copy of the Aneityum Island Lobster Fishery Management Plan has been provided by SPC to the Vanuatu Fisheries Department, which should present it to the community for endorsement and implementation.

Acknowledgements

We acknowledge the support of the community of Anelcouhat, Umej and Port Patrick, the Aneityum Tourism Project and the Mystery Island Marine Protected Area Committees who conducted inspections and gathered data used in this report, the fishers present at the Aneityum Island Integrated Coastal Management Action Plan workshop who voiced their need to improve management of the fishery, the Island Council of Chiefs and the heads of families for their support. The Vanuatu Fisheries Department coordinated this effort with funding support from The John D. and Catherine T. MacArthur Foundation under the Enhancing Coastal and Marine Ecosystem Resilience to Climate Change Impact Project and the European Union-funded SciCOFish project supported the production of this report.

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The characteristics of Pacific Island small-scale fisheries

Tim Adams

*Fisheries Management Adviser
Nauru Fisheries and Marine Resources Authority*

Introduction

This article is condensed from a paper prepared for the FAO Pacific Regional Consultation on the development of Guidelines for Securing Sustainable Small-Scale Fisheries held at SPC headquarters in Noumea from 12 to 14 June. A description of this consultation is provided by an article in this newsletter (p. 6) entitled “Securing sustainable small-scale fisheries”, by Michael Sharp and Michel Blanc.

This is not a comprehensive review, but a short paper that provided a starting point for discussion by the workshop participants, as part of their task of providing Pacific Island-specific input into the FAO process for developing a global voluntary instrument on small-scale fisheries. More information about this international process can be found elsewhere, particularly at <http://www.fao.org/fishery/ssf/guidelines/en>, but once finalised, this FAO instrument will provide an agreed set of basic principles to help governments, and others involved in fisheries governance or implementation, to ensure that small-scale fisheries are sustainable, socially and economically, as well as biologically.

FAO SSF Guidelines

The FAO Guidelines for Securing Sustainable Small-Scale Fisheries, or FAO SSF Guidelines, are expected to provide objectives and measurable indicators against which national progress towards the ultimate goal of sustainable small-scale fisheries can be assessed, and will be the starting point for the development of a toolbox of more specific advice that can be used as appropriate to the circumstances of individual communities and fisheries. It is also likely that this instrument will guide international programmes of assistance applied to appropriate governance and sustainable development in the small-scale fisheries sector, particularly in developing countries.

The process of developing this instrument has received little input from Pacific Island states to date, despite the importance of small-scale fisheries to a large proportion of the Pacific Island population. When it comes to fisheries, Pacific Island states tend to look towards regional¹ rather than international institutions to implement their obligations to collaborate in the conservation and management of trans-boundary fisheries, and in sharing scientific, development, standard-setting and advisory services on other fisheries. They tend to participate less in global fishery processes than states in other regions.

How are Pacific Island small-scale fisheries different?

Globally, small-scale fisheries are indeed diverse. They are not so diverse and discrete that different regions can be classified into entirely separate categories, but there is often a different mix of small-scale fishery types in different regions.

In general, small-scale fisheries in the Pacific Islands region — defined here as the SPC work area² — may differ from the global average in the following ways:

- Artisanal fishing rights and customary or community marine tenure are more common than in most other regions.
- Pacific Islanders who fish form the majority of the population in many Pacific Islands, and most Pacific Islanders (outside of the Papua New Guinea highlands) live near the coast. The sea, and its uses, pervades the entire national culture of many Pacific small island states.
- Fisheries are not usually the “livelihood of last resort” for the poorest of the poor, but often an inherited speciality carrying certain rights.
- Freshwater fisheries are not particularly significant at the regional scale. Freshwater fisheries are extremely important in Papua New Guinea, but most

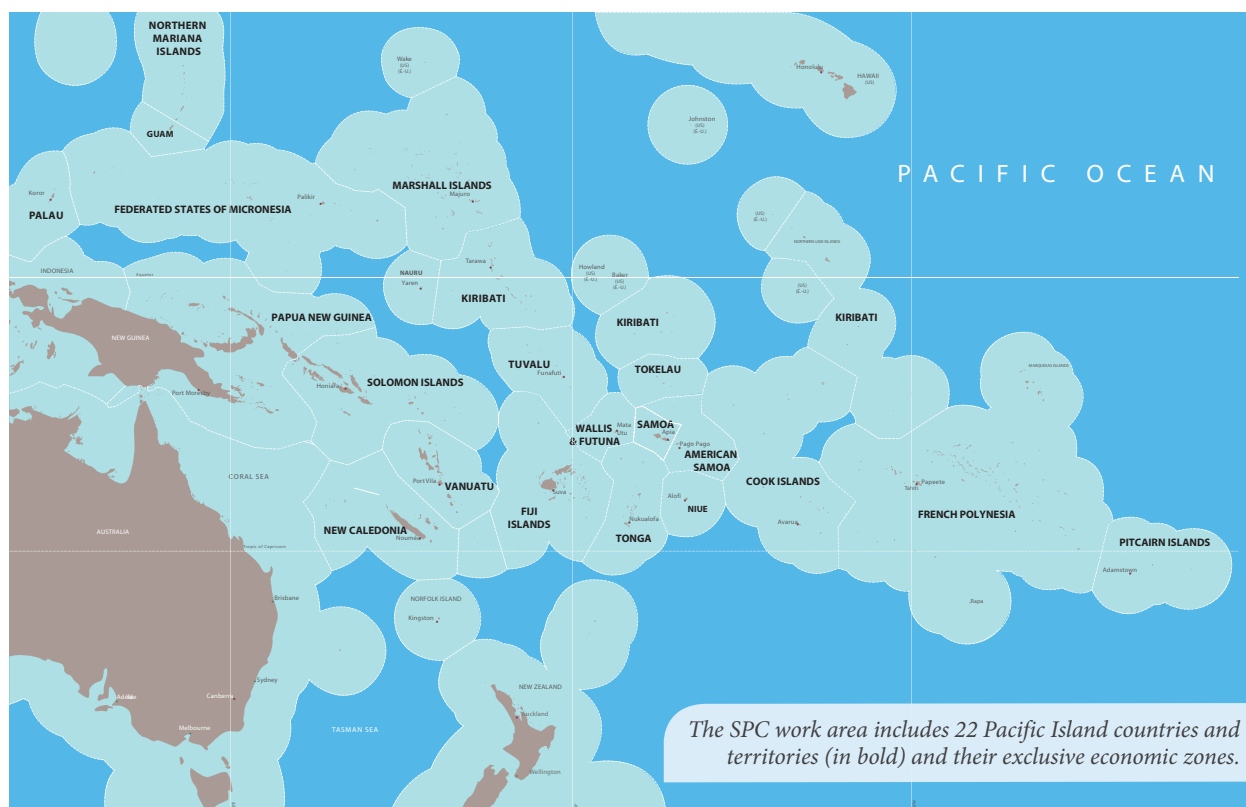
¹ Including the Secretariat of the Pacific Community (SPC), the Pacific Islands Forum Fisheries Agency (FFA), the Office of the Parties to the Nauru Agreement (PNAO), the Te Vaka Moana arrangement (TVM), and the US Western Pacific Regional Fisheries Management Council.

² The SPC work area includes fisheries waters of American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna (see map on next page).

small islands do not have significant freshwater systems, and even in the rest of Melanesia where rivers are more substantial, most freshwater species are not particularly attractive to consumers compared to marine or brackish-water fish.

Since the vast majority of residents of small Pacific Islands dwell on the coast with access to fresh fish, there is less need for comprehensive national processing, distribution and trade networks than in continental regions, and a much smaller proportion of the people involved in small-scale fisheries fall into the category of “fishworker” as defined in the FAO draft guidelines. Small-scale fisheries producing products for export are a notable exception.

- Although it is difficult to make absolute comparisons, in general the fishery resources available to small-scale fishers in many Pacific Islands appear to be less overexploited — on average — than is reported to be the case in most other developing country regions. This is probably due both to the isolation of coastal fishing areas from large consumption centres, and traditions of marine custodianship.
- Pacific Island small-scale fisheries are notably multi-species in nature, usually with more than a hundred finfish species and dozens of invertebrate species regularly being marketed or consumed. Very little is wasted, and nothing is discarded unless it is a species known to be totally unfit for consumption.
- Because of the lack of shallow slopes and continental shelves (with the exception, again, of Papua New Guinea), there is a marked distinction between coastal and oceanic areas. Benthic trawling is not possible around most Pacific Islands, and coastal fisheries consist overwhelmingly of coral-associated fish and pelagic fish that can be caught close to reefs.
- On many islands, particularly un-urbanised islands, the subsistence fishery is larger than the commercial fishery, but many fishers catch fish both for consumption and for sale. In contrast to some other regions where the highest-value component of the catch is marketed and where more unsaleable items are reserved for family consumption, many Pacific Island fishers keep the best of the catch for themselves and market the rest. Traditionally, there is little incentive to earn more money than is necessary to satisfy immediate needs, and any obvious surplus is normally shared with the rest of the community.
- On many islands, oceanic resources are available in relatively close proximity to shore and thus it is often relatively feasible for fishers to switch their effort from more vulnerable reef resources to more abundant oceanic resources, if required.
- There are few trans-boundary issues in Pacific Island small-scale fisheries that involve international law. The only shared coastal boundaries in the SPC region are between Papua New Guinea and Indonesia. However trans-boundary considerations can be



extremely important at the local level. Marine rights ownership or traditional area tenure is highly codified in some Pacific Island nations.

- Considering all fisheries combined (large-scale and small-scale), the Pacific Islands region produces far more fish than it consumes, by a factor of at least 10 to 1. The exports are almost entirely tuna from industrial fisheries and the local consumption is almost entirely produced by small-scale fisheries, but there is the potential for considerable future food security in changing the balance of this equation.

The small-scale fisheries sector in the Pacific Islands

Sharp and Blanc (this newsletter, p. 6) describe what is meant by “small-scale fisheries” and provide an idea of their economic importance to the Pacific Islands region.

In the Pacific Islands region, the line between large-scale and small-scale fisheries is drawn essentially between commercial tuna fisheries (largely purse-seine and longline, with some pole-and-line) and all other fisheries. The grey areas would probably be oceangoing tuna troll vessels (of which there are now few based in the SPC work area), the larger deepwater snapper boats, and occasional unsuccessful trial fishing by trawlers of external origin. Papua New Guinea is, however, a special case because of its extensive shelf area, and there are other fisheries that could be considered large-scale.

The Secretariat of the Pacific Community may itself provide another yardstick. SPC’s Coastal Fisheries Programme generally works on small-scale fisheries, and its Oceanic Fisheries Programme generally works on large-scale fisheries, although there is some sharing of responsibility when it comes to the monitoring of artisanal tuna fishing.

Several estimates have been made of the total volume of Pacific Island small-scale and large-scale fisheries over the years:

In 1996 an SPC review³ stated: “The total coastal fisheries production from the region amounts to just over 100,000 tonnes per year, worth a nominal USD 262 million [*in terms of landed value at market prices in Pacific Island economies*]. About 80% of this production is from subsistence fishing.” This was an extremely approximate

estimate, but the first time that a reasonably well-informed summary — taking account of the likely gaps as well as the available statistics — had been attempted. At that time there was no valuation available for the large-scale tuna fisheries in the region, but for 1996 the total tuna catch from the same area was estimated to be just over 956,000 tonnes of skipjack, yellowfin, bigeye and albacore tuna.⁴ Given that over 80% of this catch was skipjack, the total landed value would have been around USD 750 million. In short, in the mid 1990s, small-scale fisheries catches in the Pacific Islands region were about one-tenth of large-scale fisheries in terms of weight, and about one-third in terms of nominal landed value.

More recent estimates have been based on the work of Bob Gillett.⁵ Coastal small-scale (subsistence/commercial) fisheries production for the region is estimated to be 110,000 tonnes, with a value of at least USD 272 million to Pacific Island economies. This local value was estimated to be 30% more than the combined contribution of locally-based large-scale (overwhelmingly tuna) fisheries to Pacific Island economies. Expressing the tuna catch in the Pacific Islands region in terms comparable to the 1996 figures provided above, the total tuna catch from the same area in 2010 was 1,755,000 tonnes and the landed value would have been approximately USD 2.2 billion. In short, in the late 2000s, small-scale fisheries catches in the Pacific Islands region were about one-sixteenth of large-scale fisheries in terms of weight, and about one-eighth in terms of nominal landed value.

Over the past 15 years the total Pacific Island small-scale fisheries sector is estimated to have not significantly increased in volume or value, while the large-scale sector has expanded dramatically.

However, most of the value of the landed tuna catch accrues to the foreign vessels that do most of the tuna fishing, and it is the contribution of locally-based large-scale tuna fisheries to Pacific Island economies that is most directly comparable to the value of small-scale coastal fisheries. In terms of direct benefit to Pacific Island states and territories, large-scale tuna fisheries still lag behind small-scale fisheries.

Of course the potential to increase future Pacific Islands benefit from tuna fisheries is much greater, and Pacific Islands are gradually carrying out more of the large-scale tuna fishing and processing that has hitherto been mainly the province of Pacific Rim countries.

³ Dalzell P.J., Adams T.J.H. and Polunin N. 1996. Coastal Fisheries of the Pacific Islands. *Oceanography and Marine Biology: An Annual Review* 34:395–531.

⁴ Data from SPC OFP Catch-Effort Database Query System (CES). Note that the area of this estimate includes only Pacific Island EEZs and adjacent high seas and does not include EEZs of non-SPC members.

⁵ Gillett R. 2009. Fisheries in the economies of Pacific Island Countries and Territories. Pacific Studies Series, Asian Development Bank, World Bank, Forum Fisheries Agency, Secretariat of the Pacific Community, and Australian Agency for International Development. 520 p.

Types of small-scale fisheries in the Pacific Islands

Not a lot has changed in the broad structure of the Pacific Islands small-scale fisheries sector since the review by Dalzell et al. in 1996 (see footnote 3), but more recent work — despite the main focus of attention turning to oceanic, industrial, tuna fisheries — has added more detailed information. Notable amongst these is the work led by Bob Gillett on the contribution of fisheries to Pacific Island economies (see footnote 5) the reports on the state of Pacific Island reef fish resources by the SPC Coastal Fisheries Science and Management Section from 2002 to 2007,⁶ and the *Future of Pacific Islands Fisheries* review⁷ in 2010.

The following types of small-scale fishery are most obvious in the Pacific:

- **Boat-based multispecies reef food fisheries.** These may be commercial, subsistence, or anywhere in between, and vessels may range from paddle- or sail-powered canoes to small inboard or outboard boats. Usually fished with lines or gillnets, and targeting a multitude of species, these fisheries are the major domestic source of protein for Pacific Islanders, particularly in rural areas, but fish from them are increasingly being transported to urban markets or, particularly in northern Micronesia, to neighbouring island countries.
- **Spear fisheries.** These are usually boat-based when commercial and target the most lucrative market fish, but are often carried out at the subsistence level and from shore. Many Pacific Islands have now banned the use of scuba for spearfishing because commercial spearfishing, particularly at night, has



Paddle- or engine-powered canoes are used in almost all Pacific islands, including in Tarawa, Kiribati where this picture was taken (image: M. Kronen).



Spearfishing seems harmless when done for subsistence, but it can be destructive when used at a commercial scale, especially at night (image: J. Applebaum).

led to rapid depletion, particularly of large Lutjanidae, Serranidae and Scaridae. Spearfishing, however, can be extremely selective and is also an effective way of targeting Acanthuridae and Balistidae, which, while less favoured by many consumers, are usually more abundant and resilient.

- **Reef gleaning and other non-boat-based reef and lagoon fishing, including handlining, traditional fish corrals and leaf-sweeps.** This is usually the fishery (or suite of fisheries) with the most participation by women in the Pacific Islands.
- **Freshwater fisheries.** These are limited in extent, except in Papua New Guinea. Eel trapping is practised in some places, but most Pacific Islands do not have well-developed rivers or freshwater lakes, and many of these freshwater systems have been infiltrated — or sometimes overrun — by Mozambique tilapia, which is not a favoured food fish. Freshwater shellfish are consumed or marketed in large numbers in Fiji and parts of Melanesia, however, and constitute another important fishery for women.
- **Export fisheries for live aquarium fish (not usually overlapping with food fisheries).** These usually operate under tight management conditions and are thriving in a number of places, particularly those with adequate airfreight connections.
- **Live food fish export fisheries.** Shipping mainly to China and Taiwan, these fisheries are operating at a much lower level than previously, probably not because of gross overexploitation, but because of more stringent conditions imposed by Pacific Island states to maintain sustainability of fisheries which interact strongly with local food fisheries. The

⁶ See SPC coastal fisheries website (<http://www.spc.int/coastfish>) where all of the reports referenced in this paper can be found online.

⁷ Gillett R. and Cartwright I. 2010. The future of Pacific Island fisheries. Noumea, New Caledonia: Secretariat of the Pacific Community. 139 p.

opportunities for foreign operators to “make a fast buck” have been greatly reduced.

- **Non-finish export fisheries, usually for relatively imperishable products such as beche-de-mer (sea cucumber), trochus shell and wild seaweed.** These usually involve collection by part- or full-time locally based reef gleaners and divers selling to centralised fully commercial middlemen and exporters. Although limited in extent, some of these fisheries may be extremely important economically in certain countries, and many are overfished, sometimes severely.
- **Deepwater snapper (outer reef slope and sea-mount Lutjanidae) line fisheries, addressing mainly local markets.**
- **Nearshore tuna longline export fisheries (mainly for albacore, bigeye and yellowfin tuna).** It is difficult to draw a line between these and industrial tuna fisheries and they might be better classified among the large-scale fisheries, particularly as they are managed under the same mechanisms.

In the future, the work being carried out by SPC to help Pacific Island fisheries departments in developing, harmonising methodologies for, analysing, and bringing together the outputs of national coastal fisheries monitoring processes should make it possible for SPC to produce a regular regional assessment of the status of coastal and small-scale fisheries. This could be analogous to the regular oceanic fisheries assessments that SPC currently produces, including the movement of

indicators of biomass and fishing mortality relative to agreed reference points, for fisheries of high concern. For small-scale fisheries, additional indicators relating to socio-economic reference points (such as food security indices, sex-ratios, and local fish prices) would also be very important.

Small-scale fishery conservation and management initiatives in the Pacific Islands

Although in the summary above it is suggested that Pacific Islands have had the opportunity to conserve their small-scale fisheries to a greater extent than developing countries in other regions, the garden does not consist entirely of roses and the extreme dependence of Pacific small island states on fisheries makes it crucial that any problems are addressed. The following are some of the areas where Pacific Islands have been concentrating their effort:

Marine protected areas: The tradition on many Pacific Islands of occasional moratoria on all, or certain types of, fishing lends itself to the modern concept of the marine protected area, which many Pacific Island countries have embraced with enthusiasm, not only for the purpose of providing biological refugia, but also as a legislative vehicle for the purpose of establishing community-based management in areas where traditional area rights have been eroded. Reef fish spawning aggregation areas may also be protected at critical times of year in some countries.



Trochus and sea cucumber fisheries are, economically, the most important non-finish fisheries in most Pacific Islands (images: K. Pakoa (left) and E. Tardy (right)).

Alternative livelihoods: For areas where small-scale coastal fisheries are under severe stress or where limits have to be introduced, several strategies to create alternative livelihoods may be applied, depending on the area:

- Nearshore fish aggregation devices (FADs). They have been deployed by many Pacific Islands within the past four decades specifically to enable small-scale fishers to more cost-effectively target the pelagic resources that are usually more abundant and more easily sustainable than demersal and reef-associated fish. With recent concern over the role of drifting oceanic FADs in facilitating overfishing of bigeye tuna and increasing bycatch by purse-seiners, it has become necessary to emphasise the differences between the nearshore anchored FADs used by small-scale fisheries and the oceanic drifting FADs used by large-scale fisheries.^{8,9,10}
- *Bagan* raft-based fishing for small pelagics (sardines, scads, anchovies, fusiliers etc.). Like the FAD, this is another innovation imported to the Pacific Islands from Southeast Asia, with trials currently underway in Marshall Islands.¹¹ As with any fishing method, over-use can be counterproductive, but *bagan* fishing targets resources that are currently little-used in the Pacific Islands and could potentially supply the live bait that might make pole-and-line fishing for skipjack economically viable again, as well as providing food-fish alternatives. Unlike inshore baitfishing by tuna pole-and-line vessels, which gave rise to a number of social issues in the heyday of Pacific Island pole-and-line fishing, these baitfishing rafts would be operated by fishing rights owners or local communities themselves.
- Tourism-based marine livelihoods. Several Pacific Islands have found that their inshore marine resources provide more value when viewed as non-extractive resources, or to support tourist sportfishing or game-fishing. Although these tourism-based alternatives tend to arise where tourism is already extensive, such as in Palau or eastern Polynesia, there are also areas where specialised tourism may develop as a result of a highly valued marine resource-based tourism opportunity, such as the catch and release bonefish rod-fishery at Kiritimati in Kiribati.
- Small pond aquaculture. It is being promoted by SPC as an alternative to reef food-fishing, and to develop food-security resilience in the face of climate change. Most Pacific Islands do not have a strong tradition of



*Small fish ponds in Papua New Guinea
(image: Ben Ponia).*

aquaculture — reef and nearshore pelagic resources have traditionally provided most of their protein — but with expanding populations this is no longer the case in many areas, particularly peri-urban areas.

Community-based management: It has been extensively promoted by SPC and most Pacific Island governments in cases where such traditions are not already strong. It has become generally recognised that the governments of small-island developing states are currently ill equipped to directly manage small-scale reef and lagoon fisheries with their myriad landing points and hundreds of species, and that sustainable management is only likely to be effective if a degree of management responsibility is decentralised to local communities. Depending on the strength of traditional mechanisms, this devolution may be readily accomplished, or may require careful cultivation and support. There has, however, been a notable resurgence in community-based small-scale fisheries management in a number of areas in recent years, following a general decline in the latter decades of the 20th century.

Bans on scuba or night spearfishing: One specific fishery that seems to lead to problems — particularly for the larger predators within the reef fish assemblage — wherever it occurs is the scuba spearfishery, especially when carried out at night. The modern advent of underwater torches and breathing gear has made spearfishing much more efficient,¹² and many Pacific Islands have placed regulatory bans on scuba spearfishing as part of their strategy to reduce overfishing of certain species.

⁸ http://www.spc.int/DigitalLibrary/Doc/FAME/Brochures/Anon_12_PolicyBrief19_FADs.pdf

⁹ http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/137/FishNews137_36_Adams.pdf

¹⁰ http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/136/FishNews136_35_Taquet.pdf

¹¹ http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/136/FishNews136x_14_Bagan.pdf

¹² See Gillett R. and Moy W. 2006. Spearfishing in the Pacific Islands: Current status and management issues [IP7]. Noumea, New Caledonia: Secretariat of the Pacific Community, 5th Heads of Fisheries Meeting, Noumea, New Caledonia, 3-7 April 2006. 77 p. (www.spc.int/digitalibrary/doc/fame/meetings/hof/5/ip7.pdf)

Wider issues

Assessing progress in small-scale fisheries: In any strategy, plan or policy it is necessary to know the starting point (where we are now), and what we want to achieve (goal), and to have some way of measuring progress towards that goal. The problem with Pacific Island small-scale fisheries is that there are few statistics available to define the starting point and the goal, and few monitoring programmes capable of assessing progress at the level of frequency and accuracy useful in national planning. In part this is due to the fact that many fisheries are managed at the local or community level, with little need for formal statistics, but the point remains that governments need to know what is happening, they may need to step in where community-based management is inoperative due to externalities or conflict, and they are requested by the Code of Conduct for Responsible Fisheries to report on progress to FAO.

Vulnerability to war, civil unrest, climate change, and natural disasters: The Pacific Islands region is comparatively peaceful, and while cyclones and tsunamis may cause widespread devastation, it is not usually on the scale experienced in other developing regions. The potential effects of climate change are thus possibly more significant to this region, relatively speaking, than natural or social disasters. However, climate change may be less rapid than social and population change in its effect on Pacific Island small-scale fisheries.

Social conditions: In much of Pacific Island society, fishing is a respected livelihood. Fishing requires courage, it provides the main source of protein for many communities, and it reinforces the community's links with the sea. Pacific Island social consciousness does not normally need to be raised about the plight of the fisher. There is usually at least one in every family.

However, where tradition has broken down, issues may arise. Urbanisation, and drift of young people from rural areas to the town in the hope of advancement creates problems in fisheries — both for the community that originally owned the fishing rights at the site of the town, and for the new arrivals who must negotiate for the right to fish, if that is the only way they can feed themselves. And high population densities often create problems for fishery resources themselves.

In contrast to the FAO draft Small-scale Fisheries Guidelines, this brief paper has concentrated on fishers and the capture sector rather than fishworkers and the postharvest sector, because paid employment is not a major feature of Pacific Island small-scale fisheries (although it is in Pacific Island large-scale fisheries).

There are, however, certain small-scale fisheries, such as aquarium fisheries and invertebrate export fisheries, where employment or other contractual arrangements are the norm and where the rights, conditions and the health of fishers need to be focused upon. The use of underwater breathing apparatus has caused high incidences of injury or death in certain areas, and loans may be provided by export operators for the purchase of fishing gear or outboard motors that may be difficult to pay back. Contracts for aquarium fish collectors may be unfair.

Sex-specific roles: This varies by country. SPC compiled the results of its household fishing surveys in villages in 17 different groups of Pacific Islands from 2003 to 2007.¹³ Lumping all village fisheries together, the range was from 80% male fishers in villages in French Polynesia, Federated States of Micronesia, Samoa, and Tuvalu, to approximately 50% males in Fiji, PNG, Wallis and Futuna, and Vanuatu. However, these surveys did not usually take into account commercial and urban-based small-scale fishing. Looked at across the region as a whole, it is men who are mostly involved in vessel-based fishing, and women who dominate reef gleaning.

When it comes to post-harvest aspects of the fisheries, little quantitative information is available about the participation of men and women, apart from those relating to processing the products of large-scale fisheries, where women comprise most of the workforce. In small-scale fisheries, fishworkers are not such a large component of the sector as in other regions.

Conclusion

Hopefully without being dogmatic, I have tried in this article to describe the main characteristics of small-scale fisheries in the SPC Pacific Island work area, and to draw attention to some of the main possible points of divergence from the typical small-scale fishery in other developing regions.

Chief among these differences are probably the relatively high status of fishers, the greater prevalence of resource use or ownership rights, and the greater proportion of local consumption versus trade. The fishers of the Pacific Islands region look forward to participating in the agreement of a set of international guidelines that take into account their particular characteristics rather than exclusively targeting the problems identified by continental developing regions. Populous as those regions are, small-scale fisheries do not quite pervade the entire national culture, nutrition and economy as they do in many Pacific Islands.

¹³ Kronen M. and Vunisea A. 2009. Fishing impact and food security – Gender differences in finfisheries across Pacific Island countries and cultural groups. SPC Women in Fisheries Bulletin 19:3–10. (http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/WIF/19/WIF19_03_Kronen.pdf)

Waste not, want not: Better utilisation of fish waste in the Pacific

Michael Sharp^a and Catherine Mariojouis^b

^a Secretariat of the Pacific Community; ^b AgroParisTech

Globally, fisheries and aquaculture industries produce 130 million tonnes of fish waste per annum. This consists of by-catch, onboard waste, home waste and industrial waste. The waste is often disposed in landfills or dumped at sea; however, there are alternative uses that add economic value.

In June 2012, the Secretariat of the Pacific Community (SPC) and the French Research Institute for Exploration of the Sea (Ifremer) co-hosted a seminar that focused on the problem of under-utilisation of fish waste and the potential uses of the waste in the region. This article gives a summary of the seminar report written by Catherine Mariojouis (AgroParisTech) and Michael Sharp (SPC).

How is value added to fish waste?

Generally, value can be added to fish waste via two methods: mass transformation and sorting.

Mass transformation of fish waste involves the conversion of all waste into a single product. Some examples of products that are produced by mass transformation of fish waste include fish meal, fish oil, fertiliser and hydrolysates (e.g. protein hydrolysate).

As the name indicates, sorting involves the separation of different waste products (e.g. bones, guts, fins), which enables each component to be used individually for the production of specialised products. Some examples of products produced from processed sorted waste include liver oil, gelatine, omega 3, protein sports food/drinks, calcium, cosmetics, biotechnical applications and pharmaceuticals.

Why do we need to better utilise fish waste?

The potential producers of fish waste include canneries, industrial fishing vessels, small-scale fishers and processors, fish markets and commercial processing companies. The situation regarding fish waste varies according to country; although there are numerous examples in the region where fish waste is being put to some use, there are also examples of countries where fish waste is not utilised or is under-utilised.

The problem with under-utilisation of fish waste is two-fold. Firstly, there is a direct financial cost associated with the dumping of fish waste, it does not maximise the use of fisheries resources and it can damage the environment. Secondly, the opportunity cost, in terms of missed opportunity to add value to the fish waste, can be significant — there are numerous examples of successful companies that are based on utilisation of waste.



Figure 1. Fillets generally only make up around 50% of a tuna
(image: Catherine Mariojouis, AgroParisTech).

What should be done?

When considering how to manage fish waste, the following framework can be adopted:

- i. identify the availability (or production) of fish waste in a given locality;
- ii. assess the current uses of the waste;
- iii. identify potential applications for the waste; and
- iv. develop a strategy for exploiting the waste for environmental and/or economic gain.

Generally, the production of fish waste in the Pacific is not well documented; however, it is recognised that there is a need to find ways to better utilise fish waste for environmental and economic reasons. A first step to achieving this was to organise the SPC/Ifremer seminar.

The SPC/Ifremer Seminar on Fish Waste Utilisation in brief

The one-day seminar, held on 11 June 2012, was organised immediately following a week of meetings of Heads of Fisheries in Noumea, New Caledonia. This gave an opportunity to have an international audience of around 50 people representing the public and private sectors in numerous countries. The attendees included: Heads of Fisheries; regional stakeholders; experts in fish waste utilisation; and representatives of fishing associations, the private sector, governmental and non-governmental organisations. The contribution by all attendees to the output of the seminar is gratefully acknowledged.

The seminar provided opportunities for dissemination of information on fish waste utilisation through a series of presentations (accessible at: http://www.spc.int/DigitalLibrary/Events/Fish_Waste_2012).

Session 1 focused on the problem of under-utilisation of fish waste and the potential uses of waste, and it introduced a general framework when considering how to better utilise waste. A summary of fish waste production in the Pacific was provided, which introduced a typology for categorising producers of fish waste. The typology adopts the following definitions:

Category A:

remote countries or areas that do not produce waste;

Category B:

countries and areas that interact with industrial fishing and processing sectors that produce a lot of waste, but generally utilise it (at least some of it); and

Category C:

countries and areas that interact with industrial fishing and processing sectors that produce a lot of waste, but generally do not utilise it.

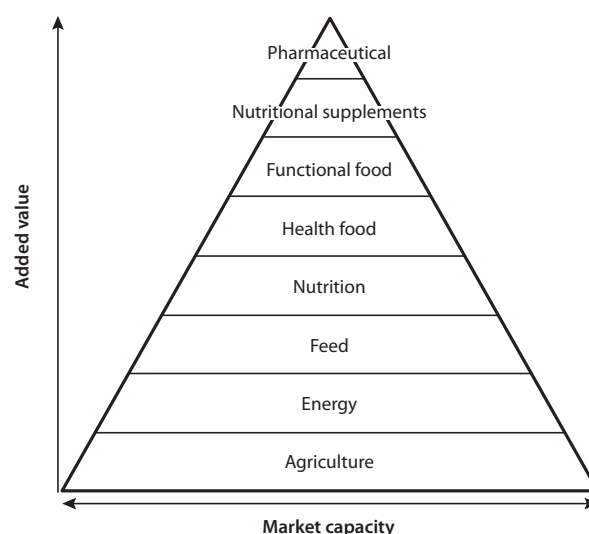


Figure 2. Market pyramid for different value adding applications for fish waste. Source: J.P. Berge (2012), Ifremer.



Figure 3. Fish waste from a Pacific-based processing company (image: BioAgri-NC).



Figure 4. Grinding tuna waste for the production of fish silage (fertiliser) (image: BioAgri-NC).

These categories were adopted in reporting on the seminar and, as an output from the seminar, Figure 5 classifies each participating country accordingly.

Session 2 focused on private sector exploitation of fish waste utilisation. Examples of small-scale and large-scale utilisers of fish waste were presented along with market opportunities for fish waste, including feed for aquaculture and food for human consumption.

Sessions 3 and 4 provided opportunity for exchange of ideas and brainstorming among participants. Working groups discussed and documented the present situation and possible future for fish waste utilisation in their countries, while considering the constraints on utilisation of fish waste.

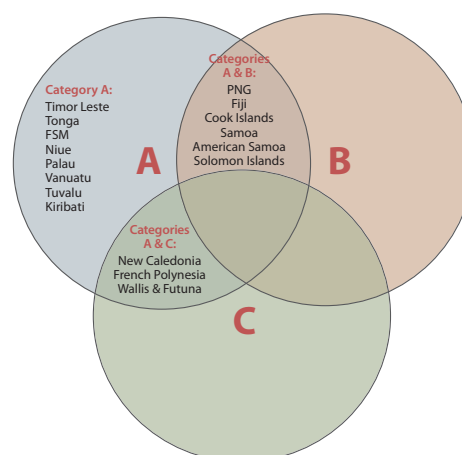


Figure 5. Categorisation of participating countries according to the adopted typology (FSM = Federated States of Micronesia; PNG = Papua New Guinea).

Seminar output and discussion

In working groups, the participants discussed and documented three general areas in relation to fish waste in the Pacific. This aimed to gather a “snapshot” of fish waste availability and current and potential use, and to identify constraints and strategy for utilising waste more effectively in the Pacific region.

The results were presented to the plenary with open discussion on the future actions that are needed to improve fish waste utilisation in the Pacific.

A summary of the working group outputs is provided below; however, it must be acknowledged that the outputs from the working groups are the views of the seminar participants and they do not necessarily represent the actual situation. Although the data cannot be fully relied upon, the seminar gave an opportunity to collate information from industry experts and present a first snapshot of the current status of waste and its utilisation in the Pacific.

Snapshot 1: Availability and present uses of fish waste in the Pacific

Context A – all used (insignificant waste or almost fully utilised)

Description	Small communities with artisanal fisheries, where all fish waste is used Generally little or no waste
Geography	Atolls, small islands, remote coastlines of larger islands
Production	Limited and scattered production of waste
Uses	Human food, animal feed (pigs or pets), or fertilisers
Opportunity	Limited commercial value-adding potential

Context B – better, but not perfect (moderate waste being used, but not everything)

Description	Low-income urban centres and islands that interact with industrial fisheries Intermediate situation with both artisanal and industrial fisheries Generally already having a specialised plant for processing waste into fish meal and fish oil Some use of waste, but not full use
Geography	Urban centres and islands that interact with industrial fisheries (onshore processing, transshipments)
Production	Medium-to-high volumes of waste, geographically concentrated
Uses	Industrial use when economy of scale allows (e.g. fish meal) Some types of waste being used as human food for food security (e.g. heads, tail trunks, belly flaps) Some waste not utilised
Opportunity	Moderate value-adding potential

Context C – completely wasted (no use of waste)

Description	High-income urban centres and islands that interact with industrial fisheries Disposal of waste at sea or landfill at cost (financial and opportunity cost)
Geography	Urban centres and islands that interact with industrial fisheries (onshore processing, transshipments)
Production	Medium-to-high volumes of waste, geographically concentrated
Uses	Entirely wasted – no use
Opportunity	Increasing awareness on waste issue, driving policy for better use High cost of discards providing economic incentive for value adding

Snapshot 2: Potential uses of fish waste in the Pacific

Application	Potential uses of fish waste
Agricultural	Produce fertiliser, fish silage or compost (organic potential) Produce pesticide (for use against insects)
Animal feed	Produce fish meal and oil for agricultural and aquaculture feeds Use of “stickwater” from fish meal process, which can be added to fish meal or in the production of hydrolysates
Food (human)	Utilise at-sea discards from tuna transshipment for human consumption (food security) Produce gelatine with fish waste Produce tuna stock from fish dust — similar to beef and vegetable stocks; it is commonly used in Japanese cuisine
Pharmaceutical	Produce collagen for micro-encapsulated medicines in aquaculture (improves palatability)
Other	Utilise pearl and crustacean shells (e.g. jewelry, calcium) Bycatch is being used for low-value add activities and should be allocated to areas that derive higher economic value (e.g. fish cakes, jerky) Potential to explore the use of fish waste for bait

Snapshot 3: Constraining factors preventing full utilisation of fish waste

Application	Constraints
Economics	Upfront investment for efficient use of waste is generally large Large scale is needed to be competitive Costs for producing a low-value product are high, again requiring scale There is uncertainty around production costs and market for waste products
Extension and development	Technical expertise for high-technology waste utilisation is lacking Support and awareness around the potential uses for waste is also lacking
Commercial	People are generally unaware of the potential applications for fish waste Few market data are available
Supply chain organisation	Collaboration and cooperation is required to get sufficient supplies to warrant fish waste utilisation – this is especially the case for small-scale processors, wide geographic distribution of waste Efficient collection mechanisms are not available
Fisheries sector	Policy required to encourage landing of by-catch and incentive to land guts (for fish silage)
Facilities	Infrastructure for large scale value adding is lacking
Administrative organisation	Separate regional administrations, resulting in a lack of global strategy
Public policies	Public policy and legislation hinder use of fish waste (e.g. Hazard Analysis and Critical Control Points (HACCP) food safety system, policies that restrict landing of fish guts)

Strategy for future developments

The following key ideas for elaborating a strategy for future developments were expressed and presented to the plenary:

- i. most PICTs are small-scale waste producers and geographic disparity and/or low production of waste may not warrant development of waste utilisation initiatives;
- ii. technical organisations (e.g. SPC and Ifremer) can facilitate the development of this sector via introducing network contacts and gathering, reviewing and disseminating information;
- iii. economic analysis is required to determine the products best suited to the scale of each location;
- iv. a summary of the main regional producers, user groups and opportunities for fish waste utilisation is required; and
- v. pilot public-private partnerships (public science, private expertise) should be developed and implemented to test ideas.

Follow-up actions proposed in the final discussion

The following follow-up actions embody the priorities identified by the participants:

1. Improve information about the potential applications for fish waste

SPC and Ifremer will prepare a brief about possible uses, technologies, application sectors, and the main conditions to consider when choosing a waste utilisation route.

2. Conduct a regional survey about fish waste

Beyond the first round of information gathering, it is considered a priority to paint a picture of the fish waste situation in the Pacific.

3. Develop a mobile pilot processing plant for testing and demonstrating different technologies

A mobile technological platform should be developed at pilot scale, with a series of machines allowing the testing and demonstration of different technologies producing different products.

4. Trial aquaculture feed production projects from fish waste

Aquaculture development in the region offers market opportunities for the utilisation of fish waste in feed applications and experimental studies are needed to develop adequate aquafeed.

Conclusion of the seminar

The role of public policy was underlined as an important factor to achieving better utilisation of waste (or reduced waste) in the region. There is a need for research and extension programmes that target private sector development for sustained fish waste utilisation.

Several representatives declared that the seminar was welcome as there are growing opportunities to lower the spoilage of valuable resources, especially in an environment of increased fish catch and processing in the Pacific.