Fisheries Newsletter

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Editorial

A Special Session of the Pacific Island Heads of Fisheries was held at the UN Food and Agriculture Organization's Sub-regional Office for the Pacific Islands headquarters in Apia, Samoa, from 11–13 February 2008. The purpose of the Special Session was to review and endorse a revised strategic plan for fisheries management and sustainable coastal fisheries in the Pacific Islands. The original strategic plan was adopted in 2003 by member countries and territories of the Secretariat of the Pacific Community. The dynamic nature of fisheries and the ongoing economic and socio-political changes taking place are raising new challenges that affected the relevancy of the plan's focus.

At the conclusion of the Special Session, member countries and territories developed and endorsed the new Pacific Islands Regional Coastal Fisheries Management Policy, now known as the Apia Policy. To achieve the goal of ensuring the optimal and sustainable use of coastal fisheries and their ecosystems by Pacific Island communities, six guiding principles were adopted. You will find more details on page 4.

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Participants at the Special Session of the Pacific Island Heads of Fisheries

in This Issue

SECRETARIAT OF THE PACIFIC COMMUNITY
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SPC BEGINS NEW STUDY ON FISHERIES AND CLIMATE CHANGE

SPC's Strategic Policy and Planning Unit and the Division of Marine Resources have begun a new research project to assess the potential impact of climate change on fisheries and aquaculture in the Pacific. The project is funded by AusAID and is designed to equip policy-makers, managers and scientists in the fisheries sector with information on the projected impacts of climate change on the productivity of oceanic, coastal and freshwater fisheries, and aquaculture. The project will also identify the planning and management needs required to build resilience to these impacts.

In addition to reviewing the advances made since the late 1990s in modelling the impacts of climate change on oceanography, weather and fisheries, the study will assess the:

- vulnerability of fish habitats, fish stocks and fisheries to climate change;
- implications of climate change with regards to national and regional plans to optimise the use of fisheries resources for economic growth, food security and livelihoods;
- adaptations and management needed to maintain the benefits of fisheries in the face of climate change;
- regional capacity to forecast and mitigate the effects of climate change on fisheries and aquaculture; and
- priorities for cost-effective development assistance to address the effects of climate change on fisheries.

A technical working group (TWG) of experts will be established to help produce a comprehensive assessment of the vulnerability of fish habitats, fish stocks and fisheries to climate change, and to guide the other components of the project. The TWG will comprise experts from advanced scientific institutions in SPC member countries, and from other Council of Regional Organisations in the Pacific (CROP) agencies.

A special effort will be made to keep the region informed about the progress of this important project. Details will be provided at the Forum Fisheries Committee Meeting in Palau in May. A website for the project will also be established in May and will be updated regularly. Further information can be obtained from Johann Bell at SPC's Strategic Policy and Planning Unit (johannb@spc.int).

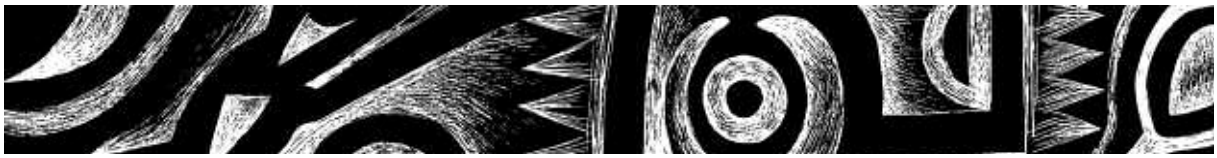
COASTAL FISHERIES MANAGEMENT SECTION

The Coastal Fisheries Management Section began the year with three regional activities: the Fisheries Statistics and Stock Assessment training (phase II), the Heads of Fisheries Policy and Planning Workshop, and the Heads of Fisheries Special Session.

Training on Fisheries Statistics and Stock Assessment Phase II

The Fisheries Statistics and Stock Assessment training (phase II) is one of SPC's Coastal Fisheries Management Section's follow-up activities from phase I, conducted at the University of the South Pacific (USP) in Suva, Fiji in November 2006. Phase I introduced participants to the basic principles of statistics and stock assessment, and the use of statistical software for fisheries data analysis. Participants were given an assignment of analysing existing data in their respective countries under the supervision of course instructors. The six-month-long assignment was a requirement for entry into phase II, which was held at USP in Apia, Samoa from 14–25 January 2008.

Financial assistance for the training came from the Commonwealth Secretariat and the Government of Iceland through the United Nations University, Fisheries Training Programme (UNU-FTP), with support from USP.



Training objectives and resource personnel

The training was designed to help national fisheries agencies use basic fisheries data in assessing the status of coastal fish stocks as stipulated under the "Strategic plan for fisheries management and sustainable coastal fisheries in Pacific Islands", which was developed by the countries and approved by the Heads of Fisheries in 2003.

Training objectives were to:

- enhance participants' knowledge of and skills in using basic fisheries data in the assessment of fish stocks in the region;
- review the theory and principal methods in quantitative biology and fisheries science, with a particular emphasis on improving skills through practical training exercises;
- review recent developments in the multi-species ecosystem approach and their potential use in fisheries science and management;
- enable fisheries personnel to establish and develop a database of their country's inshore resources; and
- further develop the training programme for accreditation as a unit of USP's postgraduate programme.

The training was conducted by resource personnel from UNU-FTP in Iceland and USP in Fiji, and was facilitated by SPC's Coastal Fisheries Management Section.

Participants

Of the 25 fisheries officers who attended phase I, 18 took part in phase II. These participants were from American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Fiji, Marshall Islands, Niue, Papua New Guinea, Solomon Islands, Samoa, Tonga and Vanuatu.

Heads of Fisheries Coastal Fisheries Policy and Planning Workshop

One of the recommendations from the Heads of Fisheries — as highlighted in the "Strategic plan for fisheries management and sustainable coastal fisheries in Pacific Islands" in 2003 — was the need to enhance the skills and experiences of heads of fisheries and senior fisheries managers in developing national fisheries policies that are compatible with the goals and objectives outlined in countries' national development plans. In most Pacific Island countries, coastal fisheries are important for sustaining socioeconomic livelihoods, exports, food security and poverty reduction. However, most countries do not have adequate policies for properly managing and sustainably using resources.

The workshop — which was attended by 26 heads of fisheries and senior fisheries officers from SPC member countries and territories — was designed to enhance the knowledge, experience and skills of its

Particpants at the Heads of Fisheries Policy and Planning Workshop; from left to right: Tupulaga Poulasi, Fisheries Officer, Ministry of Natural Resources and Lands, Tuvalu; Ray Tulafuno, Director, Department of Marine and Wildlife Resources, American Samoa; Jason Raubani, Principal Fisheries Officer, Department of Fisheries, Vanuatu.

participants in the area of fisheries policy and planning formulation, analysis and application. The workshop was held from 28 January–8 February 2008 at the FAO-SAPA headquarters in Apia, Samoa.

Training was jointly promoted, developed and delivered by SPC, the Commonwealth Secretariat, UNU-FTP, USP and FAO, and was financed by the Government of Iceland and the Commonwealth Secretariat. SPC's Coastal Fisheries Management Section coordinated this workshop.

Workshop objectives

The workshop's broad objectives were to 1) give heads of fisheries and senior fisheries managers an advanced and balanced understanding of all issues related to managing coastal fisheries and fisheries governance, and 2) assist them with future decision-making and ministerial policy advices. Specific objectives included:

- Developing policy options to address specific problems, taking into account the legal, national, regional and international context;
- Understanding data requirements (biological, environmental, economic and social) in regard to policy and management options, including data type, and the collection and processing of data;
- Developing or formulating appropriate community fisheries management arrangements and plans based on the best available information and the options that have been assessed; and
- Developing and presenting high level fisheries advice and/or information or policy briefs for ministerial consideration.

Heads of Fisheries Special Session

A Special Session of the Pacific Island Heads of Fisheries was held at FAO-SAPA headquarters from 11–13 February 2008.

The purpose of the special session was to review and endorse the revised strategic plan for fisheries management and sustainable coastal fisheries in the Pacific Islands, which was adopted in 2003 by SPC member countries and territories to guide the management of coastal fisheries in the region.

During the fifth Heads of Fisheries meeting in 2005, SPC was tasked with undertaking a comprehensive review of the plan. The review came about because of changing circumstances as well as the need to better reflect the current priorities of Pacific Island countries and territories.

The implementation of the strategic plan revealed serious coastal fisheries management problems in the region that needed to be addressed. Furthermore, the dynamic nature of fisheries and the ongoing economic and sociopolitical changes taking place in the region are raising new challenges that affect the relevancy of the plan's focus. Pacific Island heads of fisheries acknowledged that the strategic plan lacked scope and depth, and expressed their strong support for the plan to be reviewed. Based on concerns raised at the Heads of Fisheries meeting, the following issues regarding the strategic plan were incorporated into the review:

- Establish fisheries management as being pivotal to all domestic fishing operations —subsistence, artisanal and commercial — and accordingly, to pay more attention to the seriousness of the region's coastal fisheries management problems;
- Broaden the scope and depth of its coverage beyond purely coastal fisheries management to include research and development, and use the broad ecosystem approach to fisheries to manage environmental impacts on the land and marine environment;
- Directly address political directives emanated from Pacific Islands Forum Leaders' decisions (Vava'u decisions on the Pacific Plan) that are reflected in regional policy instruments, such as the Pacific Islands Regional Ocean Policy (PIROP), Pacific Islands Ocean Framework for Integrated Strategic Action (PIROF-ISA), the Pacific Plan, and other international policy instruments such as the Millennium Development Goals and the FAO Code of Conduct for Responsible Fisheries; and
- Assign full ownership of the strategic plan to PICTs with the responsibility for its implementation coordinated at a regional basis by SPC.

Most of the major projects carried out under the strategic plan were financed by the Commonwealth Secretariat and the Government of Iceland, with the Food and Agriculture Organization of the United Nations, the Western Pacific Regional Fishery Management Council, AusAID, NZAID and the French Pacific Fund contributing significantly to activities under the plan.

The Special Session of the Heads of Fisheries was funded by the Commonwealth Secretariat and the Government of Iceland.

The three-day session concluded with the Heads of Fisheries endorsing the new Pacific Islands Regional Coastal Fisheries Policy. The boxed text provides a brief outline of the policy.

To successfully achieve the guiding principles, a number of strategic actions and required assistances were assigned to each principle, including: incounty assistance needed by various countries, regional assistance to other regional institutions to cater to coastal fisheries of the countries, and specific regional training and workshops needed by the countries. The implementation of these required assistances would require close working relationships with donor agencies, regional organisations and non-governmental organisations.

The Pacific Islands Regional Coastal Fisheries Management Policy (the Apia Policy) was developed to meet the expectation of Pacific Islands Forum Leaders under the amendment of the Pacific Plan and the Vava'u Declaration on Pacific Fisheries Resources, where high priority is placed on "the development and management of coastal/inshore fisheries and aquaculture to support food security, sustainable livelihoods and economic growth for the current and future generations of Pacific people".

The Apia Policy was developed and endorsed by 19 Pacific Island countries and territories during its special session held from 11–13 February 2008 in Apia Samoa.

Taking into account the declarations of Pacific leaders and relevant instruments, an appropriate vision for the policy is "Healthy marine ecosystems and sustainable coastal fisheries that provide seafood security and continuing livelihoods for current and future generations of Pacific people." The goal that addresses this vision is "To ensure the optimal and sustainable use of coastal fisheries and their ecosystems by Pacific Island communities."

To spearhead the strategic direction in the region for sustainable management of its coastal fisheries resources, the following six guiding principles were established by the Heads of Fisheries:

1. **Improving our understanding of important fisheries species and of the ecosystems on which they depend.**
2. **Sustainably managing coastal fisheries, reducing their adverse impacts on coastal ecosystems and optimising production to meet local nutritional needs and contribute to economic development.**
3. **Creating community partnerships to support the customary and traditional management of nearby ecosystems and fish stocks.**
4. **Creating stakeholder collaborations to manage ecosystems and reduce the negative environmental impacts of non-fisheries activities, including those causing high loads of silt and nutrients in coastal waters.**
5. **Promoting the participation of women and youth in all fisheries-related activities.**
6. **Enhancing the regional exchange and sharing of information regarding common interests relating to the management of ecosystems and fisheries.**

Staff attachment

The Coastal Fisheries Management Section hosted Patterson Shed (Executive Director of the Conservation Society of Pohnpei – CSP) and Donald David (Chief, Marine Resource Development, State of Pohnpei, FSM) for a two-week attachment, from 17–29 March.

The main purpose of the attachment was to develop a community ecosystem-based fisheries management model for Pohnpei's coastal fisheries resources. The model was developed from a series of previous undertakings by SPC and Pohnpei counterparts. In addition to developing the model, Patterson and Donald also shared their knowledge of current programmes in Pohnpei and discussed with SPC programme staff possible areas where SPC could contribute to the development of fisheries in Pohnpei.

An article on the attachment by Patterson and Donald is also included in this issue on p. 55.

From left to right: Patterson Shed (Executive Director of the Conservation Society of Pohnpei – CSP) and Donald David (Chief, Marine Resource Development, State of Pohnpei, FSM)

Original text: English

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REEF FISHERIES OBSERVATORY

Staff of the coastal component of the EU-funded Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C) and the Coastal Fisheries Development Programme (CoFish) completed all substantive fieldwork in the 17 participating countries and territories in late 2007. Project staff began focusing on writing site reports and conducting some data analysis during the first quarter of 2008

CoFish loses another staff member

Ribanataake (Rib) Awira (Fig. 1) has left the CoFish project after spending almost three years with SPC as a Reef Fisheries Officer (finfish). Rib was an integral member of the finfish team and conducted survey work and training in 12 of the 17 participating countries and territories. His input during the rest of the project time will be sorely missed by the team. The good news is that Rib left SPC to take up his new position as the Director of Fisheries in Kiribati. So it is not goodbye to Rib; staff from SPC's fisheries programmes will continue to work with Rib and his staff in the future. The PROCFish/C and CoFish team wish Rib all the best in his new position.

Figure 1: Ribanataake Awira, ex-CoFish employee and now Director of Fisheries in Kiribati.

Update on country and territory site reports

With the substantive fieldwork completed, the focus has changed to writing site reports. Everything is on track to meet the June 2008 deadline agreed upon at the last Advisory Committee meeting. Considerable progress was made in the first quarter of 2008. All site reports (finfish, invertebrate and socioeconomic) have now been completed for Kiribati, French Polynesia, Nauru, Niue, New Caledonia, Papua New Guinea, Tuvalu, Vanuatu, Wallis and Futuna, and Samoa. Around half of the site reports for the remaining seven countries are now completed. All site reports are placed on the PROCFish/C website, in a restricted capacity, as soon as they are completed so that those in-country fisheries staff with permission can access them.

The next stage is to compile the site reports into country reports, and two temporary positions were recently advertised (Fisheries Officer – report compiling and editing, and Technical Support Officer) to assist with this process. There will be an update on this in the next issue of the *Fisheries Newsletter*.

Some early results from the regional dataset

Now that site reports are nearing completion, the PROCFish/C and CoFish scientists can start looking at other project objectives: a regional comparison of the huge data set, as well as identifying indicators or proxies for reef fishery status.

The search for finfish indicators

The PROCFish/C finfish team has begun analysing the status of resources and examining the condition of fish communities throughout the region. One of the greatest challenges in studying resources is in selecting indicators and conditions that can be easily assessed and used for fishery management. A wide range of parameters are influenced by fishing stress and are (or could be) used to evaluate resource condition. Some are species-

based, while others are based on the condition of the entire fish community and ecosystem. In multi-species fisheries (such as those associated with tropical reefs) the latter approach is the most indicative. Moreover, in the framework of the ecosystem approach to fisheries, stakeholders need to consider the entire ecosystem (including humans as resource users and sources of environmental impacts) when selecting management options. Coral reef multi-species fisheries and their associated ecosystems are inherently complex, however, and the models available to study ecosystem conditions are much more intricate than those used to study trends in single target species.

The selection of indicators to evaluate resource condition (e.g. from healthy to over-exploited) is complicated by the absence of a quantifiable "pristine state" (i.e. the status of the resource prior to any fishing pressure). The fish communities being studied have long been exploited, and information on ongoing stock changes over time in such communities are generally lacking. One alternative is to compare the status of exploited study sites with communities that receive little or no impact due to fishing, and that have similar environmental conditions (e.g. location, geomorphology and habitat), but this is seldom possible. As a result, the only feasible option is typically to compare sites with different fishing pressures. The resulting picture is complex, composed of overlapping responses by the fish community to natural biological forcing, environmental conditions, and human impacts.

We applied some of the most commonly used parameters in the study of resources to the available data gathered during the PROCFish/C and CoFish assessments. We looked first at the two most widely used parameters: total fish density and total fish biomass.

Density, measured as fish/m^2, is calculated by species, family or total community from *in situ* underwater counts of individuals. Biomass is obtained from the combination of fish counts and their visually estimated lengths. Tabulated information on length–weight relationships provides biomass (or weight) by species, from which biomass by family, and for the total fish population can be calculated. When the total density of commercial fish is plotted over the region for all PROCFish/C study sites (Fig. 2), a very patchy distribution of fish is obtained, with some sites exhibiting obvious fish density peaks, and others clear lows.

A clearer image emerges when the variation between the different sites within a country is analysed. At this relatively smaller scale, variability patterns can be discerned in density and biomass. These can be associated with various factors (e.g. the extrapolated catch per village per year, which is one of the parameters used in socioeconomic studies to assess the impact of fishing activity on reef resources). This variable is one of many indications of the status of fisheries in a village; it does not consider, for example, the density of fishers, consumption, level of dependence on fishing as a source of income, and distance from a market, all of which, along with other information, should be considered when assessing the fishing pressure on resources.

We examined two atolls in Kiribati. Both sites showed a high dependence on fishing for both subsistence and income generation, but the percentage of catches dedicated to export and the density of fishers were higher in one of the sites. When the value of yearly catches is compared with in situ biomass, an inverse relation is revealed between the two variables: higher fishing pressure corresponds to smaller stocks. It is rare to encounter such a clear trend, given the high variability in natural conditions and exploitation patterns across Pacific countries and territories. Moreover, the opposite result could be obtained, if, for example, the prey of exploited target species increase in numbers due to a reduction in their predators through fishing.

Average fish size changes: To test a different status marker we analysed the situation at Palmerston Atoll in the Cook Islands, where past data on some exploited species were available (such a situation is very unusual). Palmerston Atoll

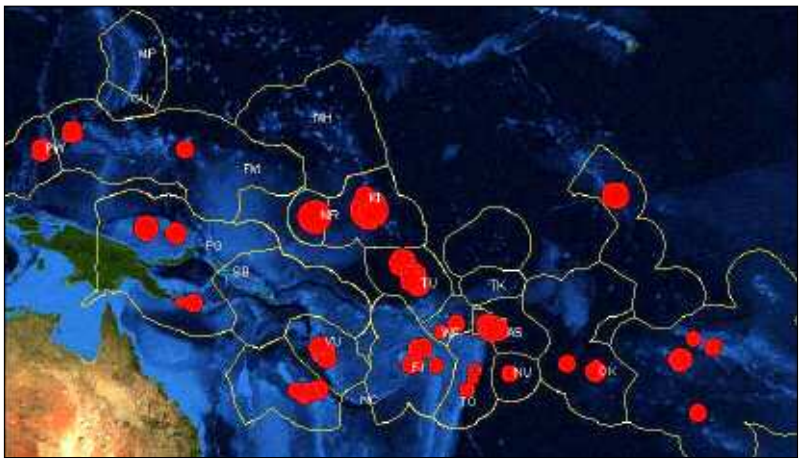


Figure 2: Variation of total commercial fish density throughout the PROCFish/C sites.

has a long history of exploitation of parrotfish for both local consumption and export to the capital, Rarotonga, for marketing. A comparison of body length records for some species from surveys done in 1988 with our underwater observations of the same species revealed a decrease in the average size of some commercial species (Fig. 3), clearly pointing to a fishing-related impact.

Size of carnivores: The average size of carnivores can also be used as a possible indicator of resource status. Data from five sites in New Caledonia highlight a clear negative relation between mean carnivore size and fishing pressure: the average size of targeted carnivores was larger where there were fewer disturbances from fishing (yearly catches per surface unit, Fig. 4).

Size ratio: The size ratio (i.e. the ratio between the average size of a species and the maximum size such a species would normally attain) is a frequently used indicator of fishing pressure. This value provides an indication of the health of the species population at a determined location and can be averaged by family, feeding guild or fish community. Note, however, that alterations in the size ratio (and in density and biomass) do not occur exclusively in response to fishing pressure, but also in relation to environmental and biological (including behavioural) conditions. In addition, maximum sizes are not absolute; even if we could witness communities in a hypothetical "pristine state", species size could be different from the maximum expected value due to specific adaptations to community forcing and particular habitat conditions.

We sought to identify a link between size ratio and fishing pressure using data from Fiji. The characteristics of the PROCFish/C sites in Fiji (e.g. geography, population, tradition, access to transportation) were very different, resulting in varying impacts on fish communities. Two of the four sites displayed similar geomorphological characteristics, and both had high dependency on finfish for subsistence needs. While the lower catch site showed the highest density of fishers, suggesting resources were being impacted, the second site displayed the lowest fish consumption in the region.

Trophic composition: Changes in trophic composition (i.e. the distribution of total biomass or

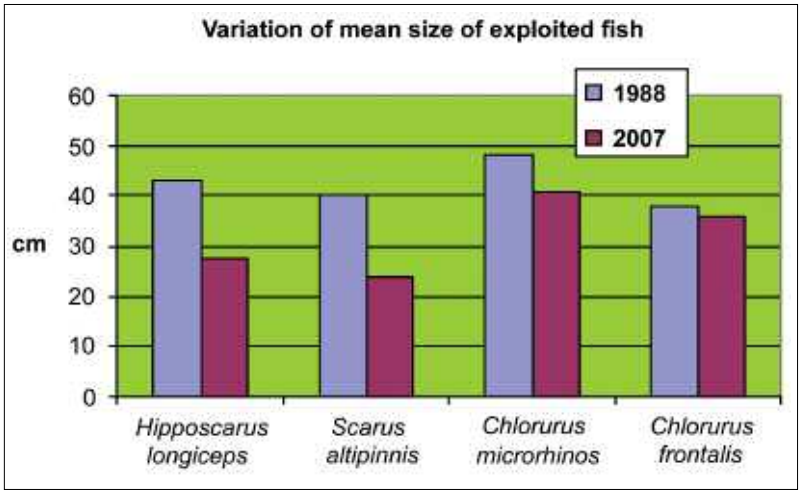


Figure 3 (top): Changes in size of four species of mostly targeted parrotfish at Palmerston Atoll (Cook Islands) from measurements made in 1988 (Preston et al. 1995[1]) and CoFish underwater assessments in 2007.

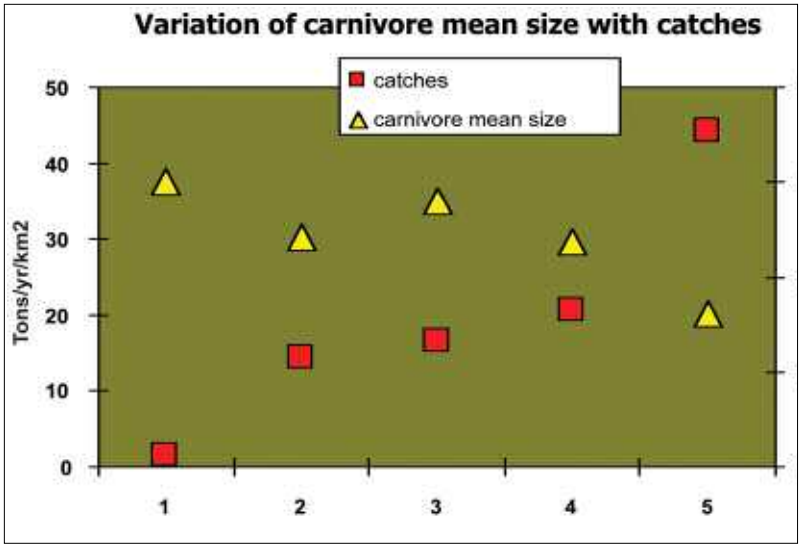


Figure 4 (bottom): Variation of average length of carnivorous fish and intensity of catches at five sites in New Caledonia.

[1] Preston G.L., Lewis A.D., Sims N.A., Bertram I., Howard N., Maluofenua S., Marsters B., Passfield K., Tearii T., Viala F., Wright D. and Yeeting B.M. 1995. The marine resources of Palmerston Island, Cook Islands. Report of a survey carried out in September 1988. South Pacific Commission Inshore Fisheries Project Technical Document. Noumea, New Caledonia. 61 p.

Figure 5 (top): *Hipposcarus longiceps*, an herbivorous species.

Figure 6 (bottom): *Caranx melampygus*, a carnivorous species.

density among different feeding guilds: herbivores (Fig. 5), piscivores, planktivores, other carnivores (Fig. 6) and detritivores) can serve as an indicator of fishing pressure. Generally, one would expect the percentage of carnivores to decrease with increasing fishing stress, because they are the largest species, and typically the most appetizing. We examined the trend among the four sites in Tuvalu. Two sites were more urbanised, and displayed low fishing pressure; the other sites were much more dependent on fishing, both as source of income and for subsistence. The ratio of carnivores was inversely related to fishing pressure, reaching almost 40% at low fishing pressure sites, vs less than 30%, at the higher fishing pressure sites.

Future finfish analyses will examine (i) how various biological parameters respond to fishing impacts on a regional scale, (ii) the selection of the most significant status indicators, and (iii) integration of *in situ* resource and socioeconomic research. Such tools will support fishery management by facilitating the monitoring of changes in finfish status over time.

Defining an area for invertebrate fisheries comparisons

To date, the PROCFish/C and CoFish projects have conducted questionnaire surveys with fishers to better understand resource use, and underwater visual censuses of important resources in order to understand the status of target invertebrates. Socioeconomic data from interviews indicate the level of fishing (number of fishers, amount of catch) across all study sites. Similarly, in-water surveys reveal the availability (density and population size profile) of important resource species.

Comparison of similar invertebrate fisheries across the Pacific ideally requires that the area exploited by the fishery be measured. It is important to quantify the extent of a fishery in order to understand resource responses to fishing pressure. The areal extent of the following habitat categories have been calculated for PROCFish/C and CoFish sites.

Habitat category	Description
1	Shallow water reef within a lagoon or protected environments (coastal intermediate and back reef. Area in km^2 – Figure 7).
2	Shallow water reef that is exposed to oceanic influence (exposed fringing reef front, outer barrier reef, offshore shoals. Area in km^2 – Figure 7)
3	Size of the lagoon (area in km^2)
4	Land area, for discrete island groups (area in km^2 and
5	Reef perimeter of exposed barrier reef and exposed fringing reef (linear measure in km)

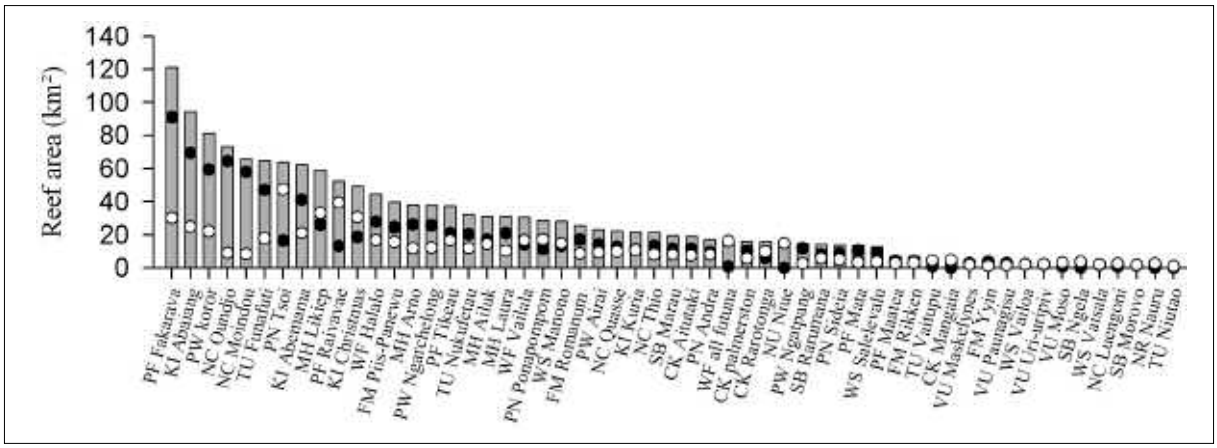


Figure 7: Overview for the calculated area (km²) for shallow reef at PROCFish/C and CoFish survey sites in 17 Pacific Island countries. In the graph, the total shallow water reef area (bars) is depicted alongside protected lagoon reef (dark points) and reef exposed to oceanic influences (light points).

Such area measures are useful in determining the areal extent of general shallow water reef fisheries. For example, fishers who glean or dive on shallow water reefs for giant clams (one of the more important invertebrate food fisheries in the Pacific) exploit the area calculated by the sum of habitat categories 1 + 2 above. Trochus and lobster fisheries are currently compared across sites by referencing the lineal measure of exposed reef front (category 5).

Determining the "best" habitat category to use when comparing fisheries across sites is not simple, and one category is unlikely to fit all needs; even a generic category for a single species fishery may be difficult to measure accurately, as species are not well dispersed across recognised habitat types.

It is clear from our early work that there are no shortcuts for determining fishery areas, and information collected from either in-water environmental surveys or remote sensing alone can provide only a rough areal estimate. A more accurate and reliable determination of the area coverage according to important species groups requires local knowledge and intensive *in situ* resource measurements (using GPS, with followup GIS work).

Some invertebrate fisheries pose particular challenges. To determine the area exploited by sea cucumber fisheries (sold as beche-de-mer), infaunal bivalve fisheries (which target shell beds), or fisheries that concentrate effort on certain habitats (e.g. seagrass or mangroves), several questions must be answered that cannot be resolved using "remote" tools alone (e.g. remote images and habitat maps).

First, the true nature of the fishery must be resolved. Currently, some 35+ sea cucumber species in the families Holothuriidae and Stichopodidae are thought to be harvested in the Pacific Islands region. Greater endemicity occurs in Melanesian countries, which are closer to the centre of biodiversity, while species richness generally declines with distance (eastward) from Papua New Guinea (Fig. 8). The environmental complexity of a site also affects the site's potential to support different species groups.

On average, about 13 commercial species are harvested per country (this count is likely an underestimate due to the lumping of species in the *Actinopyga* spp. and *Bohadschia* spp. groups, because of morphological similarities and taxonomic aggregation).

Although some sea cucumber species are recorded across many shallow reef habitats, most species are sourced from just a few specific habitats (e.g. some are found preferentially in sea-

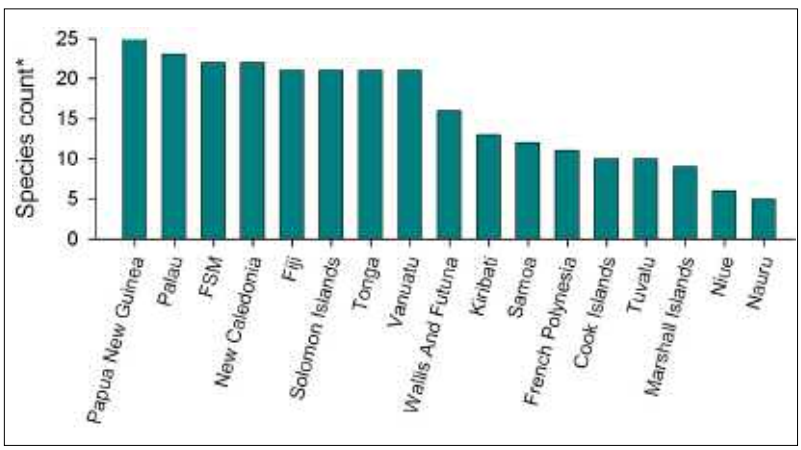


Figure 8: Count of commercial species of sea cucumbers per country.

grass near mangroves), while others are confined to reefs exposed to oceanic swell. Therefore, in order to determine reef areas for a "sea cucumber fishery", at least 5–10 different habitat measures related to species or species groups are needed. Such measures would be difficult to determine from remote (satellite) imagery alone, even with limited local knowledge that could be gleaned from a survey.

Second, it is necessary to determine which habitats can reliably be estimated from remote imagery. For example, can the area of seagrass in a study site be reliably measured from relevant satellite imagery (e.g. Landsat), or is it necessary to determine the actual area using a GPS? For some habitats, remote imagery is useful (general shallow reef), but in most cases the resolution is inadequate, especially when the goal is to determine bottom cover (which may be under water of marginal clarity, or in the case of mangroves, under canopy cover, which blends well with general tree cover as one travels away from the coast). In other cases, no remortely accessed data are available to produce area measurements, e.g. for infaunal shell beds.

A third question relates to the importance of scale when choosing generic area measures. Many invertebrate target species are not evenly distributed within discernable habitat boundaries, but are aggregated, often occupying a small proportion of these habitats. Such variability is of particular importance when making population estimates from site samples, but will also affect the relevance of general fishery area estimates, when these are based purely on habitat or environmental gradients. For example, in trochus fisheries, trochus are usually found in "patchy" aggregations within a recognised reef habitat (such as an exposed barrier reef slope). Our experience suggests that a minimum of two measurements are needed to accurately determine the area covered by a trochus fishery: (i) "core fishing areas" (those with the greatest concentrations or aggregations of trochus), and (ii) "marginal fishing areas" (where trochus are found, but in low density).

In summary, we lack a generic approach to the areal measurement of beche-de-mer fishing grounds and infaunal shell beds. Areal data can be assembled for fisheries of major importance (e.g. trochus) on a site-by-site basis, given adequate time to make *in situ* measurements of specific areas with the help of local fishers. In some cases, habitats such as seagrass beds can be distinguished relatively easily (e.g. if they are found in discrete locations, and high resolution satellite imagery, such as "Quickbird", is available). In other cases our understanding remains incomplete, and we continue to examine how the areal extent of all fisheries can be determined by employing standard area measurements collected at all study sites using knowledge gained during site visits and available remote imagery linked to GIS.

Sub-regional workshops

One of the major outcomes of the PROCFish/C and CoFish projects is the set of methodologies, approaches and tools that have been developed for assessing the resource and user status of reef and lagoon resources in the region. The methodologies are aimed at bringing together the data collected from the various surveys, in particular to join biological and ecological with socioeconomic and fisheries datasets. The need for such methodologies and tools has been highlighted by the demand for training in these areas.

Socioeconomic workshops

The first of three sub-regional workshops on "Socioeconomic fisheries surveys in Pacific Island countries: Collecting a minimum dataset and using SEMCoS" was conducted in December 2007, and was reported on in the last issue of the *Fisheries Newsletter*. The other two sub-regional workshops were held from 21–25 January (Fig. 9), and 31 March–4 April 2008 (Fig. 10).

The main resource material for these workshops was the recently published PROCFish/C and CoFish manual "Socioeconomic fisheries surveys in Pacific Islands: A manual for the collection of a minimum dataset", and accompanying software. This manual covers the design and implementation of socioeconomic fisheries surveys, including questionnaire survey design, data input, data analysis, interpretation of results, and drafting of recommendations. The software and manual are available in English and French, and copies were given to all participants. Additional manuals were provided to the fisheries departments in all member countries and territories. Both versions of the manual and software are available on the SPC webpage:

http://www.spc.int/coastfish/Sections/reef/publications.htm

These workshops followed the same format as the first. All participants were made familiar with 1) the objectives and back-

Figure 9: Second socioeconomic workshop, 21–25 January 2008: from left to right, back row: Dorothy Solomona (Cook Islands), Franck Magron (PROCFish/C), Dave Mathias (Federated States of Micronesia), Mecki Kronen (PROCFish/C), Ebelina Tsiode (Nauru), Tony Taleo Wamle (Vanuatu); front row: Candice M. Guavis (Marshall Islands), Lora B. Demei (Palau), Luanah Koren (Papua New Guinea), and Wesley Garofe (Solomon Islands)

Figure 10: Third socioeconomic workshop, 31 March to 4 April 2008: from left to right, last row: Enoha Terou (French Polynesia), Henri Humuni (Province Îles Loyauté, NC); middle row: Jean-François Kayara, Province Nord, NC), Bruno Mugneret, (Wallis and Futuna), Mecki Kronen (PROCFish/C), Franck Magron (PROCFish/C); front row: Bernard Fao (Province Sud, NC), Philippe Postic (Province Sud, NC), Elenea Takaniko (Wallis & Futuna), Maire Bustamante (French Polynesia)

ground of planning and conducting socioeconomic fisheries surveys, 2) how to plan and collect data, 3) the 10 major subject areas of the manual (including examples for each step), 4) calculation and detailed explanations of some of the extrapolation and calculation formulas applied, 5) survey questionnaires, and 6) other information sources needed. A detailed introduction to SEMCoS software was provided, and emphasis was given to steps involving installation, de-installation, database backup, and the export and import of data. Participants learned to establish the hierarchical order of any survey to take into account country, region, island, village and survey properties. Several exercises aimed at teaching how to complete the questionnaire forms from household interviews, and finfish and invertebrate fisher interviews, to access, design and run queries.

Upcoming underwater visual census (UCV) finfish workshops

In early April 2008, the PROCFish/C and CoFish projects announced a series of four sub-regional workshops on underwater visual census (UVC) methodologies for assessing reef fish resources will be held in Noumea from June to August 2008. Because this form of survey requires two divers to work together as a team, the project is funding two participants per country. The schedule for these workshops is as follows:

a) The first training workshop will be held in Noumea from 16–25 June 2008, and will include participants from Fiji, Nauru, Papua New Guinea, Solomon Islands and Vanuatu;

b) The second workshop will be held in Noumea from 30 June–9 July 2008, and will

include participants from the Federated States of Micronesia, Kiribati, Marshall Islands, Palau and Tuvalu;

c) The third workshop will be held in Noumea from 21–30 July 2008, and will be conducted in French only, for participants from French Polynesia, New Caledonia, and Wallis and Futuna;

d) The fourth workshop will be held in Noumea from 4–13 August 2008 and will include participants from Cook Islands, Niue, Samoa and Tonga.

The PROCFish/C and CoFish finfish team look forward to receiving the nominations from the 17 participating countries and territories for these workshops, and to providing the training so that in-country fisheries department staff are better equipped to undertake future surveys by themselves or with minimal assistance from SPC.

AQUACULTURE SECTION

ACIAR aquaculture mini-projects

Project leaders for the ACIAR-funded aquaculture mini-project scheme met in Fiji in February to develop small, flexible project proposals that will help aquaculture development in the Pacific region to overcome bottlenecks. The meeting was also an opportunity to learn about ACIAR post-graduate scholarships, which are open to students at the University of the South Pacific.

Five projects, with a forecasted total budget of AUD95,000, will be developed into final proposals. A further nine projects — with a projected budget of approximately AUD115,000 — will be further developed into concept notes (see Table 1).

Project funding will target the eight ACIAR Pacific Island countries, although non-ACIAR countries are also invited to

Table 1: Mini-projects formulated during the project leaders meeting

Project Title	Targeted Countries	Project Size
ACIAR-approved project concepts for implementation		
Half pearl (mabe) trials to assess key factors affecting pearl nacre quality and growth	Fiji, Kiribati, Tonga	Medium
Sandfish sea cucumber *(Holothuria sabra)* restocking and sea ranching trials	Fiji	Large
Locally available feed sources for subsistence tilapia fish farmers	Samoa	Small
Status of significant diseases in wild populations of tiger shrimp *(Penaeus monodon)* in the Pacific	Papua New Guinea, Solomon Islands	Small
Clownfish "Nemo" hatchery breeding and village grow-out trials	Vanuatu, Solomon Islands	Medium
Project concepts submitted to ACIAR for approval		
Freshwater prawn, *Macrobrachium lar,* trials	Vanuatu	Medium
Intensive Nile tilapia cage culture in inland lakes	Papua New Guinea	Small
Small-scale Nile tilapia economic modelling	Papua New Guinea	Small
Locally sourced diet for herbivorous fishes (e.g. rabbitfish, milkfish)	Solomon Islands, Tonga	Large
Artificial base for live rock cultivation	Tonga	Small
Bivalve spat collection (pearl and edible oyster)	Fiji, Vanuatu	Medium
Preliminary literature reviews for aquaculture project concepts on mud crab, nursery grow-out for giant clam, and comparison of growth between Mossambique tilapia and Nile tilapia		

explore opportunities to collaborate on these projects.

Dr Tim Pickering from the University of the South Pacific provided an update on the ACIAR post-graduate scholarships, which he is coordinating. Five of the eight awarded scholarships are aquaculture related and most will be associated with the upcoming mini-projects. The aquaculture scholarship awards were awarded to:

- Jone Varawa (Fiji) – MSc marine peaneid shrimp cage-culture;
- Marilyn Vilisoni (Fiji) – MSc pearl oyster spat recruitment;
- Shirleeni Baa (Fiji) – MSc; aquaculture;
- Pranesh Kishore (Fiji) – MSc pearl mabe;
- Marie Satoa (Samoa) – PgDip local feed sources for tilapia feed formulation;

There is also possibility for MSc research on sea cucumber restocking.

The meeting was held at the Hot Springs Hotel in Savusavu, Fiji. This location was chosen because Justin Hunter Pearls Ltd offered its facilities for mini-project research. The pearl farm will be used as a site for pearl mabe and spat collection research. The pearl oyster hatchery will be used for technology transfer and sea cucumber breeding. Sea cucumber ranching trials are also expected to take place in the vicinity of Savusavu.

The Australian-commissioned agency for the ACIAR aquaculture mini-projects is James Cook University of North Queensland. The project coordinator on behalf of the Pacific is SPC. Collaborating agencies include the University of the South Pacific and WorldFish Center. ACIAR funding is approximately AUD1.2 million dollars over a four-year period.

For further information on the ACIAR mini-projects contact Ben Ponia (benp@spc.int) or Cathy Hair (cathy.hair@jcu.edu.au).

Aquaculture updates

In January 2008, SPC's Aquaculture Adviser, Ben Ponia, visited Tonga to meet with government and private sector personnel to share information on aquaculture developments, and to plan for regional assistance to the aquaculture sector. Some highlights of this visit are included here.

Tonga's Fisheries Department

Poasi Fungalea is Tonga's newly appointed Secretary for the Department of Fisheries, and he is assisted by Ulunga Faanunu who is the Deputy Secretary. Poasi was previously the director of the Aquaculture Section of the Department of Fisheries. During our meeting, we discussed a variety of aquaculture ideas that the department is interested in pursuing:

- Reducing coral exports and the live rock trade to encourage more cultured ornamentals. The department is supportive of investigating locally sourced ingredients for artificial live rock base.
- Taking advantage of regular recruitment spikes of certain herbivorous reef finfish in Tongatapu lagoon, and harvesting them using post-larval capture techniques and growing them out in lagoon cages for local markets. Past research into mullet (Mullidae) recruitment patterns could complement this effort. Another opportunity is the mass recruitment of rabbitfish (Siganidae) juveniles.
- Investigating hatchery protocols for breeding *Pteria*

Sopu Mariculture Facility

oysters. There is potential for breeding the winged pearl oyster *Pteria penguin*, and an ACIAR project with James Cook University is being developed.

Tonga's Sopu Hatchery has been partially commercialised through a rental agreement with a private marine ornamental company. Although energy costs for operating this facility are prohibitive, the government is exploring ways to maintain the hatchery. The aquaculture staff are raising clams, mostly *Tridacna derasa*, which are on sold to private sector businesses to recuperate some of the hatchery's operating expenses. The commercial operator at Sopu Hatchery (Island Tropical Marine Exports) is handling a variety of invertebrate species, mostly hard corals.

Discussions were also held with Penisimani Vea, Chief Executive Officer for the Ministry of Agriculture and Forestry, and the recently appointed Minister of Fisheries the Hon. Lisiate Aloveita 'Akolo.

Marine ornamental industry

Tonga is one of the largest marine ornamental traders in the Pacific. The export of marine ornamentals to overseas aquarium markets is probably one of Tonga's most valuable export commodities. The industry has maintained relatively steady progress since its establishment more than a decade ago, which reflects well on private sector operators in this industry. Visits were made to some of the key traders in this sector, including:

- Walt Smith International Ltd. Manager Dickie Joe explained that the operation deals mostly with wild-caught fish and invertebrates. The main market is in the USA, but freight is a constraining factor. Dickie feels that one advantage that Tonga has is that all coastal areas fall under government jurisdiction.

- South Pacific Paradise Exporters. Owner Al Taulonga explained that his operation deals mainly with invertebrates but includes a large variety of species. During our visit, about a dozen staff were observed packing live animals for air transport to the USA.

- Jay Hawk Ltd is named after its owner. The business was set up because Jay wanted to get involved in a business that had long-term prospects. This approach underscores the fact that it is the industry players themselves who are striving for sustainability. The operation employs up to 30 workers. Jay thinks that regional organisations need to provide some technical support in dealing with

Top: Invertebrate marine ornamental species.

Bottom: Private clam hatchery for aquarium trade.

issues relating to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITIES) and the World Organisation for Animal Health (OIE), which the industry struggles to keep pace with. There is also the need to improve the image of the ornamental trade because there are a number of myths about harvesting practices, which has caused negative publicity.

- Dateline Aquarium Fish Co Ltd. Owner Dave Gilbert is one of the first operators who became established in Tonga more than 10 years ago. Dave estimates that the industry employs around 100 families and is worth around 5 million Tongan paanga per year. However, he feels that the wild ornamental harvest is becoming a political scapegoat and causing public misconceptions that harvesting is unsustainable. In Dave's opinion, divers in the trade only harvest from a very small proportion of the total reef area and their impact is negligible compared with other users and impacts.

VAVA'U PEARL ASSOCIATION

Vava'u Island is famous for its rock island scenery and the whales that migrate through its deep bays. Vava'u was also the main site for previous pearl farming trials. Much of this was focussed on black-lip pearl oysters, which occur naturally but are becoming increasingly rare. Several decades ago the winged oyster (*Pteria* sp.) was introduced by a Japanese project. Pteria oysters are now established in sufficient quantities that they can be collected using artificial collectors placed in the lagoon and cultured for half (mabe) pearls.

At the Vava'u market, vendors sell various mother-of-pearl handicraft items that are manufactured locally and which are popular with tourists.

The fisheries department on Vava'u organised a workshop with members of the pearl association. During the pearl market boom of the late 1990s, the association was active and focussed mostly on farming black-lip pearl oysters. Today, however, membership in the pearl association has dwindled. None of the black pearl farms have succeeded, and the association is in a general agreement that Tonga should consolidate what resources it has and refocus its efforts on farming the *Pteria* oyster. This option is much more attractive because of the oyster's availability and because farming mabe pearls requires less capital and technological investment than black pearls. In addition, there are opportunities for value-adding the harvested mabe pearl through handicrafts and jewellery.

Workshop participants agreed that SPC should assist in developing a *Pteria* mabe pearl economic model to determine a sustainable and profitable level of farming. This analysis would also enable prospective pearl farmers to develop business models and bank loan applications. SPC will engage a consultant trainer to run an advanced level pearl carving and jewellery making workshop. This is currently being followed up with a master carver from the Cook Islands who will visit Vava'u in May to run an advanced course in pearl jewellery and handicraft making.

Some pearl craft on display at Vava'u market.

NACA Governing Council meeting

SPC's Aquaculture Adviser, Ben Ponia, participated as a delegate in the 19th Network of Aquaculture Centres in Asia-Pacific (NACA) Governing Council meeting, held in Kathmandu, Nepal from 5–8 March 2008. NACA is an inter-governmental organisation whose members represent the bulk of the world's aquaculture production. Aside from sharing regional perspectives, the Governing Council meeting is often a good barometer of the global trends occurring within the aquaculture sector.

The opening session of the Governing Council meeting included speeches by Nepalese officials, such as the Minister of Agriculture, the Director General of the Department of Agriculture, and chaired by the Minister of State, Agriculture and Cooperatives. Addresses were also made by Dr Ichiro Nomura, Assistant Director General of the UN Food and Agriculture Organization (FAO), and Prof Sena DeSilva, Director General of NACA.

NACA's Aquatic Animal Health Programme (managed by Prof CV Mohan) maintains an active schedule of training workshops, some which are applicable to the Pacific Islands region. Collaboration between NACA and the World Animal Health Organisation (OIE) is also increasing, and there are benefits for the Pacific to participate in this linkage. A field manual for disease diagnostics is about to be released.

NACA's Training Programme (managed by Mr Zhou Xiaowei) continues to be a good source of contacts for regional training and tours. NACA has offered to help SPC with an Asian study tour/trade mission targeting high level government and private sector officials scheduled for some time this year.

NACA's Genetics Programme (managed by Dr Thuy Nguyen) has several projects that examine the impact of restocking programmes on the local gene pool of wild stocks, as well as how to maintain the genetic quality of hatchery breeders. This may be an opportunity to compare with the situation in the Pacific. NACA's countries are often focussed on restocking efforts in inland and freshwater bodies concerning vertebrate species, such as local catfish, whereas the Pacific is mainly interested in restocking coastal invertebrate species, such as sea cucumbers.

One of the key discussion points was the issue of aquaculture trade certification. A similar certification scheme is currently being proposed for the tuna industry by the Marine Stewardship Council. Related to certification is the issue

Top: Trout farm in Nepal.

Bottom: Valley in Nepal with fish farm below.

of traceability, which will also become important, especially for European Union markets. Producing countries, such as NACA members, are concerned that certification standards from importing countries do not become trade barriers. Draft international guidelines for developing certification standards will be presented to the FAO Aquaculture Sub-committee, which meets in October 2008.

Jia Jiansan, FAO's Aquaculture Chief of Service (Rome), presented FAO's work programme, which takes a proactive approach to meeting emerging issues. For example, resources are being directed towards developing adaptive strategies to climate change. In its capacity building programmes, FAO encourages new modes of thinking that are similar to approaches being adopted by SPC. As an example, FAO promotes an ecosystem approach to management and encourages the use of a risk assessment framework in decision-making.

Jia pointed out that 2010 will be the 10th anniversary of the FAO International Conference on Aquaculture in the Third Millennium (the first conference was held in Bangkok in 2000). The anniversary also coincides with NACA's 20th anniversary. The Thai government agreed in principle to host this conference. It is expected that this will be a major international event on the aquaculture calendar, and the conference should attract a least a thousand delegates.

Of the annual reports presented by the NACA regional lead centres (there is one lead centre in China, Philippines, India and Thailand), China's presentation was the most interesting. Prof Mia, Deputy Director of the China Wuxi Freshwater Aquaculture Centre, noted a significant increase in funding from central government for new facilities. The research budget is around USD8.5 million with 130 research projects being undertaken. Programmes for international cooperation in training are also being boosted. The integrated freshwater aquaculture course, which is offered annually to participants from the Pacific, is a good opportunity for the Pacific Islands region, although Prof Mia notes that Pacific Island applicants need to apply directly through the Chinese embassy in order to access funding support.

Robert Toledo, Chief of the Southeast Asian Fisheries Development Center (SEAFDEC) aquaculture department (Philippines), noted that SEAFDEC provides a wide range of training programmes. He feels that the close proximity to SPC's northern Pacific countries provides a good opportunity for collaboration.

The Governing Council meeting finished with a study tour of several freshwater trout farms in Nepal's mountains.

SPC Aquaculture Action Plan 2007

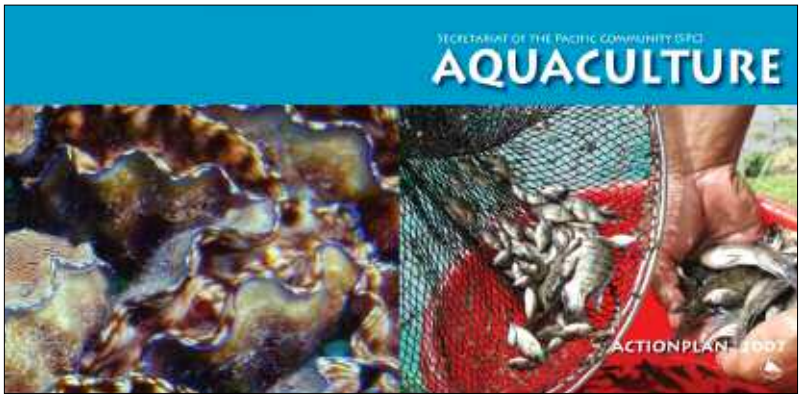
A regional strategy to guide aquaculture in the Pacific — the SPC Aquaculture Plan 2007 — was recently published.

Considerable effort was made to merge the document's glossy approach with simple but precise language so it would have broad appeal to a variety of stakeholders, including the general public, government agencies, entrepreneurs and donors.

The original basis for the action plan was formulated during the 2nd SPC Regional Aquaculture meeting held at SPC Noumea in November 2006. Subsequently, a drafting committee, formed by member governments and partner agencies, reconvened to refine the document. The current action plan has some similar features to the 2004 action plan, such as. a priority list of key aquaculture commodities for the region.

The Aquaculture Action Plan 2007 is a forward-looking perspective on the challenges facing the Pacific. The plan foreshadows that aquaculture:

- Will be an important vehicle for meeting the growing need for income generation, and for providing food security, as populations in the Pacific are expected to grow by an additional 50% percent by the year 2030. As much as an additional 100,000 metric tonnes of fish will be required



by the region in 2030 just to maintain the current rate of per capita fish consumption.

- Promises to help Pacific Island countries and territories maintain the supply of fish in the face of climate change.

- Should benefit from and strengthen linkages with its terrestrial counterpart: the agriculture and livestock production sector.

- Must integrate with fisheries and other aquatic stakeholders, through sustainable development of capture-based aquaculture (i.e. the cultivation of seed stock collected from the wild) and culture-based fisheries (i.e. the harvest in the wild of hatchery reared seed stock).

- Can contribute to the conservation of biodiversity that sustains cultural fishing traditions and ethno-biodiversity.

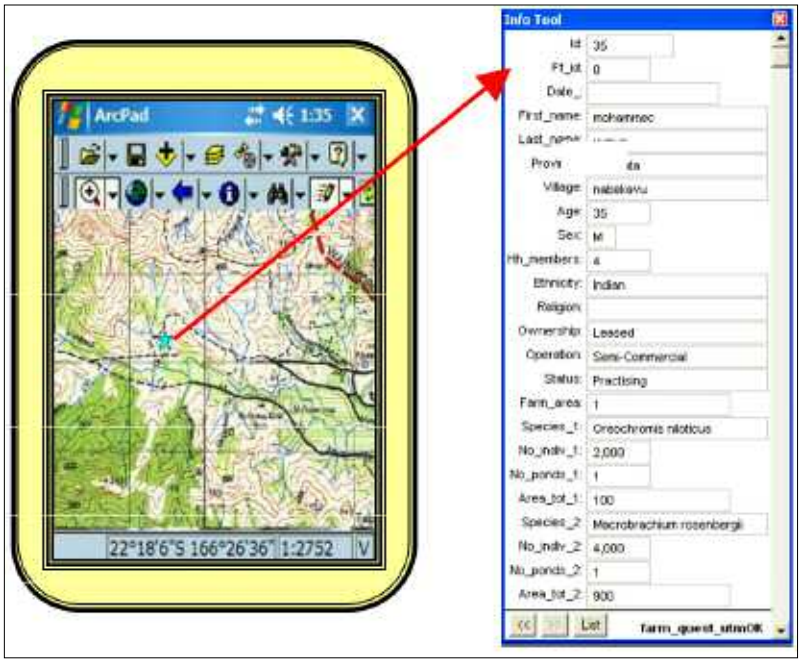
The SPC Aquaculture Action Plan 2007 is available in print form and digital format (downloadable on the SPC Aquaculture Portal at www.spc.int/aquaculture). To request a printed copy please email Marie-Ange Hnaujie (marie-angeh@spc.int).

Freshwater prawn and tilapia farms in Vanua Levu, Fiji Islands

A four-day field trip to Vanua Levu was made in February to meet with freshwater prawn and tilapia farmers and other stakeholders interesting in developing freshwater aquaculture.

Tavanesa Vakalevu (Fisheries Division, Labasa, Fiji) and Nadia Chagnaud (Aquaculture Section SPC, Noumea) met with farmers and ex-farmers around Savusavu, Cakaudrove Province in southern Vanua Levu. This fieldwork provided an opportunity to test an evaluation version of a personal digital assistant (PDA) with GPS functionalities. This tool runs a version of Microsoft Office and has ArcPAD installed (Arc PAD is a geographic information system package dedicated to PDAs).

The adjustments of the PDA's parameters and the development of the source code required to create a questionnaire form for farmers were done in collaboration with Phil



Top: PDA screen showing topographic map in backdrop and a farm location linked to a specific questionnaire.

Bottom: Freshwater prawn and tilapia ponds of Mr Yunus — an Indo-Fijian freshwater pond farmer — in Nabekavu village.

Bright from SPC's Statistics and Demography Programme. The 2004 census undertaken by SPC's Aquaculture Section was the starting point for selecting the most useful questions for determining the status of freshwater aquaculture farms in Fiji. The dropdown menus in the questionnaire avoided handwriting errors. Census results were placed into an Excel spreadsheet that with links to farm coordinates.

A visit to Montfort School at Savarekareka and the primary school at Urata village, Cakaudrove Province, gave us an insight to fish farming activities that target food security. Montfort School is an example of a successful tilapia aquaculture programme that provides fish for students every Sunday. In Urata village, the potential pond sites are waiting to be renovated (the old ponds have been neglected).

Ben Ponia (SPC's Aquaculture Section) and Tim Pickering (USP in Fiji) joined the team near Labasa, Macuata Province to visit tilapia farms in the middle of sugarcane plantations, where farmers have succeeded in collecting water from the river through irrigation.

A field visit was made to the freshwater pond farm of Mr Yunus. He is a sugarcane farmer who recently decided to try tilapia farming on his plantation, and is now expanding his farm to include freshwater *Macrobrachium* prawns.

Freshwater prawn farming appears to be a promising possibility for Vanua Levu, with some farmers already receiving orders for prawns from neighbours or customers from Labasa.

It is interesting to note the mutual assistance between farmers in harvesting tilapia. The main problems are the potential pollution of the water source, and river bank logging, which leads to the erosion of land and heavy runoff into rivers.

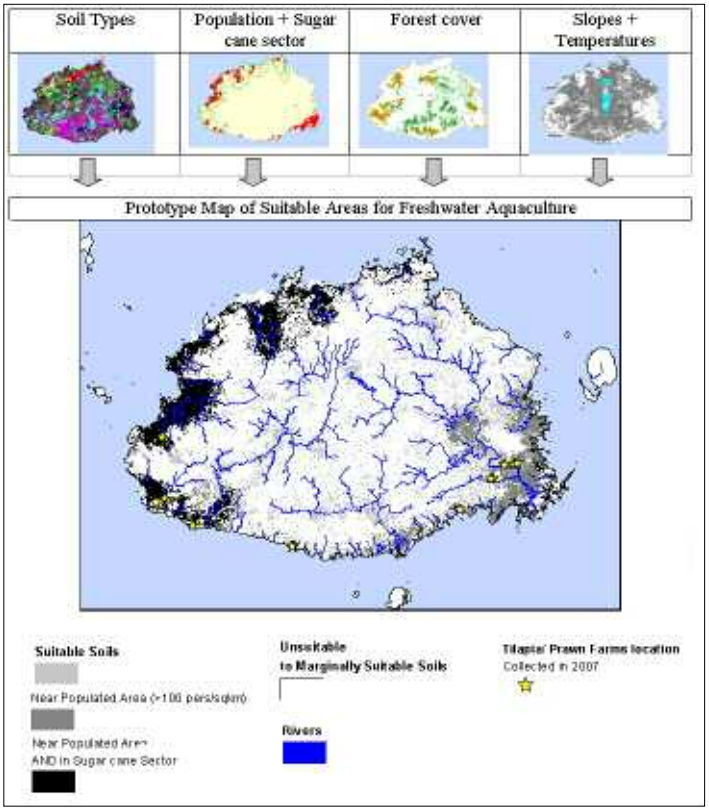
This fieldwork resulted in an understanding of freshwater farmers' constraints, successes and needs, and allowed us to test a handy new tool for future freshwater farm censuses.

Workshop in Fiji on freshwater aquaculture

A one-day workshop on freshwater aquaculture in Fiji was held in February at the University of the South Pacific (USP) in Suva, Fiji. The workshop brought together users and future users of geographic information systems, data producers and decision-makers.

Gerald Billings from Fiji's Fisheries Department, Tim Pickering from USP, Wolf Forstreuter from the Pacific Islands Applied Geoscience Commission (SOPAC), Ben Ponia and Nadia Chagnaud from SPC Noumea hosted the workshop.

Participants came from the Ministry of Agriculture, Ministry of Fisheries and Forests (Suva and Labasa), Ministry of Primary Industry, Ministry of Finance and National Planning (Fiji Islands Bureau of Statistics), USP, SOPAC, Naduruloulou Aquaculture Research Station and SPC Suva.



Prototype map of suitable areas for freshwater aquaculture.

Ben Ponia gave an overview of aquaculture in the Pacific, highlighting the increasing demand for fish in the region for both food security and income generation. Gerald Billings explained that tilapia and grass carp are now an important added source of protein for inland communities. The average areas of the farms in Fiji were 0.5 ha in 1983 and reached 390 ha in 2007. The need to find more efficient methods of pond site selection was emphasised.

Tim Pickering explained how GIS approaches can help aquaculture managers and described the necessary parameters for a GIS model for freshwater fish farming in Fiji. He mentioned that aquaculture development in many parts of Asia and the Pacific has been limited by poor information dissemination and poor management decisions. Constraints can lead to poor choices being made in locating aquaculture projects. He highlighted the importance of water sources and described the proper soils and topography for tilapia farming. The socioeconomic parameters he listed included, population size (i.e. is the local market large enough?), motivators for farming (i.e. community-based project vs a privately owned sugarcane farmer who is converting to tilapia and prawn), and understanding the potential barriers (e.g. ownership, finance, access to markets).

Wolf Forstreuter gave an exposé on the application of high-resolution GIS backdrops (i.e. high-resolution base maps and/or aerial photos) for resource management. He gave some examples of the benefits of using satellite imagery and data in technical resource management approaches (e.g. multiple images over time, digitalisation of images, creation of thematic maps and applying land use classifications). SOPAC has the capacity to pre-process images and Wolf emphasised the need for cooperation with Pacific Island countries and stakeholders.

Nadia Chagnaud described the GIS analyses and categorised factors as being either environmental or socioeconomic. After underlining the need for accurate GPS positions of freshwater farms for planning purposes, she explained how a global investigation involving the compilation of environmental and socioeconomic data could be used to identify suitable areas for freshwater aquaculture.

The last workshop presentation was about the personal digital assistant (PDA) with GPS functionalities linking the location of farms with a questionary to the farmers and the use of the GIS platform with export of vector data to Google Earth. The overlay of farms locations on the Google Earth images convinced the public of the pertinence of using the satellite images.

The first global "positive impact" of this workshop was that decision-makers became aware of the usefulness of GIS tools for planning purposes. The second impact was on data producers, who understood the added value to their data, raising interests such as sharing and updating data and metadata.

Aquaculture is taking off in Vanuatu

In the past few years, all of the necessary ingredients for making aquaculture viable have come together in Vanuatu: political and economic stability, an ideal geographic location, and the much-needed support from the government.

Aquaculture commodities targeting food markets, stock enhancement or live aquarium markets are progressing towards economic viability and sustainability. Although more commodities are being produced on a small scale in Vanuatu, the characteristics of the main aquaculture productions are described below.

Aquaculture for food

Teouma Prawns Ltd, Vanuatu's largest aquaculture facility, produced 16 metric tonnes (mt) of blue shrimp (*Litopenaeus stylirostris*) in 2006 and 18 mt in 2007. Although Teouma Prawns Ltd has a hatchery, the propagation of blue shrimp has been problematic, due to non-optimal environmental parameters. Therefore, the Government of Vanuatu, through the Departments of Fisheries and Quarantine, has assisted Teouma Prawns

Ltd with the importation of post-larvae from Brunei. The company has the potential of producing 85 mt of shrimp per year, and is planning to produce species such as *Penaeus monodon* and *P. vannamei* at its hatchery (using pathogen-free brood-stock imported from Hawaii).

As reported in *Fisheries Newsletter* #121 (2007), the large-scale production of red tilapia (*Oreochromis* sp.) in Lake Manuro (East Efate) by Vate Ocean Gardens is doing well. The fingerlings, imported from Thailand, are cultured in hapa nets and fed with meat meal (from the Port Vila abattoir) until they reach 50 g. They are then fed with imported formulated tilapia feed from Thailand and cultured in floating cages. In mid-2007, there was a very positive market response to the 12 mt of fish produced in 2006. These fish were sold under the name of "perche cerise" (French for "cherry perch"). Vate Ocean Gardens intends to increase production to 2.5 mt per week. This initiative has proven that "perche cerise" is acceptable as a valuable food fish for both the local market and the high-end restaurant and hotel market. The Vanuatu Fisheries Department is interested in pursuing its ongoing efforts of promoting tilapia in rural communities in the future.

AQUACULTURE FOR STOCK ENHANCEMENT

Trochus (*Trochus niloticus*) remain a valuable export commodity. Overall, the total trochus export for 2007 was 55.2 mt with a total

Top: Marine shrimp grow-out pond at Teouma prawn farm.

Middle: Hapa nets used for on growing juvenile red tilapia at Teouma prawn farm.

Bottom: *Tridacna gigas* introduced from Tonga at Vanuatu Fish Dept. hatchery.

export value of USD780,000. This is a significant increase from 2006, which was 35 mt. In 2007, 51% of the trochus shells processed for export originated from Tafea Province, followed by Sanma, Shefa Malampa and Penama provinces. These shells are not cultured, but the Vanuatu Fisheries Department still produces juvenile trochus for stock enhancement purposes. It is estimated that 10,000–20,000 pieces are produced per year. The minimum harvesting size for all trochus in Vanuatu's waters is 9 cm (basal diameter).

Tridacna gigas, the true giant clam, is extinct from the Vanuatu archipelago but was re-introduced from Tonga. This arrangement was done in exchange of 70 adult *T. crocea* exported from Vanuatu to Tonga. A total of 400 *T. gigas* clams (22–26 cm shell length) were imported and placed on reefs near villages in North Efate: Mangaliliu, Tassiriki and Sunae (Mosso Island). Survival was reasonably high after transport, and in early 2008, most clams measured over 30 cm. These *T. gigas* will later be used for broodstock and their offspring will be reseeded on Vanuatu's reefs.

Green snail (*Turbo marmoratus*) seeds are currently being cultured at the Vanuatu Fisheries Department as part of the Japanese International Cooperation Agency (JICA) funded "Grace of the sea" project. The first mass seed production of green snail was conducted in February 2007. The survival rate was less than 1000 juveniles, but 3500 more animals were produced in September. Large adult green snails were translocated from Aneityum to restocking sites north of Efate. The aim of translocating the animals is to create a group of protected spawners that will likely help in naturally reseeding the reefs at low cost. These spawning groups are protected by coastal communities with assistance of Vanuatu's Fisheries Department and JICA.

Exports for the ornamental trade

The colourful species of giant clams (*Tridacna* spp.) remain a favourite export commodity for the aquarium trade. The trade of wild clams has been banned from Vanuatu and all exported animals must now be cultured. In addition to the Vanuatu Fisheries Department hatchery, which has been producing clam spat for the past few years, two private companies are producing clams for the ornamental trade. The demand for giant clams is still high and the companies can't always keep up with demand. Vanuatu's Fisheries Department is pushing hard to involve communities in grow-out farming of clams. In February 2008, the first batch of *T. squamosa* were transferred by sea to coastal waters for grow-out in sea cages. The highest value species for the aquarium trade are the colorful, but slow growing, *T. maxima* and *T. crocea*, although other species are also exported. *T. squamosa* is a fast growing species that fetches a fair value. In 2007, over 10,000 pieces were exported and this amount is expected to increase in the near future.

Corals are still popular aquarium items. The aquaculture of corals has developed in Vanuatu since the trade of wild-caught fragments from the reef is prohibited. Two private companies now carry out these practices on a commercial basis using mostly, but not only, fast growing species such as branching staghorn corals (*Acropora* spp.). The corals are farmed directly in the sea, using various settling substrates, and then placed on tables and left to grow for four months to a year. Six thousand pieces were exported from Vanuatu in 2007 and this activity is also likely to increase in the near future.

***Acropora* spp. fragments cultured for the aquarium trade.**

Institutional strengthening of the aquaculture sector

The Vanuatu Fisheries Department is about to release its aquaculture development plan. This document demonstrates the much needed support to the sector. The Vanuatu Aquaculture Association is about to be established and will be based on

the Fisheries Department's premises. The association's aim is to promote and assist with the development of aquaculture in Vanuatu. There will be an update on both of these events in the next issue of the *Fisheries Newsletter*.

For more information, contact Sompert Rena Gereva (Senior Fisheries Biologist at Vanuatu Fisheries Department): sfb-ra@vanuatu.com.vu or Antoine Teitelbaum (SPC Aquaculture Officer): antoinet@spc.int

NEARSHORE FISHERIES DEVELOPMENT AND TRAINING SECTION

Technical assistance to Niue Fisheries Department

SPC trained Niue's Fisheries Department staff in the planning, construction and deployment of fish aggregating devices (FADs).

FADs are very important to Niue's fishermen because they concentrate fishing effort, which saves fishermen time and fuel in getting to the fishing ground. Although the Niue Fisheries Department staff have participated in some areas of previous FAD work, they need to be proficient in all aspects of the work in order to maintain a sustainable FAD programme to ease the operations of the island's commercial and recreational fishermen.

SPC's Fisheries Development Officer, William Sokimi provided the necessary training. He worked with Niue Fisheries Department staff in constructing three FADs (Figs. 1 and 2), one of which was deployed at the Halagigie site and the other at the Matapu site. The third FAD will be deployed near Namukulu by fisheries staff at a later date. The Halagigie and Matapu sites were recommended because they were closer to Alofi and were previously successful sites. FAD deployment points were selected from earlier bathymetry survey work done by the Pacific Islands Applied Geoscience Commission (SOPAC) in Niue. The Halagigie FAD is 2 nm offshore in 720 m depth, while the Matapu FAD is 1.5 nm offshore in 700 m depth. The Namukulu FAD will be placed 1.7 nm offshore at a depth of 700 m.

The FADs were constructed according to the design recom-

Figure 1 (top): Flotation sections for the three FADs completed.

Figure 2: (bottom): Transporting FAD to the deployment site.

mended by SPC in its FAD manual. A "V" deployment strategy was used with the flotation and anchor coordinates on the V ends and the turning point at the V point. The flotation section of the FAD was dropped off at a preset coordinate at the 750 m contour. The launch then headed for the second coordinate, which was approximately half the mooring length. The positioning of the second coordinate was angled towards the 650 m contour. Before the vessel arrived at the second coordinate a slight angle on the rudder was used to bring the launch gently around to a third coordinate that marked the approximate full length of the mooring. This action created a "U" path, although once the vessel settled on its return course, the heading was angled a bit to head for the flotation section. The U turn was towards and parallel to the shallower slope (i.e. the island side).

Once the full length of the mooring rope was paid out, the anchor deployment depth was confirmed and the anchor deployed (Figs. 3, 4 and 5). Aggregators were tied on after the FADs had settled. The final settling positions were:

Halagigie: 19° 03.787'S 169° 58.861'W
Depth: 720 m

Makapu: 19° 00.674'S 169° 56.875'W
Depth: 700 m

The charted positions are shown in Figures 6 and 7.

Figure 3 (top): Deploying the anchor.

Figure 4 (middle): Anchor deployed.

Figure 5 (bottom): Halagigie FAD settled in the water shortly after deployment.

Compared with the straight line deployment method, the V or U deployment methods place less strain on the mooring ropes because the anchor makes its way to the bottom. In the straight line method, the heavy anchor places considerable stress on the mooring rope and also pulls the flotation section underwater for a short period before it resurfaces. The U method, however, does not pull the flotation section underwater, but instead trails it slowly through the water until the anchor settles. Sometimes deeper moorings pull the flotation section of the FAD underwater using the U method, but the movement is much gentler than the straight line method. Also, the anchor is deployed on the shallower slope so that there is less chance of it settling in deeper water.

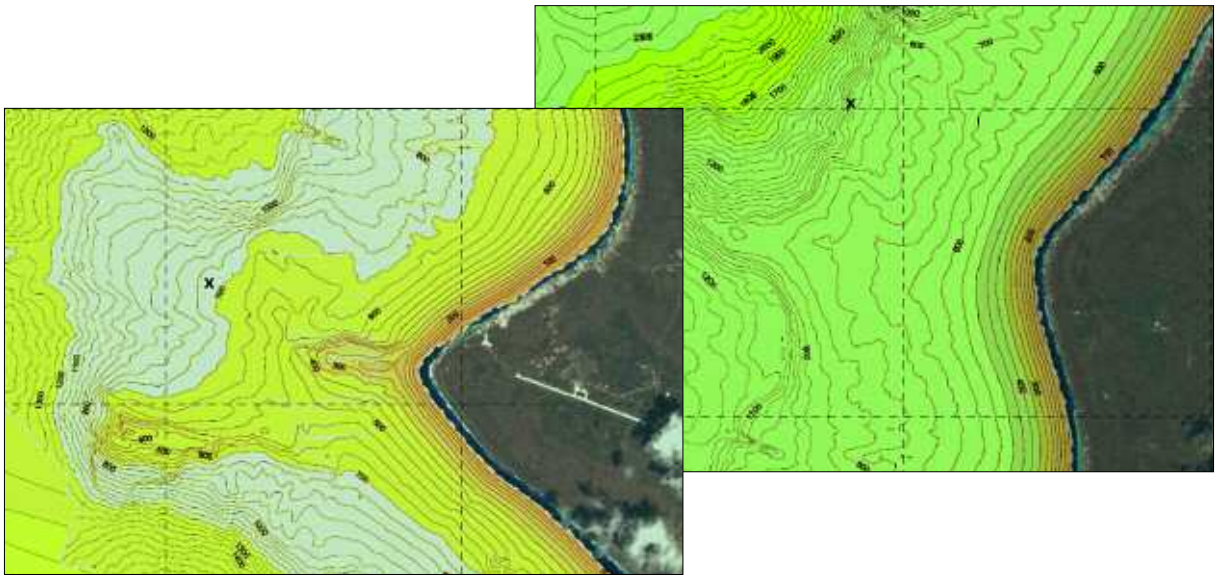


Figure 6 (left): Halagigie FAD final settling location marked with an X.

Figure 7 (right): Makapu FAD final settling location marked with an X.

Kavieng pump boat handline fishing trials

In mid-November 2007, SPC's Fisheries Development Officer, William Sokimi, worked with staff of the Commercial Fishing Operations (CFO) section of the National Fisheries College (NFC) in Kavieng, Papua New Guinea, on a pump boat handline fishing trial.

The inspiration for this project was the success of pump boat fishing operations carried out in Lae (Morobe Province, PNG), in mid-2005. The purpose of that project was to supplement tuna supplies to Frabelle Limited, a tuna fishing and canning company based in Lae. The Lae pump boat operations were based on those used in the Philippines and focused on mid-water jigging methods around FADs. Initial positive outcomes suggested that the concept could be used elsewhere in Papua New Guinea where there is infrastructure and marketing access to support a tuna fishery (e.g. Kavieng in New Ireland Province).

The objective of the Kavieng pump boat fishing trials was to ascertain whether sufficient volumes of tuna could be caught in pump boat handlining operations to encourage the introduction of a tuna and pelagic fish species value-adding processing capacity at the Kavieng seafood processing facility.

FADs for pump boat fishery

The pump boat fishery is highly dependant on FADs to aggregate and retain tuna schools. Between 20 and 30 FADs have been deployed off the coast of Morobe Province to support the Lae tuna pump boat fishery. For the Kavieng trials, however, four FADs were deployed by the National Fisheries College (NFC) a month prior to pump boat handlining trials (Fig. 1). These were spaced approximately 5 nm apart and 2–3 nm off the reef shoreline to maximise aggregating capabilities. Previous use of FADs in pump boat operations showed that tuna migrated unpredictably between the FADs within a cluster, and were most probably driven by baitfish movements, changes in local current, or regional seasonal influences on tuna migration habits.

Figure 1: N° 2 FAD in Kavieng.

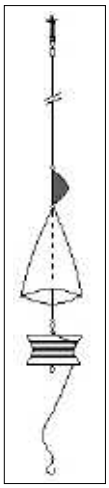


Figure 2: Chum bag gear.

PUMP BOAT HANDLINE FISHING METHODS

The most effective way to catch large tuna is to use live bait. Baitfish are jigged with 15–30 kg test monofilament lines and small 4/0 J hooks with pink/blue plastic strips or chicken feathers attached. These artificial lures are attached to a trunkline in a series of three to six hooks per trunkline, with a 200 g lead sinker at the end. The mainline is lowered to approximately 20–60 m (and sometimes 100 m) where it is haltingly retrieved in a jigging manner. Live bait is hooked onto stronger lines with larger hooks to catch the bigger tuna species.

When no live bait is available, fresh bait is used with squid ink or chumbait attractant methods. The traditional dropstone fishing method is the main technique used to carry out the chum bait function. Although this method is effective, its application in commercial fishing is burdensome and restrictive because a large amount of suitable flat rocks must be carried on each fishing trip. The Filipino fishermen in the Lae fishery use broken flat pieces of building blocks for the dropstone method. When the rocks run out, fishing stops and the fishermen return to port, regardless of whether there is a good catch or not. The other restrictive aspect of the dropstone method in commercial fishing is that it does not give fishermen much scope to test the waters when tuna detection becomes difficult due to movement of schools from one FAD to another. However, the Lae pump boat fishermen have the advantage of many boats to detect the whereabouts of tuna schools within their FAD cluster. In times of low tuna aggregation, the boats spread out among the FAD cluster and keep in radio contact, sharing updated information on tuna aggregation at their station. The boats then convene at the FAD with the most tuna.

In replication of the Lae pump boat fishing methods, the dropstone method was improved on while the live bait jigging methods were retained. A chum bag with 1 kg sinker was attached to the end of the mainline. The chum bag was used to envelope the chum bait as well as 20 m of 2.0 mm monofilament trunkline with a baited 14/0 to 16/0 tuna circle hook at the end (Fig. 2). This tuna handlining method is very effective in the multi-mil-

Figure 3: Pomat Litau completing a sinker for the scatter bait fishing method.

lion dollar Okinawa FAD fishery. The principles are the same as for the dropstone method, except that the "stone" is retained as well as the "wrap around" leaf.

All fishing gear used during the trials were constructed at the NFC waterfront workshop by NFC staff and participants (Figs. 3, 4, 5 and 6). Two sets of fishing gear were made for each fishing vessel.

Outcome

The handline fishing trial did not produce the amount of catch that was envisaged to promote the pump boat fishery in Kavieng. However, the concept should be pursued. The live-bait jigging methods went well (Fig. 7) and would have resulted in a high bait catch had not controls been implemented to leave the baitfish in place for when the bigger pelagic species return.

The four FADs closer to Kavieng were aggregating abundant numbers of baitfish after two weeks in the water. Fishermen in the area were recording tuna catches three weeks after deployment. However, during fishing trials, only baitfish schools were sighted at the three remaining FADs. Tuna schools were nowhere to be found in the vicinity of the FADs and all the way along the coast as far as New Hanover. NFC's training vessel, the FTV *Leilani*, covered the east and west coast searching for running schools but none were

Figure 4 (top): Jigging rods and accessories for the scatter bait fishing method.

Figure 5 (middle): Completed lead sinker for the scatter bait fishing method.

Figure 6 (bottom): Malakai Komai displaying the bait jigging lures made from drinking straws.

found. Only small schools of Indian mackerel and rainbow runner were spotted.

The disappearance of tuna schools could be due to seasonal migration, changes in currents, or the recent spate of bad weather that passed through New Ireland. This should serve as a warning to do more research on tuna movements in the New Ireland area. Pump boat fishing should be conducted over a whole year; fishing two to three days a week, using the handline fishing methods introduced in this trial. The results from these fishing trips can be used to determine the time of the year when tuna are abundant, the period in which the large sized tuna frequent the area, and tuna spawning times.

Figure 7: Bait caught using straw lures.

Sea turtle bycatch mitigation workshop and FAD fishing workshops

During the first few weeks of 2008, SPC's Fisheries Development Officer, Steve Beverly, began working as the managing editor of the *Sea Safety Bulletin*. Also during this time, Steve participated in a sea turtle bycatch mitigation workshop, held at the Novetel Hotel in Nadi, Fiji Islands.

The workshop was organised and sponsored by the Pacific Islands Forum Fisheries Agency (FFA) and was attended by fisheries officers from most FFA member countries, as well as experts from around the region in the field of sea turtle bycatch mitigation. During the workshop Steve, along with Carolyn Robins of Beldi Consultancy (Australia), gave a presentation on bycatch mitigation awareness raising materials, and the tools and techniques used for mitigating turtle bycatch in longline fisheries, and releasing hooked turtles unharmed. Workshop participants helped to provide advice and direction on the development of a strategic work plan (action plan) relating to the mitigation of interactions with sea turtles and fisheries in FFA member countries. Most discussions related to longline fisheries, with a focus on circle hooks and the use of release equipment.

The results of the workshop will help direct related work by FFA members and will be used in determining obligations under WCPFC Resolution 2005-04 (resolution to mitigate the impact of fishing for highly migratory fish species on sea turtles) and FAO's guidelines for reducing sea turtle mortality in fishing operations.

After the workshop, Steve visited Wallis and Futuna where he conducted two FAD fishing workshops, one on Wallis and one on Futuna. The workshops were organised by Wallis and Futuna's Office of Agriculture, Forestry and Fisheries in Mata Utu. Steve described to participants the three FAD fishing methods that would be used during the workshop: vertical longline, palu ahi and bidon dérivant (drifting bottle).

After the classroom instruction, participants began making up gear (Fig. 1). Six vertical longlines were fabricated and

mounted on Alvey Reef King reels, four palu ahi lines, and numerous drifting bottles. The Alvey Reef King reel (the largest model) can hold a vertical longline fabricated from 2.0 mm monofilament with 20 spaces for branchlines (Fig. 2).

On the third day of the workshop Steve accompanied five fishermen on a 7 m aluminium half-cabin boat. Two other similar were (Fig. 3). These boats were ideal for this type of training because they were previously equipped with Alvey Reef King reels and had the reel mounts on the rails. This made it easy to install the project reels, some of which were purchased by the Office of Agriculture, Forestry and Fisheries for this workshop, and others that were the property of the fishermen. Steve and the fishermen departed early for the FAD in the south.

Unfortunately, the FAD was not productive. No fish were caught on any of the workshop gear and no fish were caught trolling. There were no birds either. One boat, however, had caught several skipjack tuna on the way to the FAD by trolling. Upon returning to the office and discussing the outcome, it was decided that all boats would fish in the north the following day, in the vicinity of a lost FAD that had been productive before disappearing. Some fishermen expressed concerns that the gear, circle hooks, and bait (Pacific sardine, *Sardinops sagax*) were not suitable. However, circle hooks and sardines work well elsewhere, especially in

Figure 1 (top): Fishermen making up vertical longlines.

Figure 2 (middle): Alvey Reef King reel with a 20-hook vertical longline.

Figure 3 (bottom): One of the workshop boats: a 7 m aluminium half-cabin runabout.

industrial longline fisheries, and vertical longlines have caught fish in the past. Steve reminded the fishermen that the workshop was an exercise in demonstrating techniques, and was not a commercial venture.

On the following day, the same three boats headed out. A 15 kg yellowfin tuna was caught while trolling and Steve used the opportunity to demonstrate proper fish handling techniques for sashimi quality tuna. Several small yellowfin and skipjack tunas, two wahoo and two barracuda were caught while trolling, and one rainbow runner was caught on a vertical longline.

Steve debriefed participants after the workshop. pointing out that the total effort for the vertical longlines had been only 240 hooks soaking for about two hours, which is not much effort. A mid-sized longliner sets about 2000–2500 hooks daily that soak for 8–16 hours. A good catch rate might be one fish (e.g. a large bigeye tuna or yellowfin) per 100 hooks, or 20–25 fish per set. Based on these amounts, the fact that participants caught no fish on 240 hooks is not unusual. Vertical longlines, like horizontal longlines, need to count on numbers. After several days' fishing and several sets in different areas (depending on whether or not fish were present), Steve assured participants that if they were patient and persevered, they would start catching fish with the vertical longlines.

Steve conducted a similar workshop on Futuna. The main difference was that there was no FAD to fish on so participants fished off the reef on the northernmost point of Futuna, which is normally a good fishing spot. Results, however, were similar to those on Wallis: no fish were caught on any of the workshop gear.

Steve observed that fishermen in both workshops, although disappointed with the fishing results, learned a good deal about making up all three gear types and the techniques used for fishing with these gear types. Steve found that in general, the artisanal and subsistence fishermen in Wallis and Futuna could benefit from further assistance and training in safety at sea and in fish handling. None of the boats used during the workshops had adequate safety gear, and some had none at all, not even life jackets. None of the fishermen were knowledgeable about proper fish handling techniques, and fish were handled roughly and not iced properly. Steve noted that any future assistance to these fishermen from SPC should concentrate on these two facets of fishing. He also reported that the Office of Rural Affairs and Fisheries could use some assistance in their FAD programme.

DevFish assists Tongan fishing association

The importance of national fishing industry associations in representing the views and interests of their members is recognised in many countries in the region, although most associations rely on the voluntary services of their members. But because members are likely to be occupied with running their own fishing business, they are seldom able to devote the time needed to association work. There also the perception that they are pursuing the interests of their own company, rather than those of the association. Unfortunately, fishing associations typically have a small membership of relatively small companies, and lack the resources to hire staff.

To try to address these problems, the European Union-funded DevFish project provided funding support for an executive officer post with the Tonga Export Fisheries Association (TEFA) for a six-month trial period, starting in late 2006.

TEFA's request for support was primarily due to 1) the increasing amount of outstanding work and issues affecting the interests of the association and its members, and the fishing industry as a whole; and 2) lead TEFA executives having difficulty in attending to association matters, as well as concentrate on running their own businesses.

Naitilima (Tima) Tupou — a Tongan national with several years of work experience in the tuna industry — was hired as executive officer (see photo below). While waiting for office space to be provided, Tima arranged TEFA's files, set up a library, and created an email account. Tima was also given the responsibility of managing TEFA's bank account with cheques endorsed by the association's treasurer or president.

A setback in TEFA's work plan was experienced with the passing away of the king and the subsequent riot in Nuku'alofa. As a result, the executive officer's real work didn't begin until January 2007.

The hiring of an executive officer for the fishing association has been a success, and the DevFish project hopes the situation will be a model for similar in-country assistance to other Pacific ACP countries. The establishment of the position has proved to be a positive step, not only for association members, but for the fishing industry in Tonga as a whole.

Positive outcomes

Although acknowledgement of the executive officer's role by private sector and government agencies has been slow, there has definitely been more representation of the association and the industry. Tima has also been able to initiate contacts with lead donors and development assistance agencies, identifying potential future support for the association. There is also more openness within the association. The executive officer conveys members' views to the government; previously, individual companies were often reluctant to communicate directly with the government.

The industry's ability to be represented and to participate in core policy-making committees and consultations has increased dramatically. Before the appointment of the executive officer, TEFA had membership in five forums (Pacific Island Tuna Industry Association (PITIA), Fisheries Working Group, Fuel Concession Committee, Tuna Management Advisory Committee, and the Fisheries Management and Advisory Committee).

Through the executive officer's efforts, acknowledgement and membership has expanded to include the following additional organisations:

- National Economic and Development Council;
- National Export Strategy Team;
- Export Working Group To Government Task Force;
- Ports Authority Advisory Board;
- WTO Facilitation Committees;
- Department of Fisheries Working Group.

Tangible results of the executive officer's representation in various committees include: 1) the new Customs Act (to be implemented in early 2008), which contains tax concessions favourable to the fishing industry; 2) the gazetting of the Snapper Fishery Management Plan (which contains a cap on vessel numbers); and 3) the accountability of Tonga's Fisheries Department with regard to some of its fisheries management obligations (e.g. on the prompting of the executive officer, the fisheries minister requested the department to report on implementing agreed upon recommendations of the National Commercial Fisheries Conference).

Setbacks

Some problems were experienced during this trial period of the executive officer. The restructuring of the government, and the Ministry of Fisheries downsized to a department, has meant that the industry is a lower priority for the government. The voluntary redundancy programme last year, after the civil service strike, has left the Department of Fisheries with some core positions vacant.

With the increased capacity for representation and participation by fishing organisations, there is a misconception that industry is badgering government departments. Some fishing association members feel that their operations have been singled out and discriminated against. One member had been "disadvantaged" from an open forum where he had openly discussed the shortcomings of a government department.

The tragic national event of November 2006 affected the association's activities, both internally and externally, due to a shift in the government's priority and Tonga's immediate development partners. This in turn affected Tima's efforts to secure alternative funding sources for the continuation of her position and for certain association projects. Despite these setbacks, Tima was able to establish contact with lead donors and development assistance agencies, and secure some assistance for TEFA.

Executive officer's observation

Tima acknowledges that because of the diversity of the association's membership, there are both common interests and conflicting issues between members. The association represents companies in the tuna longline, deep bottom fish, and aquarium fish businesses. Tima believes she has built a rapport between members, and hopes to further nurture this relationship.

Tima believes that planned association activities must be concrete and objective, time limits must be set, responsible persons identified, and a form of measurement determined so as to assess the progress towards objectives. Tima plans to continue working and building relationships with different government departments and organisations, building the association's capacity; and maintaining

the ability to be objective to ensure the association's views are not marginalised.

Tima believes her independence and representation of the association definitely limits the misconception that association representatives are only pursuing their personal interests.

Accountability and good governance

The DevFish project acknowledges the timeliness with which Tima carried out TEFA's obligations under the MoA of this funding support. All required reporting requirements, including full expenditure acquittal and financial records, have been provided.

Industry representation in various forums and committees enables good governance practice by having a balanced and objective discussion on issues and policies. In recognition of the objectiveness and integrity displayed by Tima, the Government of Tonga nominated her, in her capacity of executive officer of TEFA, as the official delegate for Tonga to the Tuna Commission meeting in December 2007.

TEFA is a member of the Pacific Island Tuna Industry Association (PITIA), and Tima assists with work of the PITIA secretariat. Tima is also in discussions with PITIA and SPC for some collaborative training work.

This success in Tonga has been brought to the attention of multiple fishing associations in Samoa and Fiji, and has generated some interest in those associations for putting aside their differences and forming umbrella associations to focus on policy issues of common concern.

External review

The DevFish Project recently had a mid-term review. On the subject of the TEFA executive officer, the review noted:

> *DevFish funding for a committed and qualified officer at the Tonga Export Fisheries Association has had significant positive impact on fisheries policies and has resulted in a situation that could be considered a model of the positive benefits of a fisheries association…"*

The executive officer has promoted the association's interests. While DevFish cannot support the position indefinitely, other potential sources of funding have been identified as well as some revenue generating initiatives. DevFish approved TEFA's request for an extension of the executive officer position and has provided funding support for a further six months. DevFish has provided similar assistance to three other countries. Other donor agencies interested in supporting private sector fisheries development in the region may wish to consider this kind of assistance to fishing industry associations.

For DevFish Project assistance and project technical reports, visit: www.ffa.int/node/542.

Economic benefits of a domestic tuna purse-seine fishery

The purse-seine fishery

Purse-seine fishing catches the largest amount of tuna in the western and central Pacific: about 1.5 million metric tonnes (mt) or 70% of the total tuna catch in each of the last two years. The catch consists mainly of skipjack as well as small yellowfin.

The purse seine is a large net that is closed at the bottom ("pursed") to trap fish. The fish are then transferred onto a fishing boat and frozen in large tanks of refrigerated brine. Purse seining is an efficient and capital intensive fishing method. Most purse-seine vessels operating in the Pacific catch an average of more than 30 mt of tuna per day, and can carry over 1000 mt onboard. A new vessel of this type now costs more than USD12 million, and has operating costs of over USD2 million a year, but needs less than 30 crew members.

Fishing is concentrated near the equator. There are also impor-

Purse seiners

tant tuna purse-seine fisheries in the waters of Japan, Indonesia and the Philippines, but most of the catch comes from the EEZs of eight Pacific Island countries: Kiribati, Federated States of Micronesia, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu, all of which work together to manage and regulate the fishery.

Processing the catch

Nearly all purse-seine catches in the region go towards making canned "light meat" tuna. This is a huge industry, with a global demand for around 7 billion cans per year. In the Pacific Islands, there are canneries in Solomon Islands, Fiji, and two in Papua New Guinea, but these are small by international standards. Cannery production in the Philippines and American Samoa is higher, but the world's biggest producer of canned tuna is Thailand.

Preparing tuna for canning is a labour intensive process, and has become very expensive in countries with high wages. Tuna canneries in Europe, for example, now mainly import loins (cooked, cleaned tuna fillets), which are prepared in factories nearer to the fishing grounds. This creates savings in both labour and freight costs. All Pacific Island canneries now also export loins; there is one factory in PNG that only produces loins; and a loining plant that operated in the Marshall Islands for some years will re-open soon.

Economic benefits of the industry

The high capital and operating costs of purse-seine vessels have made it difficult for Pacific Island companies to participate in the fishery, which has been dominated by foreign fishing fleets. Currently, purse-seine vessels from Japan, Korea and Taiwan catch most of the fish taken from Pacific Island waters. These catches are landed at processors in Japan, or are transshipped in large refrigerated ships to canneries in American Samoa, Korea, the Philippines, and Thailand. Transshipping is a common activity in Honiara, Pohnpei, Tarawa, Majuro and other Pacific Island ports. Access fees paid to Pacific Island countries by foreign fleets are substantial — around USD60 million per year — and make up a high proportion of government revenue in countries such as Kiribati and Tuvalu. Development aid is often linked to access agreements, and there may be some benefits to local economies through port dues and the local purchase of supplies and services during transshipment.

Despite these benefits from foreign access arrangements, most Pacific Island governments feel that they are not capturing the full economic benefits from their tuna resources. Papua New Guinea, in particular, has pursued a determined strategy to attract foreign investment in locally based tuna purse seining and processing operations. The purpose of the DevFish study was to measure the economic benefits that can be secured by the development of a domestic industry.

Measuring economic benefits

As in an earlier DevFish study of the longline fishery, six measurements of economic impact were used, each in US dollars, and calculated per metric tonne of tuna. These six measurements were:

- *Value added* — the key measurement. This is calculated from the value of goods produced by an enterprise, less the cost of goods and services purchased from other firms. It can be considered as the net gain to the national economy from a fishing or processing activity;
- *Net local purchases* — Adds the value of supplies bought by fishing companies, less the cost of import of supplies from overseas;

Left: A locally based purse seiner landing fish in PNG.

Right: Preparation of tuna in a Pacific Island cannery.

- *Employment earnings* — The wages paid to crew and onshore workers who are resident in the country;
- *Gross profit* — Measured as earnings before interest, tax, depreciation and amortisation;
- *Contribution to the balance of payments* — The value of export sales, less the cost of imported goods used;
- *Government revenue* — The amount from licence fees and other charges.

Data were collected from purse-seine tuna fishing and processing companies in the Marshall Islands, Papua New Guinea and Solomon Islands. These enterprises are classed as "locally based" and account for 105,000 mt of purse-seine catches and 70,000 mt of fish processed per year as well as 5500 jobs. These enterprises have a combined annual turnover of USD150 million. The study used their actual financial results for 2006.

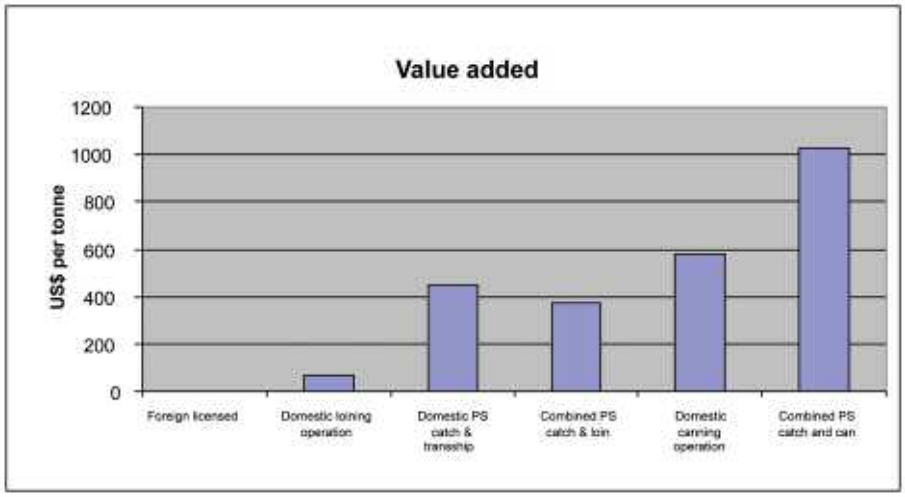
The DevFish study looked at six operational models:

- Domestic purse-seine vessel catch and transshipping in a local port;
- Domestic contract loining operation;
- Domestic canning operation;
- Combined domestic catching and loining;
- Combined domestic catching and canning; and
- Foreign licenced (fishing offshore and transshipping elsewhere).

Each of these has different impacts on local economies.

What are the benefits?

The graph below shows the value added per metric tonne of tuna caught and/or processed under each of these models. The table below gives the average values for all six criteria.



Note that these are average values for more than one enterprise, often covering more than one country. There were considerable differences between enterprises of the same model, reflecting the nature of their investment and operations. It should also be noted

Operational model	Value added	Net local purchases	Employment earnings	Bal. of payments	EBITDA (profit)	Gov't revenue
Domestic PS catch and transshipment	447	81	9	528	424	24
Domestic loining operation	71	214	114	143	188	42
Domestic canning operation	577	279	41	856	528	52
Domestic PS catching and loining	375	296	123	671	236	66
Domestic PS catching and canning	1024	361	50	1384	952	76
Foreign licensed, no transshipment	-	-	-	-	n/a	80

All values are in USD per metric tonne of tuna (catch or factory throughput)
PS = purse seine; EBITDA = earnings before interest, taxes, depreciation and amortisation

that the study looked at direct expenditure by fishing and processing companies. The wider effect on the economy and tax revenues from increased employment, for example, was not considered.

Conclusions

This study demonstrates that returns to the national economy from the surface tuna fishery are significantly enhanced with local basing of vessels and as the level of onshore processing increases. This supports the policy direction of countries that have sought to develop locally based purse-seine fishing operations and onshore processing, particularly canning. However, under the current tax regimes, these returns (particularly direct government revenue) are small compared with the returns to fishing enterprises.

Despite the various incentives, the scale of onshore tuna processing from the surface fishery in the region remains small. It is suggested that the main reason why these government interventions have failed to achieve more significant onshore processing is that those policies have been directed at vessel operators in an attempt to persuade them to become food processors. This has often been ineffective because, as shown by this study, vessel operators are already making adequate profits without getting into the unfamiliar business of onshore processing.

A policy option that directs vessel operators to land their catch for onshore processing in the host country, without requiring them to get involved in processing themselves, may be more successful in increasing the volume of processing in the Pacific Islands. A strategy is also needed to restructure tax, operational and management regimes applied to the surface tuna fishery to improve the balance between resource owners and the enterprises exploiting the resource.

Further information

This summary is based on a report by Peter Philipson that was commissioned by the DevFish project. A copy of the full report can be downloaded from www.ffa.int. A printed copy can be requested from Jonathan Manieva, DevFish Project, Secretariat of the Pacific Community, BP D5, 98848 Noumea Cedex, New Caledonia.

The DevFish project is funded by the European Union and jointly implemented by the Pacific Islands Forum Fisheries Agency and the Secretariat of the Pacific Community.

GROWTH OF RARE QUEENSLAND JEWEL

Queenslanders may be seeing more of one of the state's iconic tropical reef fish with Australia's first ever juvenile coral trout bred and grown by Department of Primary Industries and Fisheries (DPI&F) scientists using aquaculture farming.

DPI&F principal scientist Dr Richard Knuckey, who led the team of researchers, said this breakthrough had the potential to significantly boost the live-fish export industry and follows advances made by the project in the culture of other tropical groupers.

"Given that international demand for most tropical reef species is increasing, the opportunity to reliably produce commercial numbers of reef fish using aquaculture farming is a great boost to Queensland's economic future," Dr Knuckey said.

"Industry partners together with the DPI&F are already growing tens of thousands of gold-spot and flowery grouper to test the new technology and hopefully develop the local market for these quality fish.

Coral trout, flowery grouper and gold-spot grouper are a few of Queensland's more prominent tropical fish and currently form the foundation of a multi-million dollar Queensland export industry into the Hong Kong market.

"Around 60 per cent of the international live reef-fish industry is exported to Hong Kong, worth in excess of AUD350 million, which makes this new technology an even greater asset to Queensland aquaculture farmers," he said.

Specific research into coral trout began 18 months ago, following identification by industry that it would be a priority species. Coral trout production will compliment the current focus of the Tropical Marine Finfish project to support the existing marine prawn and finfish aquaculture industry.

"Queensland is an ideal location for developing a diverse aquaculture industry," Dr Knuckey said.

"DPI&F is working to support this potential by facilitating the uptake of innovation and technology, encouraging investment in the aquaculture sector and minimising the risk of impact on fisheries resources."

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Australia's first ever juvenile coral trout are being bred by DPI&F scientists using aquaculture farming.

REVIEW OF THE STATE OF MARINE CAPTURE FISHERIES MANAGEMENT IN THE PACIFIC OCEAN

The "Review of the state of world marine capture fisheries management: Pacific Ocean", published by FAO, provides trends in legal and administrative frameworks, management regimes and status of marine capture fisheries for twenty-nine countries in the Pacific Ocean.

In the chapter concerning "Small island developing states of the Southwest Pacific", it is highlighted that the development of fisheries management plans since 1998, with the support of FFA, has acted as a catalyst. Although the process has not always been smooth, there have been substantial benefits:

- The first experience of some countries at formally establishing fisheries policies and articulating management goals was during the process of formulating these plans.
- The plans have brought a degree of transparency to the fisheries management process,

which was somewhat nebulous in several countries.

- The stable and/or reliable set of policy measures promoted by the plans is crucially important for attracting domestic and foreign investors to the fisheries sector.

- In some countries the first government/sector consultative mechanisms in the fisheries sector are those established by the plans.

However, a table also indicates that no International Plans of Action (IPOAs on capacity management, conservation and management of sharks, IUU, etc.) have yet been implemented in National Plans of Action (NPOAs).

Sources

Review of the state of world marine capture fisheries management: Pacific Ocean.

FAO Fisheries Technical Paper. No. 488/1. Rome, FAO. 2007. 170 p.

http://www.fao.org/docrep/010/a1465e/a1465e00.htm

Chapter on Small island developing states of the Southwest Pacific.

ftp://ftp.fao.org/docrep/fao/010/a1465e/a1465e08.pdf

SELENIUM IN TUNA PROTECTS AGAINST MERCURY

Yellowfin tuna was first shown in 1972 to protect against mercury toxicity, not cause it. Further studies by Dr Howard Ganther and his team at the University of Wisconsin led them to conclude that the rich levels of selenium in tuna were responsible for the protective effect.

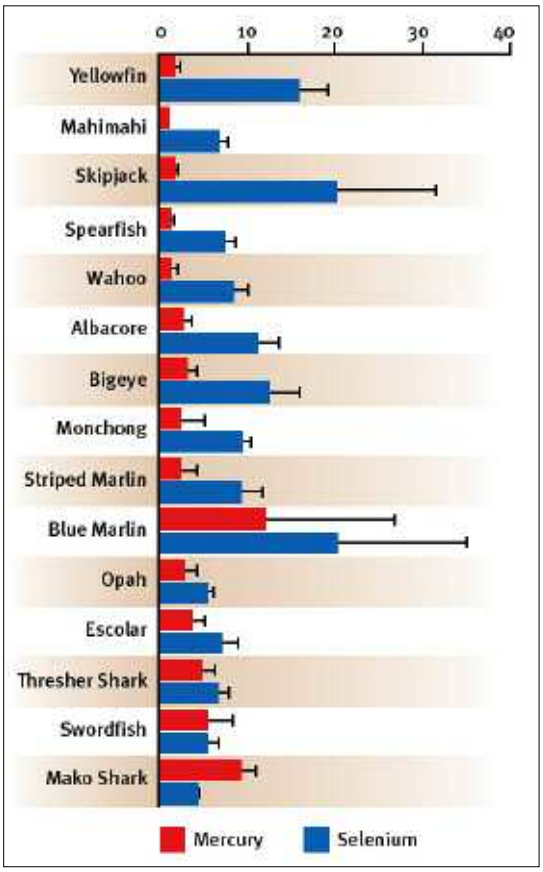
Selenium, an essential element in our diet, is vital to the body's antioxidant system and proper immune system function. It has anti-cancer effects and is known to detoxify metals including mercury. It has been shown to protect against mercury in every animal model tested.

If the ratio of selenium to mercury determines if a food is safe, what are the ratios in Hawaii fish? In a Hawaii Seafood Project study supported by NOAA, Dr John Kaneko of PacMar Inc. in Honolulu and Dr Nick Ralston of the Energy and Environmental Research Center in North Dakota analyzed selenium and mercury in 15 pelagic fish species caught near Hawaii.

Regardless of the amount of mercury, if the selenium level is higher, the fish is safe to eat. In the figure to the right, molar concentrations of mercury and selenium in 15 Hawaii fish species are expressed as means ± standard deviations.

They found that all of the tuna and billfish species and most other pelagic fish species contained an excess of health promoting selenium over mercury content. Mako shark was the only fish in the study that had more mercury than selenium. For this reason, most Hawaii fish are not only a healthy source of high quality protein and omega-3 fatty acids, they are also excellent sources of selenium. Our favorite fish are more likely to protect against mercury toxicity, than cause it. The good news for Hawaii seafood lovers: the selenium is in every bite!

Source: Pacific Islands Fishery News, Winter 2008
www.wpcouncil.org



DOES FISHING ON DRIFTING FISH AGGREGATION DEVICES ENDANGER THE SURVIVAL OF TROPICAL TUNA?

Biologists talk of an ecological trap when individuals of a species, behaving in response to misleading signs generally associated with a human activity, colonize a habitat, which might be inappropriate for their survival. An IRD team studying tropical tuna fisheries aimed to establish if the use of drifting fish aggregation devices (FADs), a technique employed increasingly for industrial-scale tuna fishery, could act as just such an ecological trap for these species. Comparison was therefore made of biological indices in two tuna species caught under drifting FADs with those of individuals fished in free-swimming schools.

Examination revealed that the tuna species caught from under the floating objects had less plumpness and were therefore less healthy than those taken from free schools. Results suggested that the tuna, in following the artificial rafts fishermen use, move away from their usual migration routes, which leads them into ecologically less appropriate waters, with scarcer food resources. The scientists recommend that a simple restriction on the use of drifting FADs near the coasts, where tropical tuna juveniles concentrate, would in the long term minimize the danger to the survival of these species.

Fishermen hold empirical knowledge that tuna aggregate under floating objects, such as lengths of old rope, pieces of wood, or even large marine mammals. There is still no full explanation for this aggregation behaviour, but the past 20 years have seen purse seine fishery operators take advantage of the associated concentrations of fish. Fishermen cast off floating rafts equipped with buoys which act as FADs. An enormous purse seine net, deployed in a wide arc on either side of the vessel, encircles the school of tuna that come to shelter under the FAD. The lower part of the net is tightened, enclosing the fish in a hemisphere large enough to entrap a mass of tuna.

A sudden growth in the size of tropical tuna catches taken from under these artificial drifting objects was observed for the early 1990s. This was true especially for juveniles. Between 1996 and 2005 the average annual catch taken on FADs reached 1,115,000 tonnes, nearly a third of the global figure for tuna, all species considered together. In Japan, the fish processing industry furthermore had long reported that the flesh from floating-object associated tuna was less plump than that of specimens caught from free schools.

This prompted an IRD research team to investigate whether or not the practice of drifting FAD fishing could set up an ecological trap for the tropical tuna species. This trap concept is a notion from population biology used to describe situations in which the population falls following a sudden change in its environment, most often linked to human activity. An example is give by marine turtles which, after hatching on beaches, use the sparkle of moonlight on the sea surface to guide themselves back to the ocean. However, high light pollution levels on urbanized coastlines in certain regions disturbs their sense of direction. Young turtles therefore set off on a path that leads them to land, where they die from dehydration.

Over the past ten years, over 30% of world catches of skipjack (*Katsuwonus pelamis*), bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacares*) tuna, the three tropical tuna species which can be caught at drifting FADs, have been achieved using this fishing method. For the skipjack amounts taken under drifting FADs reached even as high as 72% of all catches. To check if the large-scale deployment of drifting FADs could present an ecological trap for these species, a range of biological (fish plumpness, growth rate, stomach fullness) and ecological (migration pattern and distance) indices were determined on yellowfin and skipjack captured under FADs in the Atlantic and Indian Oceans.

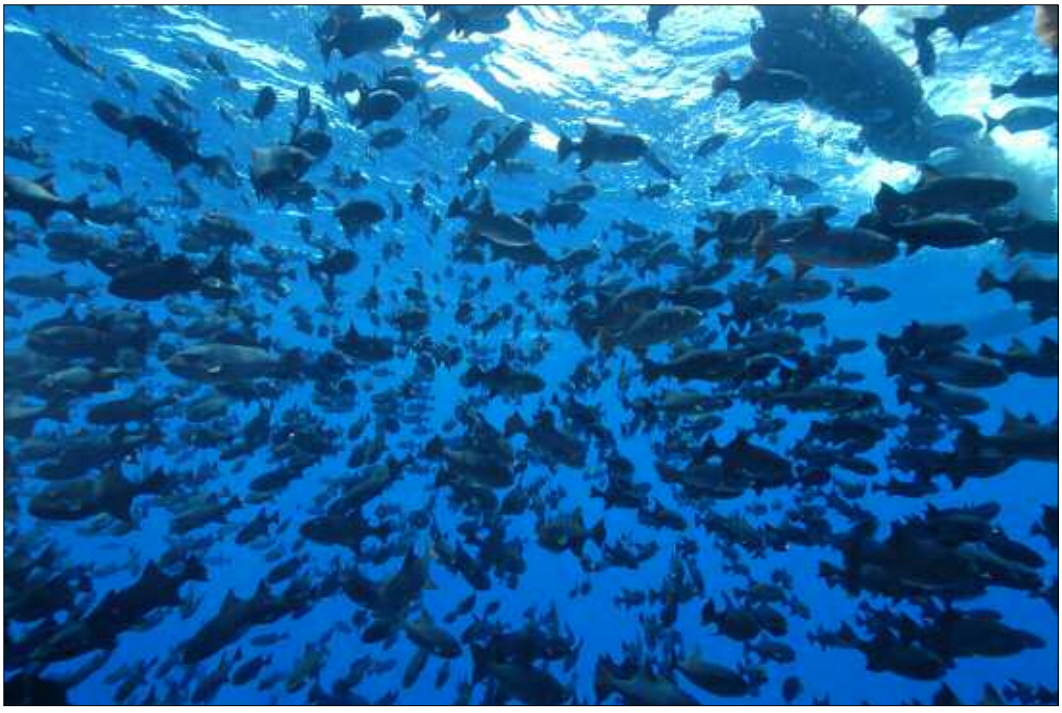
Comparison was then made with data gathered from free-school caught individuals of these same species. A salient finding was that 74% of drifting FAD-associated skipjack had empty stomachs at the moment of capture compared with only 13% for those fished from free schools. Figures of the same order of magnitude were obtained for yellowfin, with

Katsuwonus pelamis

proportions respectively reaching 49% caught on drifting FADs and 7% from free schools. The survey indicated that the tuna caught under the FADs fed less well than those fished from free schools. Moreover, the fact that for the same weight the FAD associated specimens caught showed lower plumpness than the free-school ones could reflect a deficiency in energy-reserve accumulation in those that concentrated around the floating devices. The research team also sought to find out if the large-scale deployment of drifting FADs could affect the migration patterns of these far-travelling fish species.

Tagging surveys allowed comparison of the nature of migrations accomplished by fish moving with the drift of FADs with that of non-FAD-associated individuals. The migration directions and displacement rates in terms of daily distances travelled were indeed affected by the presence of artificial floating objects. Drifting FADs therefore appeared to act as super-stimuli, like strong magnets exerting a binding attraction that leads the tuna towards ecologically inappropriate waters with scarcer food supplies. This survey brought support for a body of reasonable assumptions regarding the tuna behaviour. However, it did not provide certain confirmation of drifting FADs' negative impact on the entire life cycle of these tuna species and therefore of their possible role as a true ecological trap. Nevertheless, the biological effects observed indicated that it would be more reasonable to preclude deployment of drifting FADs near coasts where tuna juveniles aggregate. These young fish represent the future of the whole stock and such a restriction would be a way of avoiding their being led astray, away from the zones which are ecologically most favourable to them.

Source : IRD, Scientific News, Sheet 291, March 2008
www.ird.fr



Fish schools aggregate naturally under floating objects
© IRD - Ifremer/Fadio

NAURU NEARSHORE FAD PROJECT – POST-IMPLEMENTATION REVIEW

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In mid-2007, SPC's Nearshore Fisheries Development and Training Section helped the Nauru Fisheries and Marine Resources Authority (NFMRA) deploy seven simple inshore fish aggregating devices (FADs) in waters less than 320 m deep (SPC *Fisheries Newsletter* #121 – April/June 2007). These FADs, funded by Taiwan (ROC), have innovative mooring systems, using grapnels instead of concrete blocks, and can be deployed from small vessels. SPC also trained local fishermen in mid-water fishing methods and arranged for an Australian boatbuilder based in Kiribati to teach local boatbuilders how to construct small one- and two-person canoes using plywood and fibreglass. The canoes weigh only 40–65 kg, making them easy to launch and take out of the water, which is especially important in places where there are no launching ramps.

The main aim of the project is to improve food security in Nauru by giving communities easy access to pelagic fish. Other likely benefits include the potential to generate income through marketing the fish and reduced pressure on other inshore fishery resources.

To monitor the ongoing results of the Nauru project, about 30 fishers were given logbooks to record the size and location of catches and the disposal of the catch — whether it was kept, given away, or sold. NFMRA was charged with collating the data, conducting interviews with fishers to collect additional information, and forwarding the results regularly to SPC. Accurate monitoring of the project's results is important because it will show whether this relatively small investment in community infrastructure offers new and sustainable opportunities to boost long-term food security and improve livelihoods.

Seven months after the FADs had been put in place, Michel Blanc, SPC's Nearshore Fisheries Development and Training Adviser, returned to Nauru to review the results of the project to date with NFMRA staff.

On the positive side, feedback from local fishers was very encouraging. They considered that the inshore FADs had worked well and complemented Nauru's two offshore FADs. The FADs also provided good fishing opportunities for fishermen who did not have a motorised skiff. In Nauru, there are 40–50 motorised skiffs, only about 20 of which are used regularly, while around 70 canoes are actively used for fishing. In late 2007, NFMRA Chief Executive Officer, Charleston Deiye, commented that all the FADs had yielded fish and three had large mixed schools of rainbow runner, skipjack, frigate mackerel, yellowfin tuna and wahoo.

It was therefore doubly disappointing that a survey carried out as part of the review located only one of the FADs. Five FADs were confirmed to have been lost and the remaining one could not be located, though it may still be in place. Eyewitness reports from fishermen who had used the FADs indicated that they had stayed in place for periods of between four and six

KIR 7 one-man canoe.

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months. Reasons for the loss of the FADs included contact with motorised vessels ("the rope was cut off by a fisherman after it got caught in his propeller") and possibly top ropes being bitten through by sharks attracted to hooked fish entangled in the rope.

After discussions with NFMRA, it was decided to modify the various FAD designs to combat some weak points. Pressure floats will be added to the "all-wire mooring" FADs to increase the buoyancy of the flotation section. All new FADs, especially those deployed in higher traffic areas, will be equipped with markers to make them more visible to motorised vessels. The top polyester rope on the FADs will be shortened (10-m lengths were used, but only about one-third of the rope was covered with floats). The ropes will be cut to the exact length of the string of floats, which should reduce the risk of FAD loss due to shark bites, and will be covered by plastic tubing as added protection against abrasion.

These modifications are no substitute for regular maintenance, however, and the review recommended that NFMRA should secure resources, such as a fuel budget and snorkelling equipment, needed to carry out monthly inspections and maintenance of FADs. This will help prevent unnecessary losses and enable quick replacement if FADs are lost.

After the canoe-building workshop in May 2007, the four canoes that had been completed were shared between two communities. One community was making regular use of the two

Top: KIR 6 two-man canoe.

Middle: Construction jig for shaping the canoe hull.

Bottom: Canoe hull takes shape.

canoes it had received, while the other one appeared to be using its canoes less often because there were no easily accessible launching sites nearby and the prevailing wind conditions were unsuitable for fishing. No further canoes of the type demonstrated at the workshop had been built, though some materials and tools were available. However, canoe building seems to have become a regular activity on Nauru, with new canoes being made from flattened aluminium roofing sheets. In the longer term, the renewed popularity of canoe fishing is likely to result in more use of the FADs.

The review found that data on FAD catches had not been collected regularly, either from the logbooks or through interviews, at least partly because the Coastal Section of NFMRA did not have the dedicated resources, such as transport and a computer, needed to gather and enter the data.

There were limited data available, however, including NFMRA data on catch levels for different fish species from July to September 2007, and data on catches extracted from 15 logbooks at least partly filled out by fishermen. These data showed that during the four-month period between July and October 2007, catch levels at the nearshore FADs were twice as high as catch levels at the more traditionally fished mooring buoys outside the main harbour (4147 kg compared with 2038 kg) and were comparable to catch levels at Nauru's two offshore FADs (5373 kg). This shows that the nearshore FADs worked well and that local fishers quickly capitalised on their introduction to Nauru.

The market value of catches made at the nearshore FADs from July to October 2007 was estimated to be around AUD21,619. The total cost of one nearshore FAD was AUD2100, which meant the value of catches at the nearshore FADs was equivalent to the cost of 10 of the FADs. Considering that seven FADs were deployed in Nauru, and that the actual level of catches was likely to have been much higher than the estimates given above, the review concluded that the nearshore FADs tested by SPC and NFMRA were cost effective.

There were no data on the disposal of catches, so the contribution of the FADs to improving livelihoods could not be estimated.

Despite the loss of at least five of the FADs, and the problems in regular collection and collation of data, the project has been a positive demonstration of the value of deploying easily accessible nearshore FADs. Fifteen recommendations were made as a result of the review. They include modifying the design of the FADs, rapidly replacing lost FADs, ensuring that all FADs are deployed in locations that are easily accessible by canoe fishers, promoting canoe building through the establishment of a revolving fund, improving data collection systems, and setting up a scholarship to enable a local postgraduate student to be based on Nauru for a year to collect and analyse daily catch data.

Canoe safety checklist card.

The development of a small-scale tuna fishery in Nauru fits well with the NFRMA's strategic direction and SPC, through its Nearshore Fisheries Development and Training Section, is ready to provide continuing technical assistance and advice on the FAD project.

An additional benefit of the project is that it provides a model for other Pacific countries and territories to follow. Considerable interest has already been expressed in its progress to date, especially in relation to the potential of nearshore FADs to improve food security for vulnerable communities.

A workshop participant with an 8 kg tuna caught using the scatter bait method.

UPDATES ON POST-LARVAL FISH CAPTURE AND CULTURE TECHNOLOGY TRANSFER BETWEEN COOK ISLANDS AND FRENCH POLYNESIA

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The last issue of the *Fisheries Newsletter* contained a description of the first set of post-larval capture and culture (PCC) experiments that were run in the Cook Islands. These experiments were made possible, thanks to technical input of experts from French Polynesia and financial support from the French Pacific Fund. This article describes the Cook Islands Ministry of Marine Resources (MMR) staff training on Bora Bora. Training took place on a farm where PCC activities have been developed to a semi-commercial level. Some of the results of the sampling performed in Aitutaki from November 2007 to March 2008 are presented here.

PCC training — Bora-Bora, French Polynesia

François Chevalier, manager of Bora EcoFish (BEF), and his two employees Corentine Favre and Alain Bigot (both certified aquaculturists) operate a small PCC-based aquaculture farm. BEF has been operating since 2006 and endeavors to supply ornamental fish captured with hoa nets to the global market. BEF also advises hotels that have artificial lagoons.

BEF has agreed to pass on some of its technical knowledge to its Cook Island counterparts (Koroa Raumea, Director of Inshore Fisheries and Aquaculture, and Richard Story, Aitutaki Marine Research Center manager), and to serve as a training station for one week. During this training, trainees were shown all of the activities involved in running an aquaculture facility based on PCC.

A busy schedule

At the beginning of the training, BEF technical staff gave a guided visit of the farm to Cook Island trainees. The main building has individual areas for live prey, sorting, quarantine, and a range of aquarium racks for grow-out and nursery. Filtration units are kept outside. There is a small greenhouse with several grow-out tanks used for fast growing or larger fish species, and there is also an innovative rack of floating cages in front of the farm.

It was full moon during the training so catches were fairly low, mostly small numbers of triggerfish and cardinalfish that had been trapped by the hoa net. Trainees were involved in the daily harvesting of the nets at the hoa (reef channel), 10 minutes from the station.

Cook Island trainees also had the opportunity to work on the floating cage system where they cleaned, fed, inspected and repaired the nets, all of which are routine activities for cage culture. Species of acanthurids, carangids and holocentrids have been growing out in the cages for one year. Some, such as trevallies and to a lesser extent large surgeonfish, are showing very good growth rates in cage culture conditions, and fed on artificial diets.

Feeding fish with pellets and live prey (Artemia) was demonstrated during the training. Artemia incubation and cyst hatching was thoroughly explained using BEF hatching tanks. This is an area that created much interest among Cook Island trainees as

Feeding the fish at Bora Ecofish floating cage system.

they had never worked with live zooplankton before.

Farm management was also explained and demonstrated (i.e. recording mortality, siphoning tanks, removing unconsumed feed, and adjusting feeding rates accordingly). Backwash from the sand filter was demonstrated and done on a daily basis.

All of these various processes were performed by Cook Island trainees after demonstration. As a result, harvesting post-larvae in the net, sorting fish, managing tanks, producing live prey, and feeding the fish are now familiar activities to the Cook Island trainees.

Visits to Bora Bora's lagoon hotels

One of Bora Bora's assets is its high-end tourism industry. Most hotels have large facilities with over-the-water bungalows and environmental activities for tourists. Lagoon restocking and building artificial reefs are a tourist attraction and helps stock the artificial lagoons faster. BEF works with hotels on environmental projects such as producing artificial reefs (coral frags, PCC fish and soon farmed giant clams).

To date, BEF has serviced a large hotel and are in the process of undertaking some work at the Meridien Hotel where they will provide a "reef enhancement package" that

Richard Story, AMRC station manager's views on the training:

"The training was helpful, especially with Artemia culturing, which I've never done before. Just being there and looking at simple but efficient setups gives me a better picture of what it takes to venture into a PCC operation."

"It was a pity that there weren't many fish to work with during that period. Also, some of the things I thought should have been explained in more detail were marketing ornamental fish, packaging and transportation of fish, maintenance and repair of specific equipment (e.g. crest nets). Also, what are the criteria for identifying high value food fish species?"

Koroa Raumea, MMR director's views on the training:

"As the director responsible for similar research development in the Cooks, it was useful for me to actually assess how other countries are managing and implementing such projects."

"I was quite fascinated by the fact that some of the fish were being grown in sea cages, and that we were able to sample (eat) some. Rearing fish for food is a great opportunity if fish fry can be collected easily. If this is successful on a larger scale, then this can be most appropriate for the Cooks, especially when most of the reef fish are ciguatoxic."

"Overall, the training was good, although it was a shame that there was so few fish being trapped by nets during the training period. Other aspects of the training (e.g. farm maintenance, feeding, etc.) were fine. A lot of what I learned will have direct application in the Cook Islands, and we believe that food fish will soon be a priority for the country."

includes the following concrete structure for corals and fish settlement; settling farmed corals, fish and clams; mangrove planting to stabilise the shores of the artificial lagoon; and follow-up maintenance.

Catching and raising post-larval fish for export was the initial goal of BEF. Nowadays, however, it appears that the company is working towards developing staff skills in environmental consultancy and coral garden installation and management for Bora Bora's tourism industry.

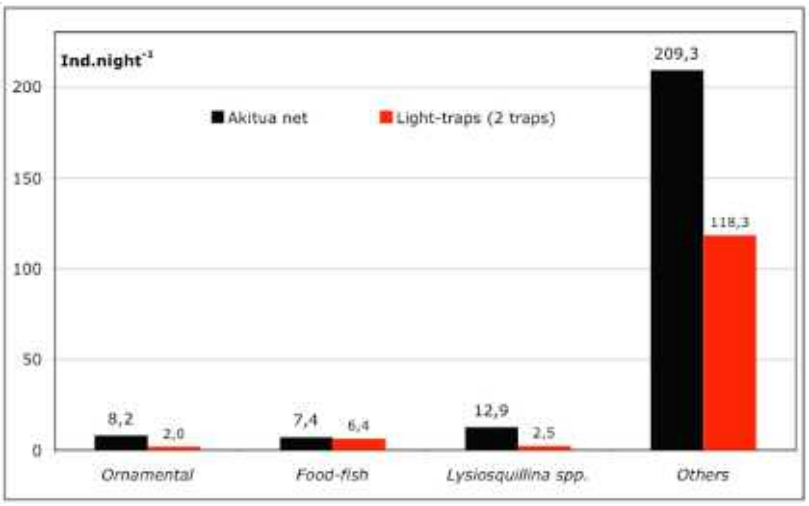

Figure 1: Average number of fish caught by traps (hoa net /light traps), based on five months of sampling in Aitutaki. Fish are classified by categories (ornamental, food fish and others) and the average number of mantis shrimp (*Lysiosquillina* spp.) is also recorded.

PCC trials — Cook Islands

Sampling results

For five months, Richard Story and his staff have been collecting post-larval fish, using the sampling design established at the start of the project in November 2007. Two light traps moored outside Aitutaki's main pass and one hoa net deployed in Akitua Channel, were used to fish five days before and after the new moon of each month between November and March (and currently ongoing). Data were entered into the computer on a daily basis during the sampling period.

In March 2008, Emmanuel Malpot from Aquanesia Consulting and myself took a trip to Aitutaki to work alongside AMRC staff for on-the-job PCC training. The aim of the trip was to finalise the five-month sampling, prepare data for analysis, and develop (together with MMR) plans for future development that should be undertaken.

During this mission, the light traps yielded better catches than the crest net. It was the first time since the initial trials in November 2007 that the light traps yielded better catches than the crest net. However, even if the overall catch was reasonably high (>120 post-larvae/trap/night), the percentage of commercial species remained low. Figure 1 shows that an average of 3.4 specimens of commercial interest for the ornamental trade[1] were caught per night per trap, and 4.6 specimens of commercial interest for food[2]. This accounts for 6.5% of the total catch for fish only.

An interesting finding is the relative abundance of varo (*Lysiosquillina* sp.), which has been recruited in all three traps, and constitutes (4.2% of the catch from the light traps. Varos fetch high market prices, and show good growth potential in captivity and seem to be recruiting consistently in Aitutaki.

Conclusions

Overall, the trial was successful and AMRC staff are fully autonomous in carrying out sampling, sorting, identification and grow-out of target species. The results of the study make it possible to draw conclusions about the potential of PCC after five month of sampling in Aitutaki within the limitation of the sampling design:

- It will be difficult to develop a profitable business for aquarium fish based on this technique because of the highly variable recruitment patterns of ornamental species and their overall low abundance;
- Varo recruits relatively abundantly and seems to be a species of interest for Cook Islands;
- The strongest interest formulated by the Cook Islands MMR was for cage culture of food fish.

These conclusions are discussed further in the next section of this article.

[1] Ornamental species are those found in the aquarium trade (e.g. surgeonfish, butterflyfish, boxfish, triggerfish), and which have a minimum export value of USD2–3.
[2] Food fish are those that exhibit good growth rates and can be raised in captivity commercially.

Where to from here?

Given the catch composition, ornamental fish do not appear to be a viable option. Several consultations with a Rarotongan-based aquarium fish exporter made us think that the sale of PCC products (even if in sufficient number and size) will not be viable. The demand for fish from the Cook Islands is very specific and targets high value and rare species such as longfin anthias, Scott's wrasse or flame angels. Therefore, PCC activities should not focus on ornamental fish in Aitutaki.

Varos seem to be an ideal aquaculture candidate for the tourism and restaurant trade. Further efforts should focus on developing culture techniques, such as ranching, in the northern soft bottom part of the lagoon, and understanding their recruitment patterns.

With declining reef fish stocks, the increasing demand for fresh fish by the tourism industry, and the high incidence of ciguatera, fish farming is of great interest in the Cook Islands. Further trials should be carried on developing low cost, small- to medium-scale fish farming in Aitutaki Lagoon.

Due to the relative reliability of PCC techniques, other local sources of fingerlings should be identified.

Milkfish, rabbitfish and mullet fingerlings are known to recruit in high density during the summer months. Capture-based aquaculture trials using these wild fingerlings could be of interest for Cook Islands. Should these trials be successful and show signs of profitability, then MMR should consider the importation of fingerlings in larger numbers, bearing in mind the risks associated with the translocation of aquatic animals. In a much longer run, finfish could be fully aquacultured in Cook Islands, following the development model of rabbitfish culture in the Pacific.

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First record of *Acanthurus achilles* post larvae caught by light traps in Aitutaki.

JICA COURSE ON COMMUNITY-BASED FISHERIES DIVERSIFICATION IN PACIFIC ISLAND STATES (FIJI STUDY)

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The 2007 Japan International Cooperation Agency (JICA) course on "Community-based Fisheries Diversification in the Pacific Island States (Fiji study)" took place in Japan and Fiji. The course covered a broad range of fisheries related studies, including fisheries diversification, community fisheries management and social development, coastal fisheries resources and management, aquaculture, interaction of tourism and fisheries, sub-surface FAD construction and deployment, basic fish aggregating device (FAD) fishing methods, and a tour of case study areas around Fiji. This course was the second of three phases to be implemented over a three-year period. The first phase — implemented in 2006 in Okinawa, Japan — provided participants with the opportunity to examine and apply Japanese experiences and techniques relating to the sustainable use of fisheries resources. The second phase (implemented in 2007) commenced in Okinawa for two weeks and then continued in Fiji for five weeks. Participants gained an idea of the differences in fisheries development between Japan and the Pacific region, which helped to identify, select and propose suitable measures and directions towards the sustainable use of fisheries resources in their island countries.

Because the Secretariat of the Pacific Community (SPC) has done considerable work on fisheries development in the Pacific region, JICA sought SPC's input in two areas: community fisheries management and FAD development. SPC's Coastal Fisheries Management Officer, Etuati Ropeti, discussed community fisheries management, while FAD development was covered by SPC's Fisheries Development Officer, William Sokimi, who authored this article.

Eight participants attended the 2007 (phase II) course. The preferred approach was to have the same participants attend the course throughout the three phases although this was not possible in some cases as in-country commitments and personal developments prevented some participants from attending.

The 2006 course was attended by one participant each from Fiji, Nauru, Palau, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, and Vanuatu, and two from Samoa. In 2007, participants from Nauru, Palau and Tuvalu, and one from Samoa could not attend. The 2007 participants (who also attended the 2006 course) were Tekata Toaisi, Fiji; Ferron Kolose Fruen, Samoa; Lionel Luda, Solomon Islands; Sione Tuimoala Mailau, Tonga; Graham Nimoho, Vanuatu; and Ephraim Ridley, Papua New Guinea. Two new participants joined the 2007 group: Candice Guavis from the Marshall Islands and Peter Louis Logomina from Papua New Guinea.

Course objectives

Course objectives for phase II included:

- Expose various management and diversification methods in Okinawa's fisheries sector, such as FAD fisheries, aquaculture, tourism, etc.
- Identify possibilities and constraints in applying Okinawa's scenario to the Pacific region.
- Identify actual situations, issues, and possibilities faced by the fisheries sector in Fiji, which is similar to the situation faced by other Pacific Island countries.
- Prepare presentations for an action plan relevant to the development of fisheries in each participant's island state.

Activities

Prior to the course, a subsurface FAD was constructed by JICA's sub-surface FAD adviser with assistance from Fiji's Fisheries Department staff member Sailosi Drili. A second sub-surface FAD was constructed, engaging the author and course participants in all facets of the operation. The plan was that as soon as the two subsurface FADs were completed, they would be deployed in two different locations on the same day. The design and construction method was led by Takayuki Kai, JICA's course adviser on subsurface FADs. The course leader was Hideyuki Tanaka of JICA Fisheries and Aquaculture International Co., Ltd., with the author assisting in coordinating participants in carrying out the actual construction work on the second subsurface FAD, and leading the loading and deployment of the FADs.

Subsurface FAD constructed and deployed in Fiji

The Fiji sub-surface FAD has three sections. The top section consists of a cylindrical cage 1 m in diameter X 1 m in height to hold ten 360 mm hard plastic pressure floats that make up the flotation section. The middle and bottom sections are two more cylindrical cages but are 1 m in diameter x 2 m in height. The top of the flotation cage was shaped with a circular vinyl pipe 30 mm X 1 m diameter. Three 20-mm metal rings were used as the floor of each cage, acting as a weight to keep the cages from collapsing. Cage nets were constructed from 8 mm polypropylene rope with a net mesh of 300 mm.

Participants were divided into three groups, with each group constructing one section of the FAD. Although it was the first time that most participants constructed a FAD, they took to the work well. At the end of the first day, three quarters of the flotation section was completed (Figs. 1 and 2).

At the end of the second day, the three sections were completed but were kept separated while the individual hard plastic buoys were fitted with a layer of netting to prevent them from knocking into one another while in the cage. On the third day, all sections of the sub-surface FAD were connected and adjustments were made where needed (Fig. 3). Meanwhile, the 24 strand, 22 mm polypropylene

Figure 1 (top): Sub-surface FAD construction.

Figure 2 (middle): Sub-surface FAD section almost complete at the end of day 1.

Figure 3 (bottom): FAD constructed and ready to be loaded on the deployment vessel.

mooring ropes were uncoiled, spliced and flaked ready for stretching. The next day the mooring rope was stretched using a forklift. Depth marks were placed on the rope every 100 m for the first 400 m, and every 10 m thereafter. The rope was then reflaked and the FAD was prepared for transfer to the deployment vessel. A group was assigned to prepare the FAD anchors, which were constructed from reinforced cement, and weighed 1600 kg each.

Robert Smith, senior adviser on marine geophysics at the Pacific Islands Applied Geoscience Commission (SOPAC) presented SOPAC's work in using multi-beam surveys and mapping, and the application of maps to FAD deployment. Sam Zinck, a local fisherman, was consulted on his use of the previous FADs and the effectiveness of the locations for local fishermen. Sam and Robert were asked to assist in selecting two sites for deploying the newly constructed FADs, preferably in depths between 400 m and 500m, and up to 3 nm from the reef breakers.

The author gave a presentation on recent development of FADs in the region, highlighting the new Indian Ocean type FAD constructed with pressure floats, deployment of FADs in Papua New Guinea, and the deployment of inshore FADs in Nauru for a canoe fishing project.

FAD DEPLOYMENT

The two sub-surface FADs and moorings were loaded on the Fiji inter-island government freighter M/V *Tabusoro* (Fig. 4). The FADs were positioned with one on each side of the vessel and the ropes flaked to ensure smooth deployment (Fig. 5). It would have been preferable to have the anchors rigged and ready for deployment on a tilting platform as recommended by the author, but since this was the first time the vessel's skipper performed this type of operation, he preferred to have the anchors sitting securely on the deck and lifted for deployment at the required time. The tilting platform would have guaranteed immediate deployment of the anchors at the designated time and reduce risk factors that might arise from using the derricks. When a heavy weight is lifted out over the open sea, the centre of gravity for that weight moves to the far end of the derrick, creating a potentially unstable condition for the vessel as a whole. There is also the danger of the anchor swinging out of control due to the vessel's pitch and roll motion caused by swell. Fortunately, the sea was reasonably calm and the deployments went well, except for slight delays in getting the anchors overboard and some apprehension when the anchors were lifted.

Figure 4 (top): Loading the FADs on to the vessel FV *Tabusoro*.

Figure 5 (bottom): Transporting the FAD to the deployment sites.

The first FAD was deployed at 18° 13.992′ S and 178° 27.425′E in 500 m depth, approximately 2 nm from the sandbank next to Nukulau Island. The second FAD was deployed at 18° 13.787′S and 178° 18.878′E, approximately 2.5 nm from Naqara Passage also in 500 m depth. Robert assisted in marking the spot where the FADs were to be deployed. Two Fiji Fisheries Department staff checked the submerged depths after FAD deployment. SOPAC's equipment was rigged on a chartered vessel from the Suva Yacht Club. The vessel drifted above the deployment position to mark the deployment site and later record the depth and final settling positions of the FADs (Fig. 6).

The first FAD was successfully deployed. This was measured by a marked pilot line that ran from the submerged FAD to the surface. The second FAD, however, did not submerge, although the mooring section was rigged for 460 m (Fig. 7). A check of the deployment site after the FAD had settled confirmed that the site was in fact 510 m deep.

During the end-of-day debriefing, it was determined that the reason the FAD failed to submerge, even though the mooring section was rigged shallower than the deployment depth, was because of the elongation percentage of the polypropylene mooring rope being more than what had been calculated. Although this was considered in the calculation for a stretch of up to 8.7%, the rope stretched more than this. This was probably because the rope for this FAD was stretched by a forklift instead of by hand, as was done for the first FAD. Because the flotation section had a buoyancy of 242 kg, the rope should only have been stretched to this limit or slightly less. This was a good point to take note of for future sub-surface FAD moorings.

Figure 6 (top): Streaming the FAD mooring while the SOPC vessel marks the deployment site.

Figure 7 (bottom): FAD floating on the surface instead of submerging.

Correctional plans were made for the Fiji Fisheries Department staff to return with 4 x 50 kg cement weights, and to attach these gradually to the FAD until it submerged to a depth where the water pressure would assist the buoys in bearing the surface displacement of the weights. As long as the buoyancy properties remain higher than the sinking properties, this should not be a problem. However, the heavier the weights added, the deeper the subsurface FAD will settle.

It is hoped that the sub-surface FADs will be of benefit to local fishermen and that they develop the skills to work with these types of FADs. The subsurface FADs have several advantages to surface floating FADs. They sit at a depth of at least 20 m below the surface so that transiting ships do not hit them.

Also, their inaccessibility prevents vandalism, and the deeper they sit beneath the surface, the less chances they have of being exposed to surface forces that place heavy stress on surface floating FADs. Studies of sub-surface FADs in Okinawa have proven that these FADs have as good an aggregating quality as surface FADs. However, because it they are underwater, it is difficult for banana boat fishermen to know the location of the FADs without a GPS. To actually sight the sub-surface FAD, fisherman will also need an echo sounder or sonar. Sonar would be handier as it has side-scanning, whereas an echo sounder needs to be directly over the FAD in order to spot it on the screen. Regardless of whether it can be seen or not, fishermen are concerned with whether or not there are pelagic schools aggregated in the vicinity of the sub-surface FAD to provide them with sufficient catch to make their trip cost effective and worthwhile.

THE POHNPEI, FSM EXPERIENCE AT SPC

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It is uniquely enriching to witness first hand, the work of the Secretariat of the Pacific Community (SPC). In our short attachment with the SPC Coastal Fisheries Management Section, we found the many people who are dedicated to serving the Pacific community through SPC extremely helpful. SPC attracts the elite and the best of the Pacific, thus creating a truly exemplary Pacific community at the Noumea, New Caledonia regional office. SPC also attracts many accomplished people from around the world, making its staff composition a unique world community.

Our experience with SPC goes back to May 2007. The State of Pohnpei (SoP), through the FSM Foreign Affairs Office, requested assistance from SPC in developing viable programmes and fisheries management plans that would promote the sustainable management and utilisation of coastal fisheries resources. References were made to the following key areas:

- Undertaking a preliminary study to determine how such management plans may be developed.
- Assessing the level of resources available within the SoP, at both the government and community level, with particular attention to personnel and finance.
- Making recommendations as to how the management of the local pearl industry might be facilitated by local communities.
- Providing assistance for the future management of inshore fisheries.
- Presenting the findings of the preliminary study to the state government at the end of the assignment.

A preliminary study was undertaken by SPC's Coastal Fisheries Management Officer, Etuati Ropeti, in July 2007. The main purpose of the study was to assess the resources available at the SoP Fisheries Authority to implement the programme, and most importantly, to provide key recommendations for the establishment of a management programme for Pohnpei's coastal fisheries resources. Findings of the preliminary study were presented at the end of the assignment to SoP authorities, non-governmental organisations (NGOs) and community representatives from Pohnpei's municipalities.

One of the recommendations from the preliminary study was to conduct a workshop on the community ecosystem-based fisheries management programme (CEbFMP). The workshop was carried out in October 2007, and participants included personnel from SoP's fisheries and agriculture offices, NGOs, and representatives from municipal governments.

On behalf of Pohnpei's communities and our people, we would very much like to acknowledge SPC's Director-General, Dr Jimmy Rodgers, for his empowering support, especially our efforts to equip our communities with tools to achieve sustainable coastal fishery resource management, which is a challenge across the Pacific. We also recognize Lindsay Chapman, SPC's Coastal Fisheries Programme Manager, and Ueta Faasili, SPC's Coastal Fisheries Management Adviser. Most of all, we wish to thank our facilitator Magele Etuati Ropeti for his outstanding commitment and hard work in working with Pohnpei to chart a Pacific community solution through the CEbFMP framework. Lastly we extend our sincere thanks to Nicole Milot, SPC's Travel Officer and others who worked behind the scene to facilitate this attachment with SPC.

The Lirorohki Pohnpei Sarawi model produced through this attachment recognises our communities' roles and their voices in the management of their marine resources. The guidelines presented in this model are a combined partnership between communities, government, NGOs and other relevant stakeholders. For the first time, coastal and inshore fishery management in Pohnpei has a draft model that will be beneficial to the management of our coastal resources. This model represents the foundation for sustainable resource management while fully recognising the vital roles of our communities and placing them in the "driver's seat".

Lirorohki refers to revitalising traditional resource management practices that served people well in the past. The word Sarawi has several meanings: respect, care, and that the concept that people are the proud stewards of their land and sea and should protect and preserve it at all cost through an ancestral declaration. Deeply rooted and a cornerstone in our culture, wahu means immense respect for life in order to perpetuate peace and unity in our Pohnpeian way of life.

Unique among similar CEbFMP models in the region, the Pohnpei model achieved a unified government and NGO partnership. At every step during the development of the model, staff from the Pohnpei Division of Marine Development and the Conservation Society of Pohnpei worked closely together.

Having developed this model, it is in the best interests of Pohnpei and other FSM states to actualise this programme at the community level and to provide the necessary resources and technical support to make it happen. Equally so, SPC can play a significant support role to see this programme through by commiting resources (both technical and financial) towards developing community capacity and alternative income generation strategies (e.g. FADs). We do however caution that meaningful results can only be achieved with a long-range view, and can not be treated as a "quick fix" solution. A plan is the essential first step, but it takes commitment, resources and more to achieve this vision.

From this attachment, it is encouraging to learn that SPC is taking serious steps towards strengthening partnerships with NGOs. Already, strong partnerships are being developed in the north Pacific region between NGOs and government entities, and it would be highly productive for SPC to recognise this evolution and align its programmes accordingly. Case in point: the five Micronesian jurisdictions — FSM, Palau, Republic of the Marshall Islands, the Commonwealth of the Northern Mariana Islands and Guam — have agreed to place under effective conservation, 30% of their nearshore marine resources and 20% of their terrestrial resources. This is truly an unprecedented initiative, unifying the Micronesia region with high NGO participation and support. Micronesians in Conservation (MIC) is a unique leadership network of NGOs that are highly focused on building leadership capacity.

The Locally Managed Marine Area (LMMA) network focuses on community issues and needs, the Pacific Islands Marine Protected Areas Community (PIMPAC) focuses on training mid-management level NGO staff in best conservation management practices, such as site management plan development, with an emphasis on marine protected areas (MPAs). Furthermore, conservation NGOs operate in each Micronesian jurisdiction to support government partners. The Conservation Society of Pohnpei, which has been in service for 10 years, has contributed significantly to resource management and conservation (both terrestrial and marine) through its innovative education and awareness approaches.

SPC has much to offer in terms of technical capacity development and should acknowledge the exciting, strong NGO partnerships that are forming. There is considerable capacity within NGOs and governments that could be used by SPC, thereby minimizing travel costs for SPC staff, while at the same time supporting capacity development for SPC's northern partners. Furthermore, the recent joint SPC/FSM strategic plan would serve as a good fresh start for FSM and SPC to move forward together, a step that supports the true needs of communities in FSM.

To conclude, the Pohnpei attachment would not have been successful without the generous support and partnership of SPC, in particular the Coastal Fisheries Management Section section. Ueta Faasili and Etuati Ropeti are dedicated to serving Pacific Island communities, and both have a profound knowledge and dedication to charting a sensible course for coastal fishery resource management.