



Fisheries

Newsletter

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Editorial

Welcome to this issue of the *Fisheries Newsletter*. A two-day workshop to discuss ecosystem approaches to coastal fisheries and aquaculture was held in Noumea, from 29 to 30 October 2007.

Most countries and territories in the region have committed to apply ecosystem approaches to the management of their islands, coasts and oceans by 2010 under the Implementation Plan of the World Summit on Sustainable Development. Several models have been developed for implementing the Ecosystem Approach to Fisheries, but no one model fits all situations, and the inclusion of aquaculture introduces additional issues.

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**Participants to the regional workshop on
implementing the Ecosystem Approach to
Coastal Fisheries and Aquaculture, which
was held at SPC's headquarters, Noumea,
New Caledonia, from 29 to 30 October 2007.**



■ 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) concluded fieldwork in the Cook Islands. The annual PROCFish/C and CoFish Advisory Committee meeting was held in Noumea on 28 October 2007. The first of several scheduled socioeconomic workshops was also held. In addition, the Live Reef Fisheries Specialist was involved in several projects during the second half of 2007.

Fieldwork and surveys in the Cook Islands

Finfish, invertebrate and socioeconomic surveys were conducted in two locations in the Cook Islands (Mangaia and Rarotonga) in October 2007 (see Fig. 1). The PROCFish/C and CoFish team comprised Emmanuel Tardy and Ferral Lasi (invertebrates), Ribanataake Awira and Pierre Boblin (finfish), and Mecki Kronen (socioeconomics). The PROCFish/C and CoFish team acknowledges and thanks the following people who assisted and/or worked with the team at one or both locations: Ian Bertram, Secretary for Fisheries; Koroa Raumea, Head of Coastal Fisheries Section; counterparts from the Cook Islands Ministry of Marine Resources, Ngatamaroa Makikiriti and Dorothy Solomona; boat operators and guides at both locations; Jo Akroyd, Cook Islands Marine Resource Institutional Strengthening Project; the Island Secretary and Mayor of Mangaia; and the elders, community members, fishers and people from the two sites surveyed.

MANGAIA

Mangaia is 194 km southeast of Rarotonga and is the southernmost of the Cook Islands, situated on the border with French Polynesia. After Rarotonga, Mangaia is the second largest island, at nearly 52 km² in area. Surrounding Mangaia is an ancient raised coral reef that rises steeply from the shore before dropping sharply to the island's interior. Because it is a raised limestone island, Mangaia has only one reef type, the outer fringing reef, which surrounds the island. Mangaia has three main villages: Ivurua on the east-

ern side, Tamarua on the southern side and Oneroa on the north-western side of the island. The island administration centre is based in Oneroa where the main hospital and port are located.

On Mangaia, finfish fieldwork concentrated on the northern, western and southern parts of the island. The team was unable to work on the eastern (windward) side of the island due to strong winds and rough seas, and because of the small size of the workboat, which was unsafe to use in these weather conditions. The Secretary of Marine Resources asked the survey team to include the Mangaia port area as one of the survey stations in order to provide an ecological profile of the site for their harbour expansion project.

The finfish survey covered the outer fringing reef and included

18 transect dive stations. Coral coverage was very poor on the outer reef, and the number of sea urchins on the western side of the island was very high, exposing clean coral slabs to heavy grazing. The benthic profile of all dive stations on the western side of the island showed that the level of encrusting algae and turf was very low and the rock slabs were just bare rocks. Coral coverage ranged from 2–5% on the western side, with encrusting corals being the predominant type at most stations. Coral coverage slowly increased to 10–20% from the southern to the eastern part of the island.

The same trend was also observed with fish density, which was very low on the western side and gradually increased when moving around the southern point towards the eastern side of the island. This

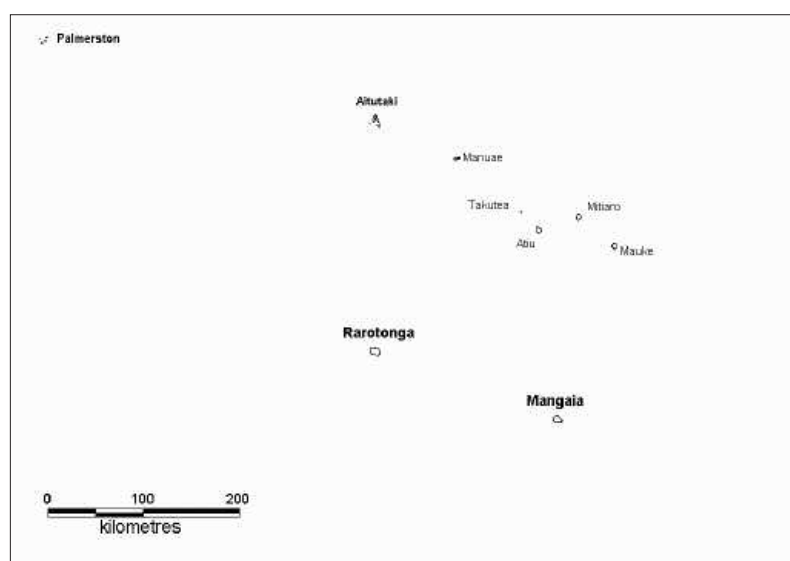


Figure 1: The two survey locations, Mangaia and Rarotonga in the southern Cook Islands.

might be attributed to the fact that the western side of the island is more exposed to heavy fishing than the eastern side. As with fish density, the size ratio was very low with respect to sought-after fish species such as snappers, groupers and emperors. However, fish species such as some acanthurids and scarids (e.g. *Ctenochaetus striatus*, *C. hawaiiensis* and *Scarus forsteri*) were quite large compared with other sites surveyed in the region. The most common fish species observed at all stations were from the surgeonfish and parrotfish families, with *Acanthurus leucopareus* being the dominant fish species encountered. Overall, fish density as well as diversity was poor, especially in areas that were more accessible to spearfishing. This was noted by the fleeing behaviour of parrotfish encountered on the western side of the island.

Socioeconomic surveys were conducted with 39 households on Mangaia. Initial results indicate that the lifestyle of Mangaia's population is very much determined by the island's size and geographical isolation, small population, and limited options for generating income. Thus, it is no surprise that 92% of all households surveyed are involved in some kind of fishing activity. On average, each household has about two members who fish or collect marine resources on a regular basis. Mangaia has a very small lagoon and an accessible outer reef system that directly leads into the open ocean. Mangaia's reef resources are not affected by ciguatera.

Although the island has some agricultural potential, seafood consumption on Mangaia is rela-

tively high with an annual average per capita consumption of 65.7 kg of fresh fish and 7.7 kg of invertebrates. The island's isolation and the high transportation and marketing cost make it impossible to export agricultural or fisheries products to Rarotonga. Past agricultural projects, including pine forestation, pineapple plantations and ostrich farming have all failed, mainly due to transport costs. Primary production on the island is, to a great extent, subsistence oriented and the exchange among community members and families is often non-monetary. Thus, government jobs (Fig. 2) and a limited number of tourist activities are the major income sources on the island.

On Mangaia, fishing activities are limited to the island's own demand, as there is no commercial export from the island to Rarotonga or any other market place. Although most fishing activities are subsistence oriented, some fish and invertebrates are sold locally. The limited involvement in commercial fishing is also indicated in the low average annual catch per fisher of 120–130 kg. Based on fisheries survey respondents and households interviews, there may be 45 fishers who target the very small lagoon habitat, and 162 fishers fishing at the outer reef from the island's 180 households. Gillnets, spears, bamboo rods (Fig. 3) and cast rods, handlines and castnets all are used.

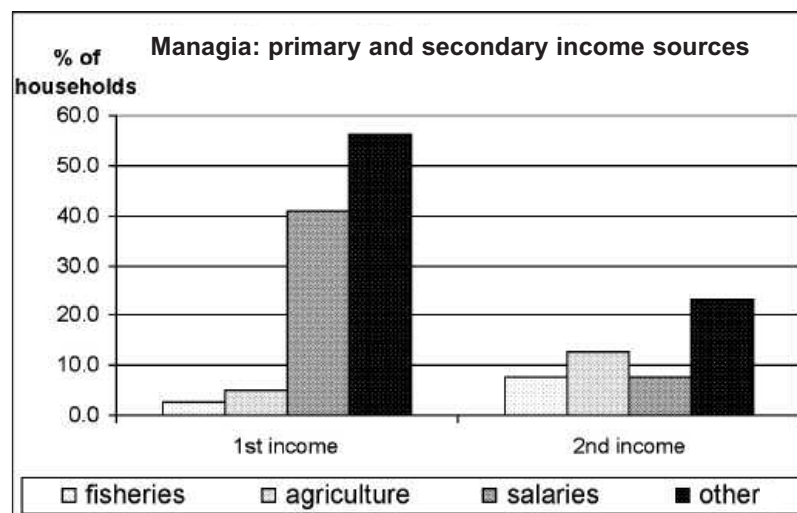


Figure 2 (top): Primary and secondary income sources (%) for households on Mangaia.

Figure 3 (bottom): Young man fishing with pole and line inside reef pool.

Tiotio (*Kyphosus cinerascens*) is the most targeted species in the lagoon area, while tiotio, paoro (*Thalassoma* spp.), marao (*Myripristis* spp.), karakarao (*Epinephelus merra*) and patuki (*Epinephelus hexagonatus*) are major target species of outer reef fishers. It should be noted that the subsistence catch of reef and lagoon fish on Mangaia does not meet the island's subsistence demand. The balance is met by the catch of a few pelagic fishers.

About 25 fishers exclusively target lobsters, and almost 200

fishers collect invertebrates on the island's reeftop. Reeftop gleaners target mainly maturori (*Holothuria* spp.), paua (*Tridacna maxima*), ungakoa (*Dendropoma* spp.), atuke (*Heterocentrus marmillatus*), several species of sea urchins and crabs, octopus, and the seaweed rimu.

Mangaia's particular geomorphology forced the invertebrate team to adapt their techniques. The reef benthos transect, which is usually made by snorkelling, was instead done by walking on the reef at low tide. Likewise,

many reef front searches were made by walking along the reef crest and the close back reef instead of swimming in the breakers. Manta techniques were all made outside the reef on the shallowest portion of the reef slope.

Seven species of sea cucumbers that are used for commercial or subsistence purpose were recorded: *Actinopyga mauritiana*, *Holothuria atra*, *H. cinerescens*, *H. nobilis*, *H. leucospilota*, *Stichopus monotuberculatus* and *Thelenota ananas*. The high value species, *Holothuria nobilis*, was recorded once, while all other species were recorded at moderate to high densities. The red surf fish, *Actinopyga mauritiana*, was abundant and could be harvested under strict control to prevent overfishing within the small reef area.

Giant clams are a heavily targeted resource on Mangaia, and only two species were recorded: the elongated clam, *Tridacna maxima*, and the fluted clam, *Tridacna squamosa*. At the deep station, large (310 mm) fluted clams were recorded in low densities. Elongated clams were recorded all around Mangaia, on the reef flat and on the outer slope, but on the reef flat, the average size was very small (50 mm), due to fishing pressure. On the outer slope, an average size of 158 mm was recorded, but this was limited to a small population.

Trochus niloticus, the commercial gastropod introduced in the early 1980s and reintroduced in early 2000, was recorded only a few times and is not a commonly found resource. Two other species of gastropods (*Turbo setosus* and *Dendropoma maxima*) are the favourite target of fishers (Fig. 4). *Turbo setosus* is found in low densities all



Figure 4: Typical aggregation of *Dendropoma maxima* (top) and a women fishing for this species on the reef flat (bottom).

around the island, while *Dendropoma maxima* is abundant to very abundant, especially on the outer part of the reef, where they become large.

All sea urchin species recorded at Mangaia were abundant. Even the targeted pencil sea urchin (*Heterocentrotus trigonarius*) was recorded in high densities on the reef crest away from villages. The edible sea urchin *Tripneustes gratilla* was found in very high densities on the outer slope at unusual depth (20–32 m). This species has never been recorded at this depth by the PROCFish/C invertebrate teams at any of the site/countries surveyed.

A broken specimen of the rare *Conus gaugini* was found during a deep dive (around 25 m). This discovery is interesting as it extends the range of the species, which has been recorded only in French Polynesia until now.

RAROTONGA

At 67 km², Rarotonga has the largest land area in the Cook Islands, and is located in the southwestern region of the southern group, near the centre of the Cook-Austral chain of seamounts. The oval-shaped island measures 11 km in length (east to west) and has a maximum width of 8 km (north to south). It is the main population and administrative centre of the Cook Islands. According to the 2001 census report, Rarotonga is the only island in the country with a positive increase in population, while the rest of the islands show a decrease.

A larger workboat was available for finfish surveys, although the team could not survey the windward side of the island (northeast) due to a very strong easterly wind. On this island the team identified and surveyed two distinct habitats, the outer fringing reef and a small lagoon area in the southeastern part of

the island (Fig. 5). For the outer reef habitat, nine dive stations were surveyed, with eight lagoon dive stations surveyed.

Most reef fish around Rarotonga are ciguatoxic, and so are not caught or eaten. The most heavily affected area is the eastern and southeastern part of the island where almost all fish species are ciguatoxic. As a consequence, unlike Mangaia, fish density on the outer reef was very high and fish were large. As observed by the team, some parrotfish were larger than normal (more than their recorded maximum length), including *Scarus globiceps*, *S. altipinnis*, *S. psittacus*, *S. schlegeli* and *Chlorurus frontalis*. Benthic coverage was similar to that at Mangaia, where coral slabs covered with turfs and encrusting algae comprised the dominant benthic profile. Coral coverage was dominated by encrusting and massive corals with coverage ranging between 15% and 25%.

Coral coverage on the lagoon intermediate reef was dominated by branching, massive and digitate corals. Schools of mullet, trevallies, parrotfish and

goatfish were common in lagoon areas, especially in closed or protected areas.

Socioeconomic surveys covered 59 households at the two selected communities on Rarotonga. The survey at Ngatangia and Titikaveka villages on Rarotonga (referred to together as Rarotonga in the following discussion) revealed that only 44% of all households are engaged in some kind of fishing, and only every second household on Rarotonga has a household member who fishes or collects invertebrates more or less regularly. There are two possible explanations for the low fishing activity level. First, these communities, as with others on Rarotonga, enjoy a rather urban lifestyle. Agricultural production and fishing activities compete with other chores and responsibilities. Second, Rarotonga's reef and lagoon resources are potentially ciguatoxic, explaining why very few people fish in the island's reef and lagoon system. Some households on Rarotonga, however, have access to a motorised boat and so are able to fish along the outer reef where ciguatera risks are reduced, or troll specific-

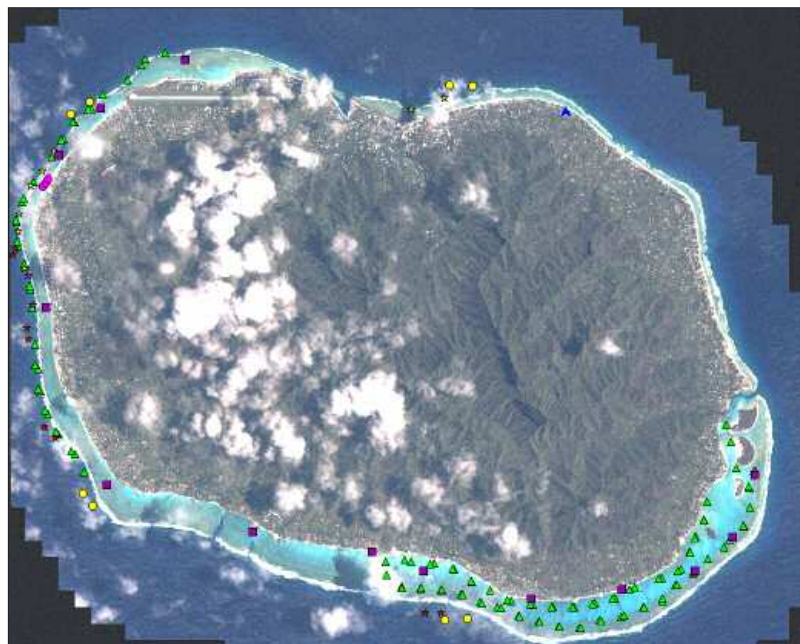


Figure 5: Invertebrate dive stations around Rarotonga.

ically for pelagic fish. Some people collect invertebrates infrequently. Imported chicken and other alternative protein sources are easily available and relatively cheap in local stores. This may explain why the per capita consumption of both fresh fish and invertebrates is relatively low (i.e. 31.7 kg of fresh fish and 1.4 kg of invertebrates).

Although Rarotongans have a variety of income-earning activities, little income is generated from agriculture, and nothing from fisheries (Fig. 6). Salaries are the main income source; other sources include income from private business and (to a great extent) social and retirement payments.

Rarotonga's lagoon is not very extensive and the likelihood of contracting ciguatera from lagoon resources is high, drastically limiting the involvement of Rarotongan people in reef and lagoon fisheries. About 90 fishers out of a surveyed population of 508 households still go fishing, mostly invertebrate collecting, in Rarotonga's lagoon habitat. Most (i.e. about 130 fishers) claim to fish at the outer reef where the risk of ciguatera is reduced. Techniques most used include gillnetting, spear diving, and cast netting. Fish species targeted include koma (*Mulloidichthys flavolineatus*), ature

(*Selar crumenophthalmus*), morava (*Siganus argenteus*), pipi (*Kyphosus cinerascens*), marao (*Myripristis* spp.), pipi nanue (*Kyphosus bigibbus*), ume (*Naso unicornis*) and patuki (*Epinephelus hexagonatus*).

About 17 invertebrate fishers on Rarotonga specialise in lobster diving. Reeftop and seagrass collection may involve an additional 60–80 fishers. While lobster diving is an exclusive activity of men, gleaning is done by both men and women. The most targeted invertebrates for consumption include matuori (*Holothuria* spp.), paua (*Tridacna maxima*), vana (*Echinothrix diadema*), avake (*Tripneustes gratilla*), kina (other sea urchins), kai (*Asaphis violascens*), octopus, trochus and ungakoa (*Dendropoma* spp.).

Reef finfish are never sold on Rarotonga. The annual catch per fisher is low (on average ranging between 65 kg and 100 kg). The total extrapolated finfish catch on Rarotonga covers only ~7% of the annual subsistence fish demand.

Rarotonga's barrier reef is larger than Mangaia's, extending 900 m from the shore to the crest at some locations. The small lagoon was large enough to make a few manta surveys, so typical invertebrate survey techniques were used. Eight species of sea cucumbers used for commercial

or subsistence purpose were recorded: *Actinopyga mauritiana*, *Holothuria atra*, *H. cinerascens*, *H. nobilis*, *H. leucospilota*, *Stichopus chloronotus*, *S. monotuberculatus* and *Thelenota ananas*. The high value species, *Holothuria nobilis*, was only recorded four times, while all other species were recorded in medium to high densities.

The giant clam family was only represented by the elongate clam (*Tridacna maxima*) on Rarotonga. The fluted clam may be present, but in such low densities that they cannot be detected by the survey. Even the elongate clam was scarce and found in low densities, with only 122 specimens recorded during the survey. The overall average size observed was higher (91 mm) than at Mangaia, but those inside the lagoon are much smaller (81 mm) than those outside the lagoon (146 mm).

Trochus niloticus was introduced to Rarotonga between 1981 and 1983. The survey recorded the density of this important commercial species to be high to very high, with some sites peaking at 1.5 specimens per m². The average density (calculated through transect techniques), is 857 specimen per hectare, which is among the highest densities recorded during PROCFish/C surveys in the region. The population here has a very singular pattern, with two distinct sub-populations. One is living on the reef crest and back reef area, while the other is living on the outer slope from 10 m to over 25 m. The spears and grooves area close to the breakers, a usual habitat for this species, is not colonised. The average sizes measured were quite different, with 96 mm for the inner population and 123 mm for the deeper pop-

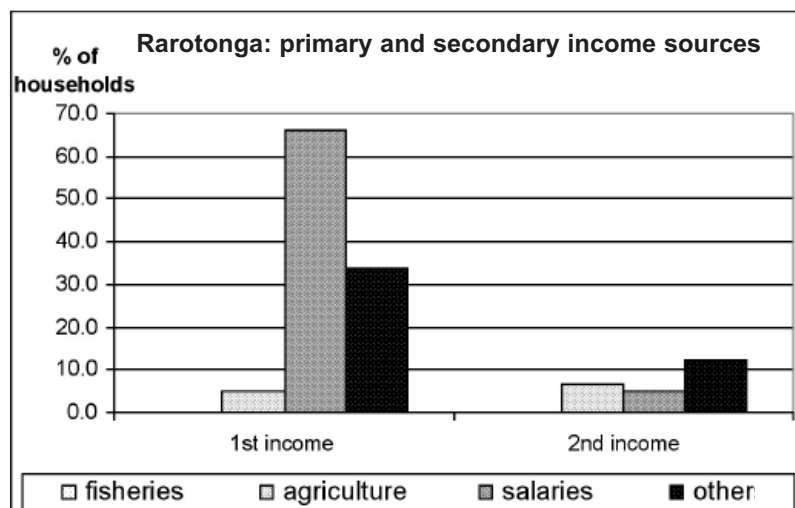


Figure 6: Primary and secondary income sources (%) for households on Rarotonga.

ulation. The deepest trochus ever observed during a PROCFish/C survey, a 135 mm specimen, was found on the south shore of Rarotonga at a depth of 30.1 m.

On Rarotonga, all sea urchin species were abundant. The pencil sea urchin (*Heterocentrotus trigonarius*) was recorded in high densities in the breakers zone. *Tripneustes gratilla* was found in moderate densities inside the

southern part of the lagoon, especially on the outer side, close to the back reef. *Echinotrix diadema* and *Echinometra mathaei* were very abundant.



Fifth PROCFish/C and CoFish Advisory Committee meeting

The fifth PROCFish/C and CoFish Advisory Committee meeting was held in Noumea, New Caledonia on 28 October 2007. Representatives from 15 out of 17 participating countries and territories attended. In addition, there were observers from Australia, New Caledonia, the University of the South Pacific (USP), the South Pacific Applied Geoscience Commission (SOPAC), and, SPC. SPC's Coastal Fisheries Programme Manager, Lindsay Chapman, chaired the meeting.

Project objectives, workplan and outcomes of 4th Advisory Committee meeting

The PROCFish/C Manager reported on the outcomes of the fourth Advisory Committee meeting (1 April 2006). He stated that the two-year, no-cost extension had been granted for the PROCFish/C project and that the extension of the CoFish project had been agreed to. The new logframe (recommended by the mid-term review) for donor reporting has been implemented, and has made reporting easier and clearer against the workplan and project objectives. Timely reporting to countries on the results of survey work has greatly improved, and capacity building has been ongoing as part of the PROCFish/C and CoFish fieldwork.

Progress to date on project objectives, and the workplan for the remaining 16 months of the project, were also discussed. All substantive fieldwork has been completed with the final sites in the

Cook Islands completed in October 2007. Data entry and cleaning is underway and should be finalised by February 2008. Around half of the site reports (89) were done and returned to respective countries, with the remaining reports to be completed and distributed by June 2008. Three country reports have been compiled and cleared by respective governments. An editor will be hired on a short-term basis to assist with compiling the country reports so that all are finalised before the end on the project (28 February 2009).

Once all of the data are entered and cleaned by February 2008, the project will focus on two objectives: 1) conducting a region-wide comparative assessment of the status of reef fisheries, and 2) developing a set of indicators/proxies, or fishery status reference points. A statistician or consultant will be contracted to assist PROCFish/C staff with the assessments. The PROCFish/C manager noted that: With the two-year extension, PROCFish/C will be able to fully meet all of its objectives; all site and country reports will be completed and cleared by countries before the project ends. The work conducted by the PROCFish/C and CoFish teams would not have been possible without the support and collaboration of the fisheries departments and local communities in the 17 participating countries and territories. The PROCFish/C staff thanks everyone involved over the last six years.

Country representatives provided comments during the meet-

ing. The delegate from Palau stated that he had received good feedback from staff, and noted that immense capacity transfer had taken place. The PROCFish/C team approached communities in a professional way and befriended community members, who wanted them to stay longer. The delegate also said that the PROCFish team had done a good job and he wished this to be conveyed to SPC's Director-General. The delegate from the Cook Islands was involved in almost all the work done in his country. He said that the work that had been done was very good and noted that community response regarding the attitudes of team members was positive.

The representative from French Polynesia noted that work in his country was not finished, but had gone extremely well so far. He also said that it was important for each country to develop capacity, and that there should be emphasis on the transfer of skills to national department staff. Vanuatu's representative noted that his country was the third one to be surveyed, and that only two people had been attached for training, and now one working for the PROCFish/C project. The representative from Tonga noted that there had been three or four representatives involved in the project steering committee since it started. The current delegate was one of the local staff involved in the 2004 survey. He also noted that a management plan was developed based on PROCFish work, and they

would be seeking additional input. The representative from the Federated States of Micronesia thanked the PROCFish/C and CoFish teams for the survey work.

Staff presentations on preliminary results and trends

Project staff presented some of the early findings and trends, although not all countries and territories were represented in these initial results, as data from the last several countries had not been fully entered into the database. All comparisons made were based on individual sites, and not on countries. This is because the site data for many countries were so small compared with the size

of the country that it was not representative, and therefore could not be extrapolated to the country level. After each staff presentation, representatives asked many questions.

Meeting outcomes

There were no actual outcomes from this meeting, although several points were made.

- Countries accepted the proposed timetable for data entry (by February 2008), the completion of site reports (by June 2008), and the completion of country reports for clearance (before the end of the project February 2009);

- Capacity building is an important issue for countries and territories, and representatives stated they wanted training in data analysis and interpretation, in addition to the upcoming socioeconomic workshops.

- Several countries were seeking additional assistance from PROCFish/C and this would need to be addressed on a case-by-case basis, depending on funds and staff availability.



Annual GIS/RS Pacific Users Conference

The yearly GIS/RS Pacific Users conference was held at USP (Suva) from 4–7 December 2007, bringing together practitioners of geographic information systems and remote sensing from Pacific Island countries, the South

Pacific Applied Geoscience Commission (SOPAC), SPC and USP as well as representatives from GIS/RS software and services, and GPS equipment companies.

The PROCFish/C Database Manager, Franck Magron, presented PROCFish/C activities with regards to shallow water bathymetry, using multispectral imagery (Figs. 7 and 8) and neural networks. He also dis-

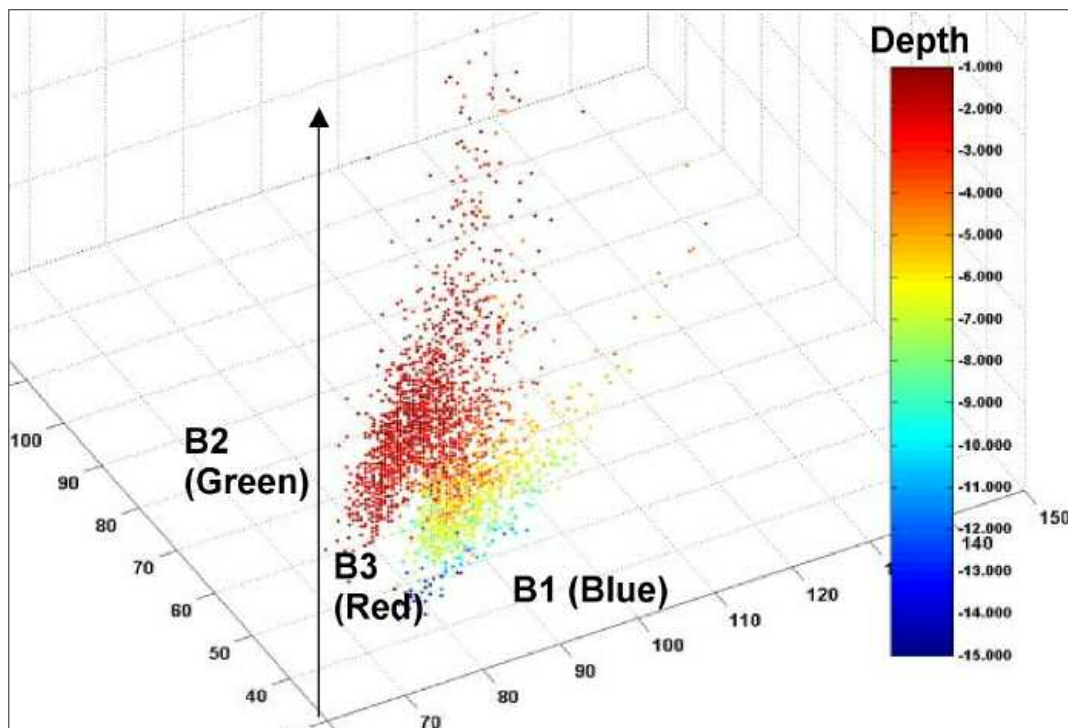


Figure 7: Depths and corresponding visible bands values for Landsat 7 sample points.

cussed the current aquaculture project that is determining suitable sites for freshwater aquaculture using GIS, with a pilot study in Viti Levu (Fiji).

SOPAC presented its new high precision RTK GPS that can be used to establish three dimensional beach profiles and follow coastline erosion in PICTs. The organisation stressed the necessity to rectify geo-referenced, high-resolution images using geo-positioned ground features that can be recognised on the satellite image. It was proposed to establish an online database of Rectification Images Points (RIP) shared among satellite image users.

Finally it was proposed to create a fictitious Pacific Island called "Atlantis" that would be used for training purposes, for which, case

studies and GIS layers corresponding to the needs of PICTs, such as management of reef fisheries will be developed.



Figure 8: Shaded bathymetry overlaying the original Landsat 7 image.

PROCFish/C and CoFish training workshop on socioeconomic fisheries surveys

The first PROCFish/C and CoFish training workshop on conducting socioeconomic fisheries surveys in Pacific Island countries and territories, was held at SPC's headquarters in Noumea, New Caledonia from 10–14 December 2007. The purpose of the workshop was to help communities and managers to improve reef fisheries management techniques. The methodology used has been developed over the past four years of the PROCFish project, and focuses on collecting a minimum dataset that answers 10 major subject areas, which have been jointly identified by the fisheries services in most SPC member countries. A manual that outlines the methodology has been developed and is complemented by software called SEMCoS. The manual is mainly aimed at fisheries officers and staff working in governmental and non-governmental organisations and institutions. Both the manual and the software follow the same structure and make linkages between the manual, data entry and data retrieval.

Participants from six countries attended the first workshop (Fig. 9). Participants learned the objectives and background of planning and conducting socioeconomic fisheries surveys, and were taught how to collect data. They also learned about the

manual's 10 major subject areas, how to calculate and interpret some of the data extrapolations and calculations, how to develop survey questionnaires, and where to find background information. A detailed introduction to SEMCoS software was pro-



Figure 9: Workshop participants and tutors, from left to right: Mandie Finau (Tonga), Franck Magron (PROCFish), Mecki Kronen (PROCFish), Teitioma Ukenio (Kiribati), Olofa Tuaeopepe (Samoa), Jamal Talagi (Niue), Tataua Alefai (Tuvalu), Shalendra Kumar Singh (Fiji).

vided, along with the steps for installation, de-installation, database backup, and data export and import. Participants learned to establish the hierarchical order of a survey, taking into account country, region, island, village and survey properties. Several exercises focused on teaching participants how to enter data from questionnaire forms for household, finfisher and invertebrate interviews, in order to access, design, and run queries.

Participants were provided a complete dataset on two villages that would be used as case studies. Three groups (two participants each) accessed the database in order to run a set of proposed queries, retrieve the generated output, place the results into table or graph format, and interpret results for fisheries management advice at both the community and governmental institution level.

Finally, a session was dedicated to demonstrating and explain-

ing the export of raw data entered into Excel (or other software package), to allow of the analysis of statistical or other data other than those automatically prompted by SEMCoS.

The second training workshop (in English) was held at SPC, Noumea from 21–25 January 2008. The third training workshop for participants from the three French territories is scheduled to take place at SPC, Noumea from 31 March–4 April 2008.



Update on Live Reef Fisheries Trade (LRFT) activities

SPC's Live Reef Fisheries (LRF) Specialist, Being Yeeting, was involved in several projects in the second half of 2007. These activities included drafting the Nauru Marine Aquarium Trade Resource Assessment, participating in Fiji's second Reef Fisheries Workshop, developing LRFT's monitoring database, and surveying work in Kosrae (Federated States of Micronesia) to examine the potential for marine aquarium fish exports.

NAURU MARINE AQUARIUM TRADE RESOURCE ASSESSMENT

A survey of Nauru's marine aquarium fish resources was made in March 2007. This was followed by a three-week attachment training at SPC Noumea for Nauru's Coastal Fisheries Officer, Delvin Thoma. Delvin was trained in entering and cleaning survey data, and making queries using the Reef Fisheries Observatory RFID software. Delvin, with the assistance and guidance of the LRF Specialist, was able to analyse and interpret survey results and later incorporate the information into a technical report that he completed at the end of his attachment. He was able to take the report back to Nauru and submit it to the government (Nauru Fisheries Authority) for review and consideration.

Survey results, as reported on in the technical report, showed a moderate abundance of several important marine aquarium fish trade species, which has triggered significant interest by Nauru's government to consid-

er developing this industry. One month after receiving the report, the Nauru government submitted a formal request to SPC for assistance in developing the marine aquarium trade industry in the country.

SPC's LRF Specialist has been searching for potential funding sources to assist with Nauru's request. After a meeting with the Forum Secretariat Private Sector Development Program, it became apparent that it may be possible to use some Forum Secretariat funding to assist Forum's Pacific Island member countries. Funding, however, can only be granted to Pacific countries upon a submission of their formal request and project proposals. After discussions with the Nauru Fisheries Authority, it was agreed that 1) the LRF Specialist would develop the project proposal and budget for activities in the second phase of developing the marine aquarium trade industry in Nauru, and 2) Nauru would submit the proposal formally. SPC will be the partner organisation in implementing the project. The

project proposal is being finalised and will be submitted to the Forum Secretariat in early January 2008, targeting June 2008 for the project to start.

PARTICIPATION IN FIJI'S SECOND REEF FISHERIES WORKSHOP

The LRF Specialist took part in a workshop entitled "Reef Fisheries Workshop – Now and the Future Part II". The first workshop was held last year. The workshop was jointly organised by the Fiji Fisheries Department and the Society for the Conservation of Reef Fish Aggregations (SCRFA). SPC's LRF Specialist attended as part of the collaborative partnership between SCRFA and SPC to assist Pacific Island countries in reef fisheries management issues, especially in relation to reef fish spawning aggregations. The workshop examined and discussed the relevant approaches and activities to take to address the main problems and issues that were highlighted in the first workshop.

The workshop also provided an opportunity for the presenta-

tion of a collaborative study between SCRFA, the University of British Columbia (Canada), Fiji Fisheries, USP and SPC, to look at the social and economic value of reef fish exports from the Pacific, using Fiji as a case study. The study will begin in early 2008 and will attempt address the lack of knowledge on the value of reef resources, which was one of the important issues that emerged from last year's workshop.

LRFT MONITORING DATABASE DEVELOPMENT WORK BEGINS

The development of an LRFT database for recording export data and LRFT trade data (among other information), began in September 2007. Three countries — Fiji, Vanuatu and Tonga — have been selected as pilot countries for the initial development of the database framework. The LRF Specialist visited Fiji in September and Vanuatu in December, meeting with industry people, such as live fish trade companies, divers and collectors and relevant government departments involved in the monitoring of the fishery (e.g. the Ministry of Fisheries, as well as the Customs and Quarantine Department). The information collected will be used to verify and refine data forms required in monitoring the LRFT, as well to understand how the dataflow should be designed for effective use and application. Meetings will be held in Tonga in early 2008.

In addition, the LRF Specialist assessed the existing in-country capacity to support and implement the monitoring programme. This provided valuable information to be used in the future for designing the project's implementation phase.

The project is aiming at developing the basic database framework by the middle of 2008, when it would be trialled in the

three countries. SPC will assist in its implementation. If successful, the database will then be extended to other countries that have live reef fisheries.

FSM LOOKS AT THE POTENTIAL OF EXPORTING MARINE AQUARIUM FISH FROM KOSRAE STATE

Following a formal request for assistance from the Federated States of Micronesia (FSM) in

October 2007, the LRF Specialist visited Kosrae to assist in assessing the state's marine aquarium fish resources and the potential for starting a fish-based marine aquarium trade (in addition to their current ongoing export of cultured giant clams).

As with other Pacific Island countries, FSM lacks local expertise in conducting field assessments. Training for local



Figure 10 (top): Underwater visual census training.

Figure 11 (bottom): Initial substrate training conducted on the reef flats.

field workers was done before the actual survey. Nine local field researchers from different agencies (government, non-government and private sector) attended the training, which consisted of classroom sessions and underwater exercises, and included learning how to conduct an underwater visual census (Fig. 10). Fish identification and recognising different bottom substrates (Fig. 11) was also an important component of the training. Following the training and after mastering the methodology, participants conducted a survey off Kosrae, which included 30 sites around the island.

In addition to the survey, the LRF Specialist organised a workshop about the marine aquarium trade for the general public. Twenty-two participants

from various public sectors attended. Presentations included background information describing the marine aquarium trade; biological, social and economic implications of the marine aquarium trade in the Pacific in general; and managing the marine aquarium trade sustainably. Presentations were intentionally made simple so that all members of the public could understand.

Trainees were given the opportunity to present the project to the public. These presentations consisted of an introduction about the project's mission and objectives; another describing the methodology and the data being collected with an explanation on how the data would be used; and field observations, noting the common species seen

that may be of value to the marine aquarium trade. These presentations were well received by the public and allowed for a quick assessment of trainees' understanding of survey methodology and data use. The same presentations were also made in Pohnpei to government officials.

Following survey work, an attachment is planned for one trainee to come to SPC Noumea and learn about cleaning data, processing and analysis. The FSM government will send a second attachment at their own expense. A three to four-week training session is scheduled for March 2008.



■ NEARSHORE FISHERIES DEVELOPMENT AND TRAINING SECTION

FAD workshops in Lifou, Loyalty Islands, New Caledonia

Fisheries Development Officer (FDO) Steve Beverly spent two weeks in October 2007 conducting a FAD fishing skills workshop in Lifou, New Caledonia. The workshop was run in conjunction with ADECAL-ZoNéCo (Agence de Développement Écono-mique de la Nouvelle-Calédonie), Province des Iles Loyauté, Sabrina Virly Consultants, and Service de la Marine Marchande et des Pêches Maritimes (MarMar). Workshop objectives were to introduce three fishing techniques (vertical longline, palu ahi and drifting bottle); demonstrate how to fabricate various fishing gear; and accompany workshop participants on several fishing trips to test the three techniques. Fishing trips were made on F/V

Dar Mad (MarMar's vessel), and on participants' own fishing boats, such as the 7 m Fargo shown in Figure 1. Sabrina Virly (Sabrina Virly Consultants); Pablo Chavance, ZoNéCo (ADECAL); Manu Ducrocq, Chargé d'étude du secteur pêche, Province des

Iles Loyauté; Christophe Fronfreyde, Ingénieur (MarMar); the crew of the F/V *Dar Mad* (Philippe, Lucky and Velio); and Amalia Fotofili, Service des Affaires Rurales et de la Pêche – Wallis and Futuna, also assisted with the workshop.



Figure 1. Henri's boat, a 7 m Fargo designed for New Caledonian waters, heading for the FADs.

Participants included Alain Talabaza, Abel Cica, Milié Goue from Lifou; and Henri Eatene, Apou Laene, Pash Eatene, and Nouvel Wamejonengo from Maré.

The FAD fishing skills workshop is part of a 12-month project in which catch and effort and economic data will be collected and analysed. A final report will document the project and discuss outcomes. SPC's role in the project was to participate in the initial planning stages and to conduct the practical FAD fishing skills workshop. During the project, the FDO will provide further advice if needed. The

project was funded by ADECAL with some input from SPC in the form of fishing gear.

Each fisherman briefly told his experience in fishing around FADs. As expected, most had only done trolling. Some, however, had also tried using drifting bottles (bidons dérivants) for mahi mahi, and one had tried vertical longlining, with limited success. None had used handlining methods such as palu ahi or drop stone. Each participant was provided with a set of SPC publications, including manuals on vertical longlining, species identification, tuna handling, and

protected species. Participants also received turtle and shark identification cards, and a small poster on proper protocols for releasing hooked sea turtles.

The workshop began with participants learning how to splice tarred Kuralon line. The FDO demonstrated how to rig a float, and how to make and coil a float-line. He also showed how to put together a monofilament branchline and how to coil the branchlines into a (Fig. 2) storage bin made from a plastic laundry basket. Participants made four more baskets and filled them with 40 branchlines each, thus completing the first day of work. Fishermen were asked to bring wood or bamboo poles to the workshop the following day in order to make gaffs.

The next day, participants were shown how to cut a hole and groove in the end of a pole for the gaff head, and how to lash the gaff head in place using a whipping knot. Each participant constructed at least one gaff for his own boat.

Participants next learned how to make up vertical longlines. Each fisherman had Kristal® electric fishing reels installed on their boats. These reels had been a part of a government-sponsored loan package that included a boat, motor, electronics, fuel subsidies, and fishing gear. The current project provided, in addition to the materials for fabricating the gear, 10 empty Kristal reels. These could be interchanged with reels already in place that are used for trolling and deep bottom fishing. The FDO demonstrated how to make a 15-hook vertical longline while



Figure 2 (top). Abel coiling a branchline into a homemade branchline bin.

Figure 3 (bottom). Alain loading vertical longline onto a Kristal reel.

loading it onto a reel. The fishermen then made an additional 10 vertical longlines (Fig. 3). Each boat would be equipped with two vertical longlines plus sufficient floats, floatlines, and branchlines to fish 30 hooks (2 lines with 15 hooks each). The fishermen were also shown how to make a palu ahi line and a drifting bottle rig.

On the third day of the workshop, the FDO and participants departed the wharf at Wé on the F/V *Dar Mad* and headed for the closest FAD. The FDO demonstrated how to bait the vertical longline hooks, throw the baited hooks, and attach the branchlines, while explaining how to choose a location near the FAD for deployment.

Around Lifou, fishermen are not allowed to tie off their boats onto FADs, so the vertical longlines had to be set adrift.

While the vertical longlines drifted, several drifting bottles were set and the palu ahi lines were deployed. The FDO also showed the fishermen a rig that is very popular in the Philippines and the Commonwealth of the Northern Mariana Islands, called a spreader. The technique is similar to palu ahi except that no palu (chum) is used. A single baited hook on a 3-m monofilament leader is attached to a stainless steel rod about 0.5 m long. The mainline is attached to the other end. Both ends of the rod have swivels. In the middle of the rod is a 0.5 kg lead weight. This spreader bar keeps the leader line from tangling with the mainline and also jigs the bait. The rig is lowered to several depths and jigged at each depth.

The rest of the workshop was spent fishing on other participant's boats and on making up additional gear such as flagpoles for the vertical longlines. The final report for this project should be ready in late 2008.

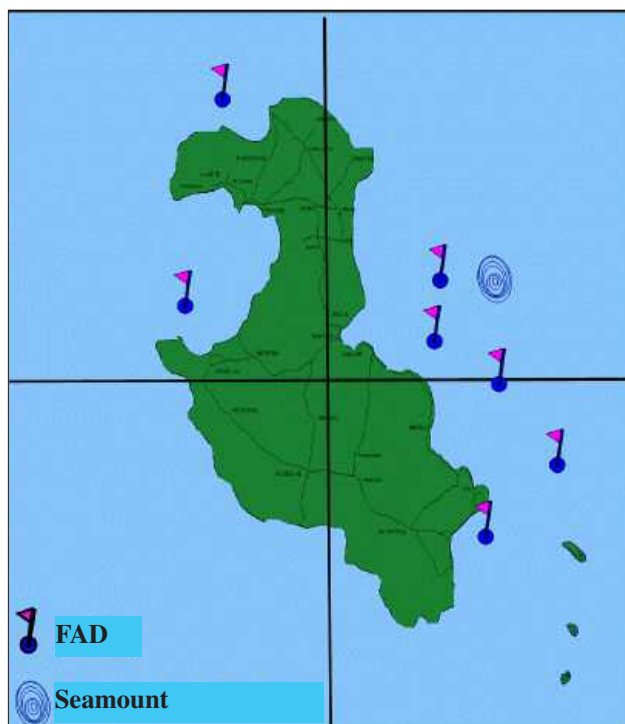


Figure 4. FADs around Lifou.

Fourth International Fishers' Forum (IFF4)

In November, Steve Beverly, SPC's Fisheries Development Officer and Michel Blanc, SPC's Nearshore Fisheries Development and Training Advisor, attended the Fourth International Fishers' Forum (IFF4), held in Puntarenas, Costa Rica. During a panel discussion on sea turtle bycatch initiatives, Steve gave a presentation on the results of the deep setting experiments that were conducted in Hawaii in 2006 (see Fisheries Newsletter #119). The final results of the six-month-long experiment will soon be published in a scientific journal. Steve was invited to

attend IFF4 by Dr Yonat Swimmer of the US National Marine Fisheries Service, who co-chaired the panel discussion along with Dr Hiroshi Minami of the National Research Institute of Far Seas, Japan (NRIFSJ). Other panel members included Dr Kosuke Yokata, also of NRIFSJ, and Dr Martin Hall of the Inter-American Tropical Tuna Commission (IATTC).

IFF4 was hosted by the Western Pacific Regional Fishery Management Council and Costa Rica's Fishery and Aquaculture Institute (INCOPECA).

The purpose of IFF4 was to bring together fishermen, fisheries managers, seafood retailers, fishing technology experts, and fisheries scientists to share information and experiences of sustainable fishing and mitigation techniques to avoid interactions with seabirds, turtles, sharks and marine mammals in longline and gillnet fisheries. The forum's objectives were to:

- review the commitments made at IFF3;
- review the status of Latin American and global longline fisheries;

- review intergovernmental organisation initiatives to achieve sustainable and environmentally responsible longline fisheries;
- review existing knowledge for reducing seabird and sea turtle bycatch, and shark and marine mammal depredation;
- share experiences on approaches to reduce bycatch and depredation;
- share progress on illegal, unreported and unregulated (IUU) fishing and observer programmes;
- share knowledge of anticipated effects of climate change on pelagic ecosystems;
- share industry initiatives and market perspectives to promote sustainable fisheries;
- identify approaches to minimising bycatch and predation;
- identify constructive roles for fishers, intergovernmental organisations, and regional fisheries management organisations; and
- identify actions by artisanal and industrial longline fisheries to achieve sustainable and environmentally responsible fisheries.

Unlike the previous three meetings of the International Fishers' Forum, IFF4 included discussions on gillnet fishing and artisanal fisheries, and was attended by representatives from several Latin American fisheries, including Mexico, Central and South America, and the Caribbean. The Pacific side of Mexico and the Central and South American countries share the Pacific Ocean with SPC member countries and territories, and so share a number of concerns.

Contacts were made at IFF4 and these will be nurtured in the future. During the meeting Steve and Michel met with Moises Mug-Villanueva of WWF Costa Rica and Pablo Guerrero of WWF Galapagos. Steve and Michel learned that the fisheries programme in the Galapagos was using the SPC FAD manuals to get their FAD programme started. This came about after some initial correspondence between SPC and Moises a few years ago. WWF is looking at an alternative to longline fishing in the Galapagos marine park.

Proceedings of the International Fishers' Forum #4 can be seen at:

<http://www.fishersforum.net/>



Some of SPC's commitments made at IFF3 and followed through on were:

- 1. Conduct further research trials of deep-setting technique with other researchers. Additional deep-setting research trials were conducted in Hawaii from June to December 2006.**
- 2. Produce a booklet on the deep-setting technique to raise awareness of this fishing technique. A brochure on the deep-setting technique has been produced in three languages: English, French and Spanish.**
- 3. Produce a species identification manual for tuna longline fishers in Pacific Island countries and territories (PICTs) plus Hawaii. The manual will cover target species, byproduct and bycatch species. The "Marine species identification manual for horizontal longline fishermen" was produced in mid-2006 as a bilingual (English and French) publication.**
- 4. Produce other awareness information on bycatch mitigation techniques. SPC — through the work of the Nearshore Fisheries Development and Training Section — continues to produce awareness materials on bycatch mitigation techniques in tuna longline fisheries, and distributes these within the Pacific region. A summary of the research on tuna longline/sea turtle mitigation techniques worldwide was also undertaken. This report can be downloaded from:**
http://www.wcpfc.int/sc3/pdf/SC3_EB_IP1.pdf

■ AQUACULTURE SECTION

SPC Pacific-Asia Marine Fish Mariculture Technical Workshop: Farming Marine Fishes for our Future

MARINE FINFISH FARMING IN THE PACIFIC ISLANDS REGION

Rapid advances are being made in marine fish aquaculture. Traditionally, large commercial interests — such as the European salmon farming industry — have taken the lead. More recently, however, the strong market demand in Asia for live reef fish has led to a rapid increase in localised production. According to the FAO State of the World Fisheries and Aquaculture, 2004, the quantity of farmed marine fish in Asia is 900,000 mt in Asia, and is 1.5 million mt for the rest of the world. These well developed industries pose relevant issues for the Pacific Islands region.

There has been considerable interest within Pacific Island countries to investigate options for marine fish aquaculture in order to supply domestic and/or international markets for food and ornamental species. Several countries have achieved commercial production of high-value species and there is an increasing list of public and private sectors involved in the industry.

At the 2nd SPC Regional Aquaculture Meeting (held in November 2006), SPC member countries identified marine finfish as an important commodity for development. Subsequently, SPC has become more involved in this field. One recent example is a three-week course in marine finfish hatchery training for Pacific Islanders held in Thailand in May 2007. In addition, SPC wishes to provide sound advice on marine finfish aquaculture by using its Asian, Australian and Pacific counterparts.

SPC later decided to organise a consultative forum among technical experts to enable a face-to-face exchange of ideas and a discussion of issues. While the situation differs from country to country within the region (and between regions), there are some strategic issues of common concern in which the sharing of technical information could be of mutual benefit.

MARINE FINFISH AQUACULTURE IN THE PACIFIC

In December 2007, SPC's Aquaculture Section hosted the Pacific-Asia Marine Fish Technical Workshop, at SPC's headquarters in Noumea, New Caledonia. Selected countries with prospects of developing a marine finfish aquaculture industry were invited to attend the workshop, together with a regional group of experts.

Government fisheries agencies representative from French Polynesia, New Caledonia, Marshall Islands, Palau, Papua New Guinea and Solomon Islands were invited to attend the workshop. The following regional organisations from Australia, the Pacific and Asia also attended: IFREMER, Network of Aquaculture Centers in Asia-Pacific (NACA), University of the South Pacific, Queensland Department of Primary Industry – Northern Fisheries Centre, The WorldFish Center and the Australian Department of Agriculture, Fisheries and Forestry. Private sector investors for the region were also represented by Good Fortune Bay Fisheries (Australia and the Marshall Islands) and Aqualagon (New Caledonia).

The workshop was a technical consultation between marine

finfish aquaculture experts and SPC member countries that are active in marine finfish aquaculture. The workshop's goal was to provide SPC with advice on the most feasible options for marine fish aquaculture and identify a regional framework for collaboration to address priority research and development needs in the Pacific.

Workshop objectives included:

- Providing an update on the status of marine finfish farming within selected Pacific Island countries;
- Assessing global trends of the industry in terms of production and markets;
- Considering niche opportunities for the Pacific region, for example in terms of export and domestic markets and ensure food security;
- Identifying priorities for research, development and training requirements; and
- Establishing programmes for further regional and inter-regional collaboration.

PRESENTATIONS AND ACTIVITIES

On the first day of the workshop, each organisation presented its work and emphasised their involvement in marine finfish aquaculture development. After a short and much appreciated visit to the "Aquarium des lagons", the official country representatives illustrated the latest marine finfish aquaculture development in their area of work.

Country and organisational presentations are summarised in the table below.

Organisation	Summary
SPC (Ben Ponia)	SPC briefly presented its strategic plan and reported that marine finfish aquaculture was ranked as a medium priority commodity for the region. Also reported on were the actions related to this activity in 2007.
IFREMER (Dominique Buestel)	IFREMER presented its work in French Polynesia with the batfish, in collaboration with French Polynesia's fisheries department. The IFREMER tropical marine fish network was presented and illustrated by work done in La Réunion, Martinique Mayotte and France.
USP (Tim Pickering)	An overview was given of freshwater and marine aquaculture-related activities at USP. USP's training/course programme was introduced to workshop participants.
NACA (Sih Yang Sim)	Most NACA-focused activities were presented and an emphasis was made on the Asia-Pacific Marine Finfish Aquaculture Network, a strong potential link for SPC and its region.
QDPI and NFC (Richard Knuckey)	The Queensland Department of Primary Industries (QDPI) has three research facilities focusing on both freshwater and marine aquaculture in Queensland: Bribie Island Aquaculture Research Centre, Walkamin Research Centre and the Northern Fisheries Centre (NFC) in Cairns.
WorldFish Center (Warwick Nash)	The WorldFish Center presented its position on profitable aquaculture in rural Pacific Island countries as a priority for livelihood and food security.
DAFF (Clayton Harrington)	The Australian Department of Agriculture, Fisheries and Forestry (DAFF) presented a concise overview of the aquaculture industry in Australia, including challenges and opportunities.
New Caledonia Northern Province (Nathalie Baillon)	The upcoming marine finfish hatchery project in New Caledonia's Northern Province (which will be aimed at export markets) was presented.
New Caledonia Southern Province (Frank Legarrec)	The Aqualagon rabbitfish (<i>Siganus lineatus</i>) hatchery was introduced. The project is based in New Caledonia's Southern Province and aims at producing fish for local markets.
Palau (Percy Rechellul)	The potential for aquaculture development was described in this presentation. Most aquaculture sites, production, current and future status were outlined.
Solomon Islands (Alex Meloty)	Milkfish (<i>Chanos chanos</i>) and rabbitfish (<i>Siganus</i> spp.) (capture-based aquaculture) were species that were of great interest to rural areas in the Solomon Islands. It was stressed that the live reef fish food trade is happening in the Solomon Islands.
French Polynesia (Georges Remoissenet)	The marine fish aquaculture situation in French Polynesia was presented along with details regarding the actions of both the private and the public sector. A development forecast was also described.
Papua New Guinea (Gideon Pama)	Commercial barramundi (<i>Lates calcarifer</i>) farming experiences in PNG were described. Potential and expectations were also outlined, especially the potential for fishmeal based on the Fly River herring fishery.
Fiji (Tim Pickering)	Mangrove jack (<i>Lutjanus argentimaculatus</i>) and grouper hatchery trials were done in Savu-Savu some years ago by commercial operators. Nowadays, there is new hope for marine fish species thanks to USP's work in isolating and mass culturing phyto- and zooplankton.

After these country and organisational sessions, Being Yeeting, SPC's Live Reef Fish Specialist, presented the live reef food fish trade in the Pacific Islands. He stressed the limitations of this fishery, as well as its potential future development in supplying sought-after high-value reef fish species such as groupers.

On the second day of the workshop, Johann Bell presented a paper entitled, "Fish for the Future". The need for fish for both livelihood and food security

in the Pacific region was discussed. This presentation also pointed out that the Pacific is not yet as advanced as its neighbours in Asia or Australia in terms of making aquaculture development a priority. Food security and basic cash income remain a major priority for the region.

Sih Yang Sim from NACA provided participants with a very detailed presentation on the status and trends of marine finfish aquaculture in Asia, including the markets, industry econom-

ics, farming practices used in the different countries, and future development. Asia is often used as a model for the Pacific Islands region, which must learn from Asia's mistakes and successes.

In the Marshall Islands, a large-scale fish grow-out project is currently being implemented by Good Fortune Bay fisheries (based on importing fingerlings from their hatchery in Australia). The production will target the live reef fish market (grouper –



Figure 1. Barramundi floating cage units in Madang.

Figure 2. Batfish in a floating cage in Tahiti.

Figure 3. Canulating rabbit fish broodstock.

Figure 4. Hatchery reared juvenile rabbitfish.

Figure 5. Juvenile hatchery reared siganids in Palau.

Figure 6. Plate size barramundi produced in Madang.

Cromileptes altivelis and others) as well as the white filet market (cobia – *Rachycentron canadum*). Provan Crump, the Good Fortune Bay's representative described the project, which is still in its initial phase, and explained how development was being forecasted and the place this industry was taking in the Marshall Islands' economy. The project is aiming at being in full commercial scale within five years.

Most up-to-date hatchery techniques were described by Richard Knuckey, from Cairns Queensland Department of Primary Industries-Northern Fisheries Centre. Research, challenges and current findings from this high-tech aquaculture centre were presented, including broodstock management, larval culture, diet development, grow-out culture (especially pond culture) and technology transfer to the private sector. The species of major interest in Cairns at the moment are *Plectropomus leopardus*, *Epinephelus coioides*, *E. lanceolatus* and *E. fuscoguttatus*.

A detailed analysis of post-larval capture and culture for marine food fish was provided by Tim Pickering from the University of the South Pacific. He analysed, together with research partners, the technical feasibility of relying on this technique for domestic food fish aquaculture development in both Fiji and the Solomon Islands (with reference to the French Polynesian experience). Other alternatives to capture-based aquaculture, which relies on wild-caught juvenile rabbitfish and natural seaweed as a feed source, was also discussed and appeared to be a viable option for rural aquaculture in the Pacific.

Two delegates presented the state of advancement of marine finfish culture in their countries

with details. Georges Remoissenet from French Polynesia's fisheries department, provided a full report on the batfish aquaculture project in Tahiti. An emphasis on biosecurity issues and a comparison of batfish production between Thailand and Tahiti was made. Percy Rechelluul from Palau described the production cycles and the most up-to-date findings related to grouper aquaculture in Palau. He also discussed the hatchery production of rabbitfish (*Siganus fuscescens*), which raised considerable interest among some workshop participants.

On the third and final day of the workshop, a special topic on training was presented by both NACA and SPC. Sih Yang Sim from NACA introduced and illustrated various training activities proposed by NACA, such as the grouper hatchery training course, the study programme on marine aquaculture and seafood market in China, the tailor-made marine fish aquaculture course, and the forecasted marine ornamental course in 2008. Finally, Antoine Teitelbaum, from SPC's Aquaculture Section provided a report on the marine fish hatchery training that SPC and NACA co-organised in Thailand.

Each day, workshop participants got together in small groups and worked on the following subjects:

- Developing linkages within the Asia-Pacific region. Three groups (representing Asia, Australia and the Pacific)

analysed the strengths, weaknesses, and opportunities of those three regions towards providing guidance to the Pacific.

- Designing a regional strategic plan for marine finfish development in the Pacific Islands region (establishing objectives, strategies, action and indicators).
- Developing project concepts to address bottlenecks in the industry within the Pacific region.

WORKSHOP OUTCOMES

As a result of this workshop, an interactive CD that includes all PowerPoint presentations as well as the results of the working groups has been produced and is available on request from SPC's Aquaculture Section (contact marieangeh@spc.int).

A marine finfish aquaculture development strategic plan will also be developed in 2008, compiling the different experiences of the Pacific and using the results of the working groups. It will be posted online on the aquaculture portal at:

www.spc.int/aquaculture

Continuous technical assistance will also be provided to countries on a case-by-case basis based on the knowledge that emerged from this very helpful workshop, for the benefit of a profitable development of this industry.



Plectropomus leopardus

French Polynesia shares post-larval fish capture and culture technology with Cook Islands

The French Pacific Fund has agreed to support a cooperative project between French Polynesia and the Cook Islands, which will share skills in post-larval reef fish capture and culture. SPC's Aquaculture Section, together with experts from French Polynesia (Aquanesia), has taken the lead in implementing this year-long project.

SPC's Aquaculture Officer, Antoine Teitelbaum, and Emmanuel Malpot from French Polynesia visited the Aitutaki Marine Research Center (AMRC) in the Cook Islands, and worked with Richard Storey (AMRC manager) and Korora Raumea (Director and aquaculture specialist of the Cook Islands Ministry of Marine Resources, MMR) as well as AMRC technical staff.

The main aim of this trip was to:

- Introduce post-larval fish collection techniques to MMR's staff;
- Trial the efficiency of two post-larval fish capture techniques;
- Train MMR and AMRC staff in collecting, sorting, identifying and growing-out commercially valuable fish species;
- Develop a database to record the catch;
- Explore the possibilities of accessing a reliable source of fingerling supplies for developing low-cost food fish culture; and
- Develop "eco-friendly" ornamental fish grow-out techniques to provide juvenile reef fish that can complement coral gardens supplied to hotels in Aitutaki.



Top. Channel net fishing at Akitua.

Bottom. Emptying the cod end into the catch barrel.



Top. Sorting fish at AMRC.

Bottom. Surgeonfish catch.

During the visit, two types of trapping devices were used: a "hoa" (or channel) net, which was deployed in a reef channel near AMRC (at Akitua), and two

light-traps, which were moored south of the main pass at Aitutaki, a five-minutes boat ride from the town centre. A temporary sorting area was installed in

AMRC's hatchery, consisting of a 1 tonne tank prepared with floating trays in it to receive the catch and sort the fish.

The eight days of collection (during the new moon period of November 2007) showed promising results; a wide variety of fish and invertebrate species were recorded. The most abundant and potentially valuable families collected were surgeonfish (acanthurids) and mantis shrimps (stomatopods). During the sampling period, the channel net generally yielded higher catches than the two light traps.

The main field tasks of this preliminary study were to train MMR staff in installing, maintaining, harvesting, sorting and identifying fish species. The SPC/Aquanesia team ensured that MMR staff were fully efficient in most operations, in order for them to repeat the operation during the fish colonisation period (from spring to summer).

MMR staff showed great diligence and skills in all these operations and were able to carry out all steps by themselves in only a few days. The bottleneck of this technology lies in the laborious task of identifying all larval fish species that are collected. Although it was fairly easy to identify the larger post larvae to the genus level, identifying to the species level was not an easy task. Fortunately, two post-larval fish identification guides were published in 2007¹ and the coral reef fish identification book by Myers and Lieske was very useful for this exercise.

A database to log all catch data was also installed on AMRC's computer and Richard Storey was trained in using it. At the

¹ Juncker M. 2007. Young coral reef fish of Wallis Islands and the Central Pacific, identification guide. Book from the Environment Department of Wallis and Futuna for the CRISP Programme. 170 p.
Maamaatuaiahutapu M., Remoissenet G., Galzin R. 2006. Guide d'identification des larves de poissons récifaux de Polynésie française. Éditions Téthys. 104 p.

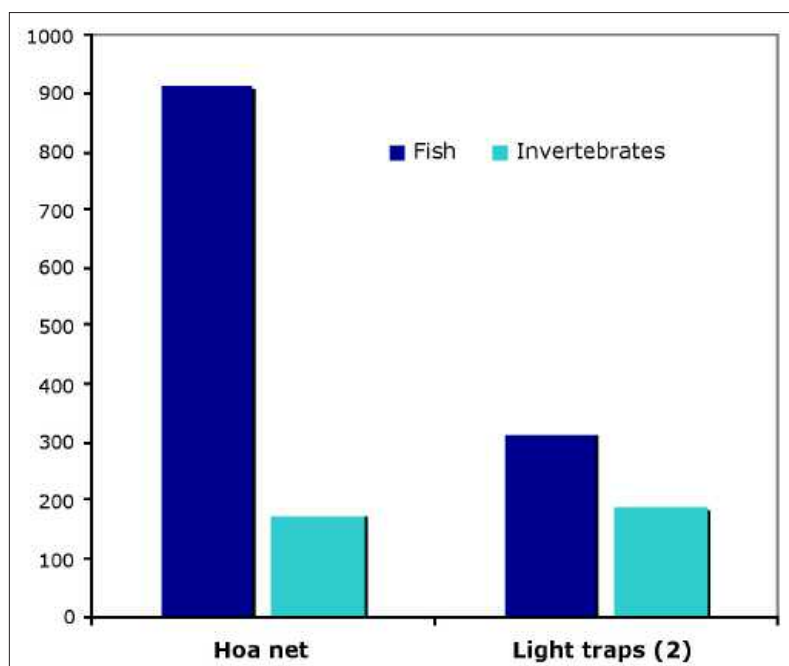
end of every sampling period, fish were recorded by species, site, abundance and status, whether they were dead or live.

Rearing commercially valuable fish was also dealt with during this trip. Most surgeonfish that were selected for nursery culture were isolated and placed in a clam raceway. That way, they could feed on turf algae growing on the sides of the tank although an artificial diet was also supplied to the fish. A small *Artemia* culture unit was also set up and AMRC staff were trained in hatching and harvesting *Artemia*, using plastic bottles and sieves.

Most non-commercial fish were released into the lagoon and a small diversity of reef fish were kept in a separate tank for display. Early trials were made with mantis shrimps, which were placed in small (10 litre) plastic containers with substrate and fed with minced fish. These immediately showed good burrowing and feeding behaviour.

The overall results of this first trip were encouraging; however, the total yield and the amount of commercially valuable organisms collected were not sufficient to prove any commercial viability at this stage.

The team also visited the rest of the island and surveyed the reefs for potential collection sites. Although there were many protected reef areas on the leeward side of Aitutaki that



Total abundance of fish and invertebrates collected in both traps devices during November sampling period.

would be suitable for mooring light traps, there was only a limited amount of crest/channel areas suitable for collection.

MMR staff will continue post-larval fish collection during the new moon periods of December, January, February and March, and the results will be analysed at the end of the collection period. According to these results and the potential for commercial activities in Aitutaki, more funds could be directed towards extending the project.

A study tour for both Richard Storey and Koroa Raumea is being organised. These MMR representatives will be sent to

Bora Bora in French Polynesia, specifically to Bora Eco Fish, a company specialises in post-larval capture and culture (PCC) activities and is currently involved in several related projects. An article discussing the outcome of this short training will appear in the next issue of the *Fisheries Newsletter*.

In mid- to late 2008, it is expected that an analysis of the potential for developing small-scale industries based on PCC in the Cook Islands will be jointly produced by MMR, local Aitutaki authorities, and external advisers.



Quality seaweed fetches better prices

A seaweed quality booklet aimed at Solomon Island seaweed farmers is now available in English. The booklet, titled "Seaweed quality manual, Solomon Islands: A practical guide for seaweed farmers, buying agents, fisheries officers and

exporters", is a simple 16-page leaflet that illustrates the various aspects of seaweed quality encountered: from planting to transportation. Topics such as drying seaweed, sorting impurities, and protecting seaweed from the rain, are discussed.

Recommendations for farmers, buying agents, fisheries officers and exporters are also included.

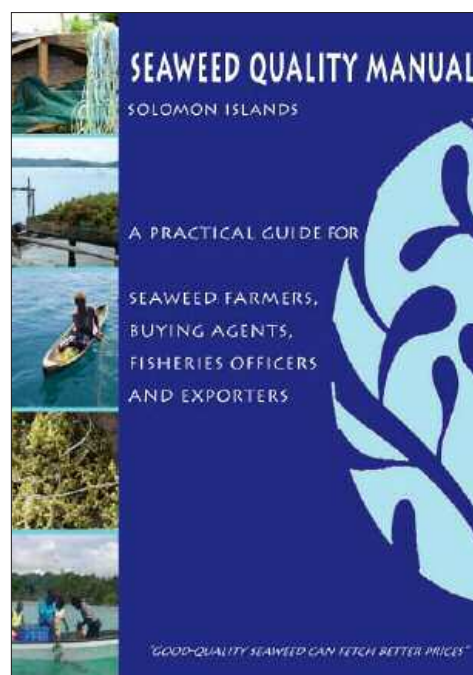
The booklet contains drawings by different Solomon Island artists (Steven Danifona, Timothy Kale and Ezikiel Tuke)

as well as photos taken in various production areas of the Solomon Islands. The drawings and photos are helpful for people with limited ability to read English. A Pidgin manual may be produced in the future.

The booklet is a joint effort by the EU-funded Commercialisation of Seaweed Production, Solomon Islands (CoSPSI) management and SPC's Aquaculture Section. In recent years, quality has become a growing concern of the Solomon Island seaweed industry, which is interested in fetching better prices for seaweed and becoming more competitive on the international market.

Two hundred copies of the booklet have been sent to the Solomon Islands, and will be distributed in the farming areas of Waghena, Rarumana and North Malaita. The CoSPSI management expects that this booklet will help farmers and other stakeholders involved in the seaweed industry to improve the quality of their production.

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Potential applications of GIS in strategic planning for freshwater aquaculture

Nadia Chagnaud, Geographic Information System (GIS) consultant for Aquaculture Planning, is leading a GIS analysis to assist in the planning of freshwater aquaculture development in Fiji. Fiji was selected as a potential site because of the strong potential for freshwater aquaculture and the availability of information regarding some of the human and environmental parameters that influence aquaculture development. The development of freshwater aquaculture has the potential to benefit both food security and livelihoods, and could provide alternatives to Fiji's declining sugar cane industry.

The project started in October 2007 and should be finalised in February 2008. Fiji's Fisheries Department and Dr Tim Pickering from the University of the South Pacific's Marine Studies Programme are the main collaborators. Dr Pickering is providing essential technical support

relating to small pond freshwater aquaculture.

In Fiji, most inland aquaculture farms produce tilapia, although freshwater prawn production is becoming increasingly popular. A census undertaken in 2004 by SPC identified 133 active farms on Viti Levu and Vanua Levu, but the geographic location of these farms was not accurately recorded.

In November 2007, the geographic locations of various aquacul-

ture facilities in different coastal and inland environments were recorded using global positioning system (GPS) equipment. Eighty farms, three hatcheries, two food supply shops and one prawn shop were visited in two days.

During the course of the field mission, staff met farmers and discussed their needs, investigated factors that must be taken into account in the GIS analysis, and determined some of the advantages and limits to the use of GIS data.



Tilapia ponds, Waidra (Viti Levu, November 2007).

On a medium scale, GIS tools will be useful for highlighting the overall suitability of various areas for freshwater aquaculture. This analysis will take into account: 1) human factors (such as population density based on the 2007 census; existing land use, distance to hatcheries, retail food outlets and markets; and the presence of a road transport network) and 2) environmental factors (such as soil drainage and pH, forest density, slopes and temperature). The main environmental factors will be analysed to determine an indicator of suitability that takes into account the requirements for tilapia and prawn farming.

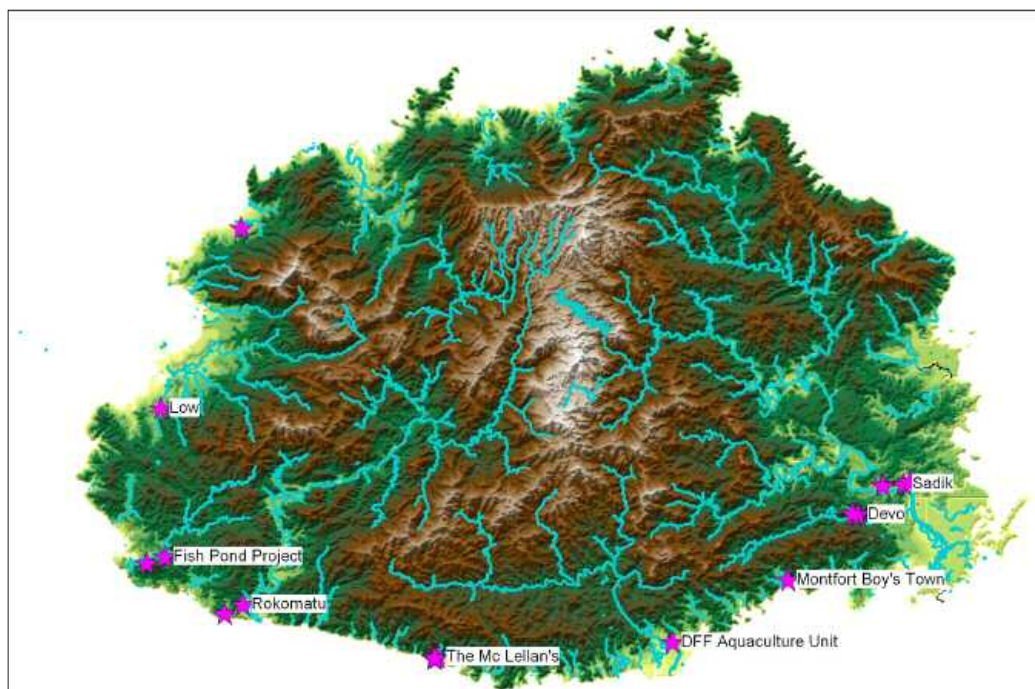
The organisations that will most likely house the GIS data include Fiji's Ministry of Agriculture, Ministry of Fisheries and Forests, the University of the South Pacific's geography department, Fiji's Department of Land and Survey, statistics department and the South Pacific Applied Geosciences Commission (SOPAC).

The last stage of this project will be to analyse the human and environmental factors, and interpret the results in order to assist decision-makers in determining preferred locations for freshwater aquaculture. In the future, additional data and field

work will support more precise analysis of the potential for freshwater aquaculture development. The GIS platform could also function as a tool to display maps, allowing users to view specific parameters for various areas and make their own interpretations.

A draft of this project was presented in Fiji for the annual GIS-RS user's conference, in December 2007.

For more information, contact: Nadia Chagnaud (NadiaC@spc.int)



**Some farm positions by GPS in Viti Levu
(elevation model and main rivers in background, Source SOPAC).**

■ AN INTERVIEW WITH MR ANDREW WRIGHT, EXECUTIVE DIRECTOR, WESTERN AND CENTRAL PACIFIC FISHERIES COMMISSION

Below is the reproduction (with permission) of an interview with Islands Business (reporter Dionisia Tabureguci), given by Mr Andrew Wright, Executive Director of the Western and Central Pacific Fisheries Commission.

IB: What are some challenges faced by the Commission in carrying out its task to help conserve tuna stocks?

AW: This is a hard question because the challenges are different depending on who you speak to. Apart from the challenges caused by rising oil prices, which impacts everyone involved in the fishery, for many years the coastal States in the region, effectively the FFA member countries and the American and French territories, have aspired to develop their domestic tuna fishing industries. At the same time, distant water fishing nations are anxious to secure long-term access to the fishing grounds to support the activities of their national fleets. Balancing these interests is challenging. Pacific countries are becoming increasingly actively engaged in the fishery. I think there are mounting pressures for the distant water fishing nations to change traditional ways of operating, which were essentially over-the-horizon modes of fishing with minimal engagement or investment in shore-based services in the region, to one where local investment is probably going to determine access to long-term fishing opportunities. Of course, an overarching concern is being able to support the development aspirations of Pacific islands countries and territories without jeopardising the ability of regional tuna stocks to sustain fishing. It is not much use promoting development, securing major investment, which most tuna fishery development initiatives require, and find that tuna stocks become over-exploited and so jeopardise those investments.

The objective of the WCPF Convention acknowledges the need to ensure our fish stocks are used sustainably. I think this is a second major concern, managing fishing effort throughout the WCPO within sustainable limits. Scientists have been telling us for some time that bigeye tuna, and to a lesser extent yellowfin tuna, are probably being over-fished and these stocks will not be able to support such high levels of fishing indefinitely.

Unfortunately, the indications in 2007 are that fishing effort in the purse-seine fishery is expanding and new vessels continue to enter the fishery. Excess capacity, or when the catching power among all vessels in the fishery exceeds that which can support sustainable fishing operations, is a major concern in nearly all fisheries around the world. In some cases, it is supported by governments which provide subsidies to vessels to enable them to continue uneconomic operations and it invariably leads to industry pressure being applied in management organisations like the WCPFC to take decisions that don't limit catch or fishing effort when over-fishing is obviously occurring. This results in stocks becoming over-fished and collapsing. World fisheries are littered with examples of this. I would hate to think we in the WCPFC will not learn by those experiences. Now some of the island countries, those making up the grouping known as the Parties to the Nauru Agreement (PNA), have developed a tool to manage purse-seine fishing effort within their national waters. This tool, known as the Vessel Day Scheme (VDS), is scheduled to become operational on 1 December 2007. It is quite a

complicated arrangement which involves close coordination among the eight PNA members to manage purse seine fishing effort within agreed limits.

IB: Is illegal fishing increasing?

AW: Yes, and I am still concerned about that. Illegal, unregulated and unreported (IUU) fishing is a concern to fisheries management agencies everywhere. Given the general deterioration of fish stocks in other oceans, the relatively productive fishing grounds here, the large geographic area covered by the WCPO, and a limited capacity to carry out monitoring and surveillance throughout this region, the WCPO probably experiences very high levels of IUU fishing. This not only involves fishing by fleets which do not participate in the work of the commission but no doubt includes the activities of some vessels that belong to members of the commission-particularly in respect



Drew Wright, Executive Director of the Western and Central Pacific Fisheries Commission.

of, for example, the under-reporting of catches. The challenge with IUU fishing is that, because it is generally unreported, we really do not know the extent of it. Some experts estimate it could account for an additional 10% on top of the estimated reported catch; so for the WCPO, that could amount to an additional 200,000 metric tonnes of tuna caught each year in the WCPO that we know very little about! Not only does IUU fishing result in lost revenue opportunities, but those operations do not provide data to assist in assessing the status of local fish stocks and they undermine the sacrifices that those that comply with the decisions of the Commission make in their efforts to achieve sustainable use. In relation to the migration west of some Latin American vessels as a result of poor fishing conditions in the eastern Pacific, yes, we have received reports of illegal activities from the zones of both Cook Islands and French Polynesia and of course the majority of their activities on the high seas are unreported. In addition, the licensing of some of these vessels by any Forum Fisheries Agency (FFA) member is in contravention of agreements both within the FFA (which relates to the licensing of vessels that are not on FFA's Regional Register of Foreign Fishing Vessels) and within the Commission (and an undertaking not to support the activities of vessels in the WCPO that are not flagged to a member of the WCPFC). This creates some major challenges for this organisation that will hopefully be addressed at its meeting in Guam in December.

IB: What is the Commission doing to try and better regulate fishing in the WCPO?

AW: The Commission's efforts to better regulate fishing fleets includes: the development and implementation of a satellite-

based vessel monitoring system for vessels operating on the high seas that will complement that being managed by the FFA secretariat for vessels operating in the national waters of FFA members; the development of a regional observer programme that will involve the placement of observers on fishing vessels operating in the region to collect independent information; procedures to support the boarding and inspection of fishing vessels on the high seas; procedures to verify transshipment when vessels transfer their catch to other vessels such as carriers; means to more effectively encourage compliance with the decisions of the Commission, including means to deter the support of any activity associated with IUU fishing; and efforts to improve the detail and scope of data that is provided by fishing vessels in respect of their fishing operations.

A recent paper by Professor Tom Kompas of the Australian National University warned of the dangers of the region being over-exploited by exposure to more open foreign fishing vessels and the use of effective modern technology.

In the early 1980s the average purse-seine vessel was catching 3500 mt in a good year; around 15 metric tonnes (mt) per fishing day. Today, although small vessels still harvest this amount, larger, high-tech vessels are averaging closer to 30 mt/day and 8500 mt a year. Some vessels now operate almost continuously for three or four years before going for major maintenance on a slip. Other than the Japanese seiners, which supply niche markets in Japan, most seiners transship their catch to carrier vessels on the fishing grounds rather than undertaking long voyages to deliver their catch to distant canneries or home ports. In places, like Solomon Islands and Papua New Guinea, canner-

ies have been established close to the major fishing grounds-which also results in increased periods fishing. Modern seiners have sophisticated equipment such as bird radars (to detect birds associated with schools of fish), side scanning sonar that can extend several thousand meters each side of the vessel, helicopters and sensitive depth sounders and fish finders. In addition, in the last decade there has been an increase in the use of man-made rafts or fish aggregating devices (FADs) and fishing on naturally occurring logs which aggregate schools of tuna. Not only does FAD fishing generally result in higher catch rates of tuna but tuna schools associated with FADs generally consist of smaller, juvenile bigeye.

IB: What is your reading of the Pacific tuna industry so far and how it has contributed to development of Pacific islanders?

AW: Approximately 45% of the WCPO tuna catch is taken from within the exclusive economic zones of FFA members, and so they do control access to a significant proportion of the total WCPO tuna fishery. For 20 years or more, observers have suggested that they have the capacity to establish a cartel type arrangement and so dictate supply to world markets, including influencing prices. The challenge to achieve this among such a diverse group of countries is to be able to satisfy the individual needs and development aspirations of all of these countries-or at least those responsible for the lion's share of the catch. It has not proven possible to do that and so some countries continue to licence fleets under bilateral access agreements while others are pushing ahead with aggressive development of their domestic industries. While the development of the domestic industries in some Pacific countries does involve Pacific Island nationals,

by and large, domestic development is driven by foreign interests. There are some good reasons for that, among them the significant investment required to establish and operate these ventures plus the fact that local experience is still at its early stages of development.

IB: Annex B of the Vava'u Declaration on Pacific Fisheries Resources, a result of this year's Pacific Islands Forum Meeting in Tonga, indicated a move by member countries to try and consolidate the region's tuna fishing industry. What are your views on this move?

AW: The Leaders' recognition of the significance of fisheries as the region's premier renewable resource requiring concerted efforts to establish conservation and management arrangements

to support sustainable fisheries is overdue and to be commended. I do believe that there are already trends towards a restructuring of the regional tuna industry that will see a gradual decrease in the proportion of fishing operations that are supported under bilateral access arrangements and an increase in operations based in the region. My only hope is that the substance of the Vava'u Declaration is not lost on administrators and managers and that the over-arching principle of supporting development within sustainable limits is in fact applied.

One of the highlights of the governments' proposed actions (Communique of Vavau Forum meet) is to: "Fully implement without delay the conservation

and management measures developed and endorsed by the Western and Central Pacific Fisheries Commission (WCPFC)" and "seeking the urgent adoption of additional measures by the WCPFC to address over-fishing of bigeye and yellowfin, including a reduction in longline catches and addressing purse seine fishing, and specific steps to reduce the catch of juvenile bigeye and yellowfin."

Source: Islands Business, December 2007:

<http://www.islandsbusiness.com>



■ GLOBALIZATION AND SCALING IN ECOSYSTEM-BASED MANAGEMENT

The inaugural issue of Marine Ecosystems and Management (MEAM, Vol. 1, No. 1) was interesting reading and should provoke a healthy exchange of ideas over the months and years to come. I particularly like Jake Rice's essay on ecosystem-based management (EBM) titled, "Investigating the roots of confusion". I want to extend Jake's investigation by addressing another source of confusion about EBM. It is the issue of scale. A closely related issue is fragmentation.

Some think of EBM at the scale of the MPA that's important to them (as a manager, researcher, or stakeholder). Others have promoted EBM at much larger regional scales, such as the scale of large marine ecosystems (LMEs). However, with globalization, even the LME scale is not large enough for some aspects of EBM.

Globalization affects people, institutions and ecosystems on all scales from local to global, and is enabled by advances in technology that allow rapid communication, and movement of people and commodities. As a result, products that were once exchanged only locally are now bought and sold on global markets. Globalization is also a natural feature of our biosphere, connecting local environmental conditions to global processes that regulate climate, ocean circulation, and ocean and atmospheric chemistry.

Globalization is a reality that presents new challenges for EBM. Globalization can increase demand for some ecosystem goods and services, such as increasing the demand for fish products as a result of global markets. One new challenge is that not only must conservation and management of these resources balance local needs

and desires with sustainability of ecosystems, but they must also respond to global pressures. Even locally, culture and traditional values are evolving rapidly in response to globalization of communications and information, which challenges institutions for conservation and management to be flexible and adaptive so that they can keep pace.

So what is the proper scale for implementing EBM in a globalized world? Ultimately, EBM needs to be implemented at a nested hierarchy of scales from global to regional to local. The appropriate scale of a particular EBM project within the nested hierarchy depends on the (a) characteristics of the ecosystem that are priority considerations for EBM, (b) natural processes that are most relevant to the priority ecosystem characteristic, (c) anthropogenic drivers of change in the priority ecosystem characteristics, and (d) the

governance institutions that are available to implement EBM. It is interesting that three of the four factors related to the appropriate scale for EBM are determined by humans, not nature. Let me elaborate.

(a) Characteristics of the ecosystem

In general, EBM is aimed at conserving and sustaining ecosystem services to benefit current and future human generations. No one disputes such a generic goal for EBM or something like it, but it does not give practical guidance for implementing EBM, setting priorities or deciding on scale. In practice, EBM is usually implemented to protect a place that many people value, such as an estuary, bay, gulf or the site of a coral reef. In such cases, practical or operational objectives are formulated usually focusing on a few characteristics, such as aesthetics, recreational opportunities, fishery production, and factors that affect public health and safety. I refer to this type of EBM as place-based, and the size of the place of interest determines scale.

Ecosystem-based management can also be sector-based. For the fisheries sector, it is often referred to as an ecosystem approach to fisheries (EAF). Of course, EAF also occurs in a place. But there is an evolution from traditional fisheries management (which usually has the goal of a large sustainable yield) to EAF, which takes account of non-fishing factors that affect fisheries, as well as direct and indirect impacts of fishing on ecosystem services other than fishery yield. Like traditional fisheries management, the starting point of EAF is typically at the scale of fish stocks. But it may evolve from there to take account of non-fishery factors that impact fisheries, and impacts of fisheries on non-fishery services of ecosystems.

Place-based EBM and sectoral approaches such as EAF should not be viewed as competitive, or either superior to the other. Depending on the specific situation, they will evolve at different paces. For example, the legal framework for traditional fisheries management may also allow progress to be made with EAF in situations where there is not a framework for place-based EBM. This is generally the case in the US, although there are some specific places that are exceptions. Ultimately, place-based EBM and sectoral approaches, such as EAF, should converge and be mutually supportive.

(b) Natural processes

Marine ecosystems do not have impenetrable barriers that create closed ecosystems. Regardless of the location of ecosystem boundaries established for the purpose of EBM, there are almost always some biotic and abiotic exchanges across the boundaries. However, boundaries can be chosen to minimize these exchanges based on topography and ocean circulation.

(c) Anthropogenic drivers

In some cases, the anthropogenic drivers that affect priority characteristics of ecosystems occur on the same scale as the ecosystem characteristic. For example, fish productivity may be primarily affected by fisheries that take place at the same scale as the range of target fish stock. However, there are many cases where the scale of priority ecosystem characteristics and anthropogenic drivers of change do not match. For example, the health of a coral reef may be more affected by anthropogenic ocean acidification at the global scale, or sedimentation resulting from coastal development, than by any of the activities that occur in the vicinity of the reef. Globalization is a

generic anthropogenic driver that affects ecosystems at all scales.

(d) Governance institutions

Governance includes both (i) non-binding arrangements that facilitate communication, priority identification and goal setting, and coordinated planning, and (ii) legally binding instruments that can be used to regulate human activities. Legally binding instruments are often available to implement sectoral EBM, such as EAF. Non-binding arrangements may be a useful vehicle for harmonizing sectoral approaches. In practice, the scale at which EBM is implemented will depend on the scale of available governance instruments (local, regional, global). It will often be necessary to decide if it is better to use existing governance institutions even if their scale is not very appropriate, or to delay EBM until a governance institution with a more appropriate scale can be created.

The scale for EBM will usually require a compromise between considerations of factors (a–d). These compromises should not be much of a problem if there is good connectivity (in terms of communication and integration) among the elements of the nested hierarchy of EBM implementations. This connectivity needs to be both vertical and horizontal. An example of horizontal connectivity is adjacent community-based EBM projects taking account of how their actions impact their neighbors. Vertical connectivity needs to be two-way. EBM at lower levels needs to fulfill higher-level policies and goals. Higher-level EBM needs to control anthropogenic drivers that impact lower levels. Unfortunately, there is relatively little experience creating effective connectivity between EBM at a hierarchy of scales. This could lead to fragmentation. In a globalized

world, fragmentation has the potential to undermine even well-executed EBM at any particular scale.

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Editor's note: The goal of the following feature, The EBM Toolbox, is to promote awareness of technology tools that can facilitate EBM processes, and provide advice on using those tools effectively. It is brought to you by the EBM Tools Network (www.ebmtools.org), a voluntary alliance of leading tool users, developers, and training providers to promote awareness, development, and effective use of

technology tools for EBM in coastal and marine environments and the watersheds that affect them. The EBM Toolbox will be a recurring feature in MEAM.

Source: Marine Ecosystems and Management, vol 1, no 2
<http://www.meam.net>



THE EBM TOOLBOX

Ecosystem-based management of coastal and marine environments requires the integration of information about a vast array of environmental and human systems. Many different kinds of technology tools have been developed to help policymakers and managers collect, visualize, and analyze this information and engage stakeholders in the EBM decision-making process. For example, EBM tools can help:

- Collect local knowledge on resource use, such as favorite areas for fishing or diving;
- Visualize the impact of development on a coastal community and coastal ecosystems;
- Select optimal areas for conservation, restoration, or development; and
- Collect stakeholder feedback on management alternatives.

When you get started using EBM tools, you should determine what you want to get from using tools, what resources you have available to use them, and how you will integrate tools in your management decision-making process. The EBM Tools Network provides a series of questions to help with these decisions at www.ebmtools.org/using_tools.html. The webpage also offers several best practices for using EBM tools, gathered from practitioners worldwide (scroll down to "Using EBM Tools Effectively").

Research the available EBM tools and what each can and cannot do for your project. On the ebmtools.org website, click on "Find Tools" to access a searchable database of EBM tools. Once you have located tools that might be useful, you should contact the tool developers and other tool users for more detailed information and advice.

Learn more about EBM tools and the EBM Tools Network at www.ebmtools.org

■ ULTRA-LOW FREEZING LEADS TO HIGHER QUALITY SEAFOOD

Transportation and storage of seafood products at ultra-low temperatures is a growing business. The writer visits two Danish companies that are leading the way in technological development.

Maersk Line, which claims to be the biggest container ship operator in the world, has been spearheading the further development of reefer container technology to meet the demands of its global customer base.

"Constant care for the cargo we carry is the driving philosophy of Maersk Line, and seafood accounts for a very large chunk of our business," Henrik Lindhardt, Maersk Line's senior general manager in charge of reefer management, operations, technical sales and innovation within reefer management, tells Seafood Processor.

In order to meet its customers' demands, Maersk has put together a team of more than 100 dedicated reefer specialists. Today, it also owns the largest fleet of new state-of-the-art reefer containers.

"There is no major shift in our transportation protocols for seafood, but our reefer containers have got better and better. We have more capacity and can freeze down to much lower temperatures," reveals Lindhardt.

Certain types of products require transport at ultra low temperatures and this is why, in 1998, Maersk developed a new type of refrigerated container specifically for such products. The Maersk Super Freezer container is able to maintain temperatures as low as -60 deg C, which makes it ideal for transporting frozen tuna into the demanding Japanese sushi and sashimi market. The cargo can be loaded as loins or as whole fish.

By utilising a special Stuffie container, also supplied by Maersk, stuffings direct from the fishing vessel can be carried out. The Stuffie is connected to the Super Freezer and insulated with an airtight membrane to avoid ambient air entering the Super Freezer container. The cargo of fish is then loaded into the Stuffie through a hole in the roof, sorted and transferred into the Super Freezer. While high-priced sashimi-grade tuna is currently by far the biggest commodity transported in Maersk Super Freeze containers, other deep-frozen species known to benefit from being transported at -60 deg C include swordfish, sea urchins and salmon.

And with the rise of the sushi bar phenomenon in many countries in Europe, North America and elsewhere around the world, Japan will surely not be the only destination for Super Freezer containers in the years ahead. Transportation of seafood products at ultra-low temperatures is a growing business, according to Lindhardt, adding that Maersk is presently the only shipping line operating Super Freezers. Benefits of using the Super Freezer container include global coverage; limited re-handling of the products to ensure optimum quality at destination; an unbroken cold chain to the final place of delivery; and fast delivery, since the products can be shipped in smaller quantities, which also yields a higher market price and improved cash flow.

Bluefin tuna transported in Maersk's Super Freezer containers is one of the most expensive loads, so the company has special procedures in place to ensure safe and effective handling of this cargo. Other important benefits include departures and arrivals with fixed schedules which enable a more reli-

able, steadier supply; reduced cold storage costs; and extended season because less cargo is required to make a shipment.

TRIALS WITH FARMED SALMON

Maersk has also been looking at the ultra low temperature freezing and transport of salmon from Norway. This has included blast freezing the fish to -60 deg C immediately after slaughter at the processing plant, packaging then transporting it by Super Freezer container to destination via a distributional terminal.

A test shipment from Norway to South Korea, including sensory testing, has been carried out with good results, as also has a static trial and test shipment to Japan. The Norwegian institute SINTEF has documented the product quality. "The Norwegian salmon project is something we have been looking into to develop a concept we are able to offer to customers," explains Lindhardt.

Most of the processing plants do not have -60 deg C freezing capability, so they can use our special Blast Freezer, which is a transportable, containerised freezing tunnel. After being frozen and packed, the fish is then transferred into a Super Freezer and sent off. We've been testing out this concept with SINTEF on salmon over the last one and a half years, and the results on the quality side have been excellent. To prove the concept SINTEF has documented the quality and the super frozen salmon, when thawed, compares favourably with air-freighted fresh salmon.

The quality of the fish is as good or even or better than fresh when frozen and distributed at minus 60 degrees Celsius [-60deg C]. SINTEF has also been testing the minus 60 degrees Celsius freez-

ing and distribution of mackerel, rainbow trout and shrimp, and in all cases you achieve very good quality - but you need our freezers and containers to do it. Maersk describes its Blast Freezer as a portable, flexible and economical solution for freezing fresh seafood. The company has developed this special unit capable of freezing seven tonnes of fresh fish from 30 deg C down to -60 deg C within 24 hours at an ambient temperature of maximum 35 deg C.

The size of the Blast Freezer (some as a 40ft/12m high cube reefer) allows easy positioning on site. After freezing the fish down to the required ultra-low temperature, it is transferred into a Super Freezer container for direct delivery to the final destination. These Blast Freezer are available worldwide and can be delivered with power-pack and external fuel tank, making it completely self-sustaining.

And, with Maersk's Super Freezer containers, a complete freezing/transport package is therefore available. Transporting fish in Super Freezer containers is a continuously growing business. Today, these containers are predominantly used for tuna shipments, but Maersk Line's bid to expand the business by offering this type of freezing and distribution solution to other seafood sectors looking for increased revenues from the quality advantages it can bring, could pay off big time.

As a service to catchers of brine frozen tuna, Maersk Line has developed a special container loading system that facilitates efficient discharging and loading of fish from fishing vessel to standard reefer containers. Explains Lindhardt: "The tuna, mainly skipjack and yellowfish, is fished by purse seiners that come into port and take the fish out of their brine tanks. The

issue then is how best to get that fish into a reefer container. You could of course tip the container on its end so that the opening is on top, but that is not the best option!" Maersk's solution - developed on the company's behalf by Bennetts Engineering of Cape Town, South Africa - is designed to fill up to two containers at the same time. It comprises a large loading hopper equipped with a chute feeding each container, and a telescopic conveyor that extends into each 40ft reefer container.

For loading, the hoppers and containers are placed directly on the quay alongside the fishing vessel. The hoppers are fully mobile if required in a new location. "With the new system, you simply empty the net onto the hopper, and loose frozen fish first slides towards and is then conveyed into the container until it is full," says Lindhardt. "The fish is typically at minus 11-12 degrees Celsius when it comes out of the seiner's brine tanks, so we are also freezing it down further to minus 18 degrees Celsius." Productivity of the new loading system is 350-500 tonnes of fish per nine hour shift. "Exposure to the ambient air, humidity, rain and wind is minimised with the fast loading," explains Lindhardt.

"On completion of container stuffing, the doors are shut and the container is quickly put on to power." Once the brine frozen tuna is loaded, the shipper can enjoy the benefits of shipping in containers versus bulk cargo. These benefits, according to Maersk, include reduced handling, better maintenance of the cold chain, ship-side to door delivery at processing plant, ability to ship small lots of fish to multiple locations, and the ability to pre-sort (thereby allowing shipment by size and variety). First roll-cut of Maersk's new brine frozen fish container loading system

was made recently in the Seychelles, an important transshipping port for tuna purse seiners fishing the Indian Ocean. Heinz has a tuna canning factory in the Seychelles, but a lot of the fish unloaded in this small island nation north east of Madagascar is transferred to Mauritius and Vigo, in northwest Spain, for canning.

Another very practical innovation introduced a few years ago by Maersk is the Sortie. This is a reefer container modified to serve as a sorting area for frozen products. The cargo of fish loaded into the Sortie through a hole in the roof directly from the reefer vessel or fishing vessel. This is to minimise exposure to ambient temperatures during the sorting and/or stuffing operation. "Holes have been made in the side walls of the container, where up to five reefer containers can be attached by use of an airtight membrane," explains Lindhardt. "This operation prevents any ambient air from entering the container, and the whole compartment remains under full refrigeration during the entire operation." Sea-going container boxes have one of the toughest roles in the cold chain.

Not only do stacked reefer containers have to withstand heavy loads, but they must also cope with severe storms. Maersk's reefer containers are therefore manufactured to strict specifications and on the basis of extensive research. Before delivery, the containers undergo rigorous testing and are subjected to extreme weather conditions; from tropical to arctic environments. Basically four different companies supply the refrigeration units for Maersk's standard reefer containers: Carrier, Daikin, Maersk Container Industri (Star Cool) and Thermo King.

But only Thermo King, which helped Maersk develop the spe-

cial Super Freezer, supplies the customised refrigeration units for the ultra low temperature reefer containers. All Maersk's reefer containers have bottom-air delivery. This means that the cold air is supplied from the bottom of the container through the specially designed T-bar floor. Maersk Line also contributed to the development of the datalogger, the microprocessor that monitors the temperature of the cargo en route. Temperature probes are inserted directly into the fish to measure its core tem-

perature and records are stored by the datalogger. The probes measure the temperature to a degree of accuracy of ± 0.25 deg C. Gensets, most of them clip-on, are used to power Maersk reefer containers, thereby maintaining the set temperature for up to five days during rail or road transportation.

Maersk has about 200,000 reefer containers on disposal worldwide, and seafood in many different varieties and product forms is transported in the com-

pany's containers. "Seafood is a very important segment for Maersk and we are trying to provide as many shipping solutions as we possibly can," says Lindhardt, hinting that yet another innovation of interest to our industry will soon be launched.

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www.seafoodprocessor.com



Maersk reefer technicians and highly trained staff at the terminals and on board the vessels make sure the containers carrying the cargo are carefully monitored.

REGIONAL WORKSHOP ON IMPLEMENTING THE ECOSYSTEM APPROACH TO COASTAL FISHERIES AND AQUACULTURE

A two-day workshop on implementing the ecosystem approach in coastal fisheries and aquaculture brought together government representatives from both fisheries and conservation/environment departments from around the Pacific. This was the first time that representatives from these areas have come together to discuss fisheries-related issues and to work towards a common approach to address the issues.

The workshop (held in Noumea, New Caledonia on 29 and 30 October 2007) was opened by SPC's Director-General, Dr Jimmie Rodgers. He commended the inter-agency approach — the workshop included participants from different government departments that may have an influence on marine resources — and encouraged the promotion of further cross-disciplinary approaches in the future. He also noted the wide range of resource people attending the workshop: agencies included the Food and Agriculture Organization of the United Nations (FAO), the US Western Pacific Regional Fisheries Management Council (based in Hawaii), the government of Western Australia, and the Pacific Islands Forum Fisheries Agency. Dr Rodgers also referred to the World Summit on Sustainable Development commitment to implement ecosystem-based fisheries management by 2010, and stated that he expected participants to shape the direction for implementation of the ecosys-

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tem approach to fisheries (EAF) at the national level. He emphasised the need to create broad-based ownership and involve all stakeholders, particularly resource owners, in order to achieve sustainable solutions.

SPC's Coastal Fisheries Programme Manager, Lindsay Chapman, chaired the workshop, which included presentations from regional agencies that are currently implementing the EAF, as well as small group discussions on specific topics. Workshop objectives were to:

- develop a common understanding of the principles and approaches to the EAF in coastal fisheries and aquaculture;
- assess the status of EAF implementation in coastal fisheries and aquaculture in Pacific Island countries and territories (PICTs); and
- develop an approach for regional assistance by SPC and other agencies to implement the EAF at the country level.

Lindsay Chapman advised participants that the workshop would also serve as the starting point for a study being financed by The Nature Conservancy (TNC) and carried out by fish-

eries consultant, Garry Preston. All countries and territories were provided with a questionnaire prior to the meeting, and were asked to provide background information on the different agencies (international, regional, governmental and non-governmental) involved in fisheries, and the main issues in regard to implementing EAF management (EAFM) at the country level, among other things. The purpose of the study is to identify and document common principles and approaches to the strategic implementation of EAFM in the region. The study will:

- summarise the highest priority issues and gaps relating to adoption and implementation of EAFM in the region;
- identify strategies or proposals for addressing these; and
- identify potential roles, responsibilities and actions for SPC, other regional organisations, institutions and key non-governmental partners (including TNC), to ensure the adoption and effective implementation of the EAFM in the region.

The study will produce a number of reports and these will be widely distributed in the region for country comment and input before being finalised. In addition, a presentation of draft study findings will be provided to the Special Heads of Fisheries Meeting to be held in Apia, Samoa (11–13 February 2008).

SUMMARY OF PRESENTATIONS

Presentation 1 — Masanami Izumi, FAO

Mr Izumi (FAO) made a presentation on FAO's approach to the EAFM. He advised participants

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that, six years ago, the 2002 Reykjavik Conference on Sustainable Fisheries in the Marine Ecosystem resulted in a declaration in which member countries committed to the principles underlying an EAFM. The 2002 World Summit on Sustainable Development in Johannesburg made specific reference to the Reykjavik Conference, and set 2010 as a target for countries to implement an EAF. The ecosystem approach was adopted by the FAO Committee on Fisheries in early 2003. FAO defines the ecosystem approach as follows:

An Ecosystem Approach to Fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

By addressing both human and ecological well-being, the definition above recognises that EAF intends to implement sustainable development concepts in fisheries. This definition merges two paradigms: 1) protecting and conserving ecosystem structure and function, and 2) fisheries management, with its focus on providing food, income and livelihoods for humans.

Mr Izumi gave examples of how an EAFM might be required with regards to trawl fisheries and the incidental capture of seabirds in longline fisheries. He pointed out the growing influence of environmental and conservation non-governmental organisations (NGOs) and international bodies in demanding a more responsible approach to marine resource exploitation. He noted that the United Nations Convention on the Law of the Sea (UNCLOS), the United

Nations Conference on Environment and Development (UNCED), and FAO have prioritised adoption of the EAFM by their adherents, with 40% of the FAO Fisheries Department's budget allocated to this. The EAFM is an extension of conventional fisheries management but recognises the need to consider and manage fisheries as an integral part of the broader natural and social environment through approaches such as implementing the FAO Code of Conduct on Responsible Fisheries, greater attention to biodiversity, and better sectoral integration. In summary, Mr Izumi concluded that the concepts and principles of EAFM are now becoming clear, and that FAO has unique skills and capabilities to promote the EAFM.

Presentation 2 — Jarad Makaiau, WPRFMC

Mr Makaiau (Western Pacific Regional Fisheries Management Council) gave a presentation on the EAFM being used within the WPRFMC, which groups together the US-affiliated islands and freely associated states in the Pacific. The Council's aim is to ensure sustainable fisheries that are socially and environmentally responsible. The Council includes a number of US federal and territorial agencies, and is advised by technical agencies, ad hoc stakeholder groups, and the industry. There are currently management plans in place for five major species groups, but the trend is to move towards more comprehensive plans that address resource groups, such as coastal or demersal species. Mr Makaiau noted the importance of addressing terrestrial issues such as garbage disposal, and including coastal development in fisheries management considerations. Many activities that have nothing to do with fishing have impacted negatively on marine resources, and

these need to be addressed. In the Pacific Islands, traditional knowledge can contribute to the EAFM, but this tends not to be sufficiently recognised or used. Greater attention needs to be paid to developing partnerships with communities in managing their marine resources. WPRFMC is currently developing a management indicator in the form of a model to assess the health of coral reef fisheries. It examines changes in the trophic level of catches over time in order to determine whether US insular states are "fishing down the food chain".

Participants noted that the Council's fisheries management plans appeared to be already fully consistent with the EAFM. Mr Makaiau confirmed that this was the case, and that US policy had not changed in regard to the requirements for fishery management plans. US laws require the Council to prepare species or species group management plans, applying "conventional fisheries management tools". Through an EAF planning framework WPRFMC is now trying to shift from single species plans to plans that are better aligned to the ecosystem approach, but single species plans will still be required by law. However, the collection of ecosystem information provides a broader framework in which the plans can be embedded.

The workshop commended Mr Makaiau on the Council's approach to using traditional information and knowledge in its approach to EAFM, but noted that in some cases such knowledge has been lost. Mr Makaiau agreed, and noted the difficulty of accessing traditional knowledge even in places where it still exists. Traditional knowledge is generally not written down, and those who hold it may be reluctant to share it due to tradition and custom.

Presentation 3 — Maruia Kamatie, FFA

Mr Kamatie (Forum Fisheries Agency) made a presentation on FFA's EAFM approach to tuna fishery management. He noted that FFA's approach, which attempts to identify the full range of issues impacting on the resource, has so far been introduced in four FFA member countries. Ecological elements include target species, bycatch species and the general ecosystem, while human elements include community well-being and administration. Ultimately this allows the development of a component tree based on these five elements, which in turn leads to a prioritisation process and a risk assessment that helps select the management strategies to be adopted. Performance measures, monitoring requirements and thresholds for management responses can then be determined. Mr Kamatie noted the somewhat differing views on management expectations and outcomes (such as resource conservation, economic yield or social benefits) that different stakeholders may hold. He also emphasised that the EAFM is a management process, not a research process.

Presentation 4 — Rick Fletcher, WA Fisheries

Dr Fletcher (Western Australia Fisheries and Marine Research Laboratories) noted that within the Pacific, the EAFM is not about managing fisheries for the sake of the environment, but to provide benefits to people and society within this region.

In Western Australia the 30 managed fisheries have already each been assessed for their compliance with EAFM principles. The assessments were required by regulations; fisheries that do not comply will be unable to sell or export their products. Western Australia

uses a similar process to FFA in regard to the identification and prioritisation of issues using risk assessment. Dr Fletcher noted that processes developed for the EAFM approach are now being applied to the agriculture sector and other terrestrial activities such as soil and salinity management.

WA is now moving to not only assess individual fisheries, but to also assess their combined or cumulative effects at a regional level, including the activities of other sectors (e.g. terrestrial activities). As in other countries, the regional-level EAFM process in WA is complicated by the wide range of sectors (e.g. mining and coastal development), stakeholders and government agencies (at both state and federal levels) involved, which leads to poor coordination and duplication of effort.

Dr Fletcher concluded his presentation with a number of lessons on the EAFM process, including recommendations that scientists not be allowed to dominate what is essentially a management process, and not to wait until more information is gathered before beginning the process.

The question arose as to whether the fishing industry had any responsibility to ensure its own compliance with Western Australia's EAFM requirements. Dr Fletcher responded that industry was not required to do its own research in this regard, but that research carried out by the government was financed mainly from levies on the industry.

Presentation 5 — Mike King, consultant

Dr King gave a presentation on EAFM efforts by the Coastal Fisheries Management Section of SPC's Coastal Fisheries Programme. He cited some ecosystem impacts of fishing, including

harvesting parrotfish, which allows algal growth on corals, and removal of triggerfish, which allows sea urchin populations to expand. He also gave examples of some land use practices that impact on the region's coastal marine resources, including sedimentation resulting from poor land management practices and excessive nutrient inflows caused by sewage and farming. These cause coral smothering, infilling of inshore lagoons, sea-grass growth at the expense of corals, and blooms of undesirable algae and other microorganisms, which in turn may lead to increased incidences of ciguatera and other health problems. He pointed out that many of these issues were beyond the capacity or scope of fisheries management agencies to address directly, indicating the need to involve a range of agencies in the EAFM. Possible solutions to some problems might include promoting community-based management, and a requirement for environmental impact assessments on development projects (especially projects undertaken by governments). Dr King provided some suggestions on the development of management targets and reference points that might be applicable to some Pacific Island fisheries. He also noted that marine protected areas (MPAs) are likely to become an increasingly important tool in managing the region's coastal fisheries. He concluded by noting the difficulty of getting government agencies to work together to address external impacts affecting fisheries.

Dr King was asked if there was information on the impacts of global warming on marine resources. Dr King advised that some literature is available on the subject, but that global warming is a large-scale issue that will be difficult for small countries to influence, and probably beyond the scope of the present workshop.

There was some discussion of an earlier comment by Dr King that "fishing down the food chain" was unlikely to occur in tropical reef fisheries, as well as the use of maximum sustainable yield (MSY) as a management target. Dr King responded that while fishing down the food chain is certainly possible in tropical fisheries, it seems less likely to occur when many trophic levels are being targeted. As regards sustainable yields, MSY is now considered a somewhat dangerous target to aim for, and maximum economic yield (MEY) is more frequently used. In many fisheries, however, insufficient data means that management is not based on either of these calculations, but on rules of thumb or intelligent guesswork.

GENERAL DISCUSSION ON THE PRESENTATIONS

The workshop noted that coastal erosion is a further unwanted consequence of degraded lagoon and reef systems. Earlier statements regarding the nature of the EAFM — that it is a process of managing humans, not ecosystems — were reiterated. Fisheries inevitably result in change, but the EAFM provides an alternative way of assessing what changes are acceptable. It may be acceptable from a fisheries perspective to allow reduction of stocks of an apex predator to 30% of its original biomass, but this may be unacceptable from other perspectives, if, for example, removal of this predator results in the expansion of undesirable species.

It was pointed out that the discussion of the EAFM appeared to be branching into two broad themes: the idea that fisheries management may impact other aspects of the ecosystem, which is within the capacity and mandate of fisheries management agencies to address; and concept of integrated coastal manage-

ment, in which fisheries is one of a number of sectors in a broader framework that requires broad interagency consultation and a higher-level management decision-making process. Essentially, managing the downstream effects of fisheries on ecosystems and other sectors may be within the capacity (and mandate) of fisheries agencies in the region. In contrast, it may not be possible for fisheries agencies to address upstream effects (i.e. the impacts other sectors may have on the marine environment, including fisheries).

It was noted that in American Samoa the approval of development projects is required by a Coastal Management Board, which is composed of all agencies dealing with topics relevant to the Board's mandate (fisheries, health, environment, etc). Development projects must obtain permits from each relevant agency and approval of the Board before they can proceed.

Similar arrangements are being established in Cook Islands in order to address broader coastal management issues, where community consultation is an important part of the process. Government departments are working together to address cross-sectoral issues, such as sewage from pig farms entering Rarotonga's lagoon. This was commended as a very positive development, and contrasted with the situation that existed just a few years ago, when it was highly unlikely that a fisheries department would spend its money on issues not directly related to fisheries.

In Palau, arrangements similar to those described for American Samoa are being put in place. This does not always ensure that development projects receive sufficient scrutiny, but the situation is improving. As part of its commitment to the EAF, Kiribati has declared the Phoenix Islands as an MPA.

The question was asked as to whether a generic EAF model for the region is needed, given the differing circumstances among PICTs. It was noted that even though there may be no common model or approach that suits all situations, countries could nevertheless share experiences and learn from each other. In Kosrae (Federated States of Micronesia), the need to balance environmental protection with economic development was also recognised.

The authorisation of development projects through high-level government decisions in the absence of environmental assessments or other due process was cited as a problem in the region.

Participants also asked which regional agency in the region is mandated to coordinate country actions in regard to the implementation of the EAFM in coastal fisheries. Lindsay Chapman responded that members of the Council of Regional Organisations in the Pacific (CROP) would have to coordinate in order to divide responsibilities and actions with respect to the EAFM.

WORKING GROUPS

The remainder of the workshop was conducted through working groups, all of which discussed the same specific questions and then reported back during plenary sessions. Four working groups were formed; discussion topics were based primarily on the presentations made earlier in the day. The discussion group topics and a summary of their findings follow.

Working Group Topic 1

What common principles do you extract from the various presentations as defining the "ecosystem approach" in respect of coastal fisheries management? Also, are any of

these principles in conflict with your own national understanding or interpretation of the "ecosystem approach"?

Some of the key conclusions from the working group presentations were summarised at plenary by the consultant. Of the 16 principles identified by the groups, those most commonly thought to be of highest relevance to the Pacific Islands region were as follows (numbers in brackets indicate the number of groups that reported a particular theme or issue).

- EAFM requires broad stakeholder engagement — community, fisheries, environment, NGO, industry (4);
 - EAFM must recognise the interdependence between people and environment, and focus on managing people and their activities (4);
 - There is a need to recognise and incorporate traditional knowledge and management practices into EAFM (3);
 - EAFM will benefit from a spatial planning approach (ridge to reef) to address terrigenous effects on marine spaces (2);
 - EAFM requires a holistic approach, involving environmental, sociocultural and economic issues (2);
 - EAFM aims to maintain ecosystem services and functions for fisheries and other uses (2);
 - Fisheries (and other sectors) must be managed to avoid unsustainable development and minimise environmental impact (2);
 - EAFM requires a shared vision and a common goal among participating stakeholders and agencies (2).
- It is not possible to address all issues, so the processes of risk assessment and prioritisation are critical (2).

In addition to these EAFM principles, many groups provided comment on the challenges and opportunities that they presented. Of the 19 challenges identified, those most commonly mentioned were:

- inadequate inter-agency collaboration, and conflicting agency remits and mandates (3);
- political interference and lack of high-level commitment to EAFM and broader environmental issues (2); and
- partitioning the roles and responsibilities of different levels of government (national, state/ province, local).

As regards opportunities, of the 11 identified by the working groups, those most commonly mentioned were:

- EAFM can commence now; there is no need to wait (2);
- Inter-agency collaboration can be improved through formal working arrangements such as committees, memoranda of understanding, etc. (2);
- Policy can be favourably influenced by public advocacy or prominent personalities, as well as through initiatives such as the Micronesian Challenge (2).

In general there was less consensus among the groups on challenges and opportunities.

Working Group Topic 2

Bearing in mind the principles of the ecosystem approach agreed above, what existing elements of coastal fisheries management in your country can be considered already "EACFA (ecosystem approach to coastal fisheries and aquaculture)-compliant"? Also, what existing coastal fisheries management measures or traditions are not "EACFA-compliant" or work against the implementation of the EACFA?

Each working group reported the conclusions of its deliberations back to the workshop, based on the initial list of principles identified above (main outcome from the first group discussions). Most groups reported on specific situations in each country represented in the group, without analysing common themes. The information presented on individual countries was quite detailed and will be helpful in the follow-up work that will be done after this workshop by the consultant. However summarising the information was difficult as many of the issues identified related to only one country, were different among countries, or concerned several of the identified EAFM principles. Table 1 summarises some of the common ideas that emerged from the working group presentations.



Table 1: Working group findings on Discussion Topic 2.

Principle	What is compliant	What is not compliant
Implementation of the EAFM requires a participatory approach that involves all stakeholders.	<ul style="list-style-type: none"> • Inter-agency boards and/or committees that must sign off on development projects. • Stakeholder engagement through advisory committees and MOU. • Partnerships with national and local NGOs. • Area management plans. • Fishery legislation that provides for management planning through consultation. • Formal public hearings on projects and proposals. • Informal task forces, communication and information sharing among public agencies. 	<ul style="list-style-type: none"> • Exclusion of important sectors from committees or other working arrangements. • Poor inter-agency coordination. • Lack of regulation of local fishers and markets. • Live rock and aquarium trade. • Translocation of marine species. • Conflicts between users and/or interest groups. • Varying expectations among communities with different levels of development. • Decisions made without proper consultation.
Traditional knowledge should be incorporated into the process wherever possible.	<ul style="list-style-type: none"> • Conservation area planning. • Community-based fisheries management plans. • Traditional gear restrictions and closed seasons. • Review of legislation and proposals by customary authorities. • Community representation through agencies or bodies formed for that purpose. 	<ul style="list-style-type: none"> • Community structure in Melanesian countries may make community-based management more difficult. • Traditional ownership conflicts. • Traditional fishing activities or user rights are not always in line with EAFM (e.g. turtles, destructive fishing methods). • Lack of enforcement authority by traditional bodies or local communities.
Absence of scientific information should not be used as a reason for not commencing to implement the EAFM.	<ul style="list-style-type: none"> • Implementation of plans and strategies, including community-based management plans. • Use of scientific information where it is available. • Precautionary measures that preclude fishing activities in the absence of scientific information. 	<ul style="list-style-type: none"> • Inadequate monitoring of human impacts. • Inadequate review and adjustment of plans to adapt to changing circumstances. • Pressure by interest groups to require scientific justification for government decisions on resource management. • Requirement for MSY to be used in fishery management plans.
A holistic approach is needed when planning and implementing the EAFM.	<ul style="list-style-type: none"> • High level environmental or other policies and mandates. • Regional mechanisms for integration/ regional agencies. • National integrated coastal management frameworks (e.g. ridge to reef) • Aquaculture development and management plans. • Rehabilitation of mine and earthwork sites. • Water discharge and waste management regulations. 	<ul style="list-style-type: none"> • Limited policy activity coordination by national government. • Poor donor harmonisation. • Single-species management frameworks. • Differing scales required for different management actions. • Most outer-island developments.
Principles of sustainable development need to underlie the EAFM.	<ul style="list-style-type: none"> • Requirements for environmental impact assessments. • Existing fisheries management arrangements based on the precautionary approach. • Planning processes requiring that environmental, social and economic issues be addressed. 	<ul style="list-style-type: none"> • Distortion of management arrangements by economic or commercial factors or priorities. • Low acceptance of EAFM by large commercial enterprises, especially in the mining sector. • Insufficient regulation of coastal development.
The EAFM, like all forms of resource management, is based on controlling and influencing human activity rather than directly changing the ecosystem.	<ul style="list-style-type: none"> • Community-based management programmes. • Education and public awareness programmes. • Fishery input controls (licensing/ permitting). 	<ul style="list-style-type: none"> • Inconsistent and/or changing government policies, political agendas. • Monitoring small-scale fisheries difficult and costly (easier and/or more cost-effective at a larger scale).
It is not possible to address all issues, so the processes of risk assessment and prioritisation are critical.	<ul style="list-style-type: none"> • National Development Strategies. • Sector strategies (fisheries and others). • National Biodiversity Strategy Action Plan (under the Convention on Biological Diversity). • Community management plans. • Protection plans for sharks and other sensitive groups. 	<ul style="list-style-type: none"> • Plans often not implemented. • No prioritisation of coastal management issues by government. • Decisions made primarily on economic development grounds. • Lack of resource allocation.

Working Group Topic 3

What measures need to be implemented before your country can be considered to be fully applying the ecosystem approach to coastal fisheries and aquaculture? (Provide as much specific detail as possible).

Each working group reported the conclusions of its deliberations back to the workshop, again in some cases by presenting specific situations in each country represented in the group, rather than by analysing common themes. A subsequent analysis by the consultant revealed that the most common themes were as follows.

Governance and policy

- harmonise government policy/legislation to improve consistency, clarify overlapping mandates, ensure consistency with international treaties;

- establish high-level, cross-sectoral bodies with strong mandates and leadership to ensure integrated decision-making;
- establish mechanisms to agree on common goals;
- establish integrated coastal management policy and legislation, with long-term horizons and periodic review;
- ensure good recording of decision-making processes so that decisions can be reviewed and understood in the future; and
- apply the precautionary approach.

Legislation and management

- examine legislation to identify and remove impediments to EAFM;
- strengthen environmental impact assessment legislation;
- develop legislation and management plans for aquaculture, which is relatively new in most countries;
- improve enforcement of existing regulations and other management measures — identify and eliminate weaknesses in compliance systems; and
- provide incentives and support to fishery and aquaculture activities that are ecologically sensitive and responsible, and discourage or prevent those that are not.

Stakeholder participation

- establish national stakeholder forums involving government, industry, NGOs, etc. in various sectors;
- establish formal and informal education and aware-

ness-raising programmes at all levels, but especially for communities;

- extend community-based management programmes;
- prioritise locations and areas that are most in need of management attention and/or support; and
- identify alternative income generation activities that provide alternatives to marine resources.

Technical measures

- provide capacity-building to make managers more familiar with how EAFM will affect the way they carry out their activities;
- establish models for EAFM implementation, and determine when these will be of benefit to management and decision-making;
- identify case studies of successful implementation — start with easy ones, then expand or replicate these;
- undertake resource and habitat mapping or characterisation through large-scale assessment tools (e.g. remote sensing, geographic information systems);
- undertake risk assessments to identify key priorities for management research;
- build agency capacity to undertake broader ecosystem assessments and monitoring;
- ensure that monitoring is done at appropriate scales, intervals and degrees of accuracy;
- establish systems to monitor progress, with realistic implementation targets and regular review; and

- identify appropriate, cost-effective ecological, social and economic indicators.

Funding and support

- increase the visibility of EAFM and identify incentives or ways to make EAFM attractive, in order to influence budget and donor processes;
- investigate sustainable financing models;
- impose levies on tourism, fishing, etc. to support EAFM;
- establish funding and technical support partnerships with relevant national and international agencies; and
- use SPC and other regional organisations to help countries meet the additional responsibilities that will flow from the EAFM.

The working groups identified many other issues and made numerous additional comments; many queried whether Pacific Island countries and territories have the human capacity to take on the additional responsibilities that the EAFM requires. The need to generate political will was noted, through the use of valuation of the contribution of coastal and subsistence fisheries to national and local economies, and clear demonstration of the benefits of using EAF. Although fisheries agencies obviously have a part to play in promoting the EAFM, it was not always clear that the fisheries agency should necessarily be the main driver in the process, given that EAFM involves many sectors.

WORKSHOP SUMMARY

During the final session, the consultant, Garry Preston, made a presentation that provided participants with a summary of EAFM principles, chal-

allenges, opportunities, areas of compliance and non-compliance, and future requirements, as determined by the working groups and presented above. Mr Preston also presented some views on how fisheries agencies might respond to the challenges that the EAFM presents, by:

- taking a more active advocacy role in promoting inter-agency collaboration and raising official awareness of the impacts that other sectors have on fisheries;
- identifying fisheries where ecosystem impacts can be observed, and improving management of these fisheries;
- considering opportunities for non-extractive use of marine resources, and promoting these where they provide economic benefits as well as clearer compliance with the EAFM;
- considering overall management approaches and trying to set management goals that maximise fishery profitability and ecosystem services, even though this may be at the expense of greater levels of participation in fisheries; and
- promoting customary and traditional systems that allocate marine resource usage rights to a limited numbers of users.

In response to the summary, workshop participants noted that in some countries there are already inter-agency committees or other collaborative mechanisms to discuss multi-sector issues such as climate change. Where they exist, these mechanisms could be adapted to promote collaboration in regard to the EAFM, rather than establishing new mechanisms for this purpose. It was also noted that, as well as promoting inter-

agency collaboration at the national level, there was a need for better coordination of the activities of Pacific regional organisations, as several are involved in issues relating to the EAFM.

It was noted that the application of the EAFM does not necessarily involve any new activities or directions. The EAFM can largely be implemented if fisheries agencies ensure that consideration of environmental, social and economic issues is integrated into the fishery decision-making process. Rather than waiting for multi-sector approaches to become effective, a good approach is to address fishery issues first, while also attempting to broaden the stakeholder base to include other sectors. Fisheries managers will always have to deal with uncertainty, but risk assessment can reduce the likelihood that poor decisions are made. Countries were advised to take the initiative of determining their own priorities and presenting these to donors and partner agencies, rather than letting others set the agenda for funding and technical support interventions.

The upstream (impacts of other sectors on fisheries) and downstream (impact of fisheries on other sectors) aspects of the EAFM were discussed. It was noted that a recent SPC questionnaire survey among fishery managers had identified sewage pollution as a more important issue than overfishing. Garbage disposal and siltation were also noted as being significant issues in many localities. Environmental impact assessments of new projects can help mitigate their impacts, but do little to alleviate existing problems. Examples were given of mitigation options for sewage pollution, which ranged from the very costly treatment of centralised sewage processing facilities, to the cheaper,

low-technology approach of mangrove replanting by coastal communities.

The question was raised whether MPAs and restocking of reefs with juveniles of important fishery species were useful approaches to management. Mr Preston responded that both approaches could be useful fishery management tools, but neither would solve fishery management problems on their own. MPAs can provide refugia for animals of reproductive age, but the overspill and recruitment benefits of these to the broader fishery have yet to be quantified, and management of fisheries outside MPAs is still necessary. As regards reef reseedling, this may be valuable in specialised situations, such as restoring depleted stocks or populating areas that are devoid of suitable habitat for juveniles. However, if restocking is not done within a management framework, then fisheries productivity, yields and profitability may continue to be held down to sub-optimal levels, and the government may find itself in a costly open-ended commitment to continue financing restocking programmes. Other participants expressed the view that, despite these reservations, MPAs and reseedling programmes raise awareness and have a positive impact on attitudes toward marine resource management; they suggested it is better to establish MPAs than to do nothing.

FOLLOW-UP ACTIVITIES

The workshop chair advised the meeting of SPC's future plans to promote the EAFM after the conclusion of the present workshop. The SPC-TNC study referred to earlier is expected to produce the following outputs over the next few months:

- a review of the current status of EAFM in the region (the EAFM questionnaires that

have now been completed by all SPC member countries will contribute greatly to this work);

- a proposed strategy for EAFM implementation (a draft of this document will be distributed widely in the region and among workshop participants to maximise comment and input from all stakeholders before the document is finalised);

- a discussion paper for the CROP Marine Sector Working Group (based on the outcomes from the proposed strategy document); and
- an information brochure on EAFM.

The substantive outputs of the study (in draft form) have been presented to the special Heads of Fisheries meeting to be convened in Apia, Samoa from 11–13 February 2008, with completion of all outputs scheduled for the end of March 2008.



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SETTING LONGLINES DEEP TO AVOID BYCATCH

INITIAL TRIALS USING THE DEEP SET TECHNIQUE

In 2006, a deep-setting longline experiment was conducted in Hawaii in coordination with the Secretariat of the Pacific Community (SPC), the Pacific Islands Fisheries Science Center (PIFSC), and the University of Hawaii Joint Institute for Marine and Atmospheric Research (JIMAR). Current commercial tuna longline setting techniques were altered to test a method developed by SPC to eliminate all shallow set hooks (less than 100 m depth) from tuna longline sets. By eliminating all shallow set hooks, researchers hoped to maximise target catch of deeper dwelling species such as bigeye tuna, reduce the bycatch of turtles and other protected species, and reduce the incidental catch of many species of marketable, but less desired fish (e.g. billfish and sharks). The technique was first tested in Mooloolaba, Australia on a commercial tuna longliner (Beverly and Robinson 2004). The technique worked well and the results were promising. Sets on one fishing trip in 2004, using the deep-setting technique, caught more bigeye tuna than sets using the boat's normal configuration.

However, because of the small amount of data (only 6000 hooks were fished in all) the results of these trials were considered to be anecdotal only. One of the recommendations from the project in Australia was that more testing was needed to get a more robust data set and to ascertain whether or not the technique could reduce the

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and Michael Musyl³*

catch of bycatch species. Just after the first trials in Australia, the deep-setting technique won the First WWF Smart Gear Competition as the best bycatch reduction method (Bazilchuk 2005); and SPC produced a brochure in 2005 for fishermen, giving details on how to set a longline deep using the deep-

setting method (SPC 2005). Figure 1 depicts one basket of deep-set gear (from Beverly and Robinson 2004) while Figure 2 depicts deep-set gear being set from a longline boat.

In 2006, a vessel was contracted from the Hawaii-based tuna longline fleet to perform 90 longline sets (45 sets using the deep-setting technique and 45 control sets using standard methods). In the experiment, fishermen were allowed to keep and sell their catch and choose their fishing areas, and setting and hauling times. A deep set was achieved by attaching paired 3 kg lead weights directly below paired floats on long portions of the mainline, there-

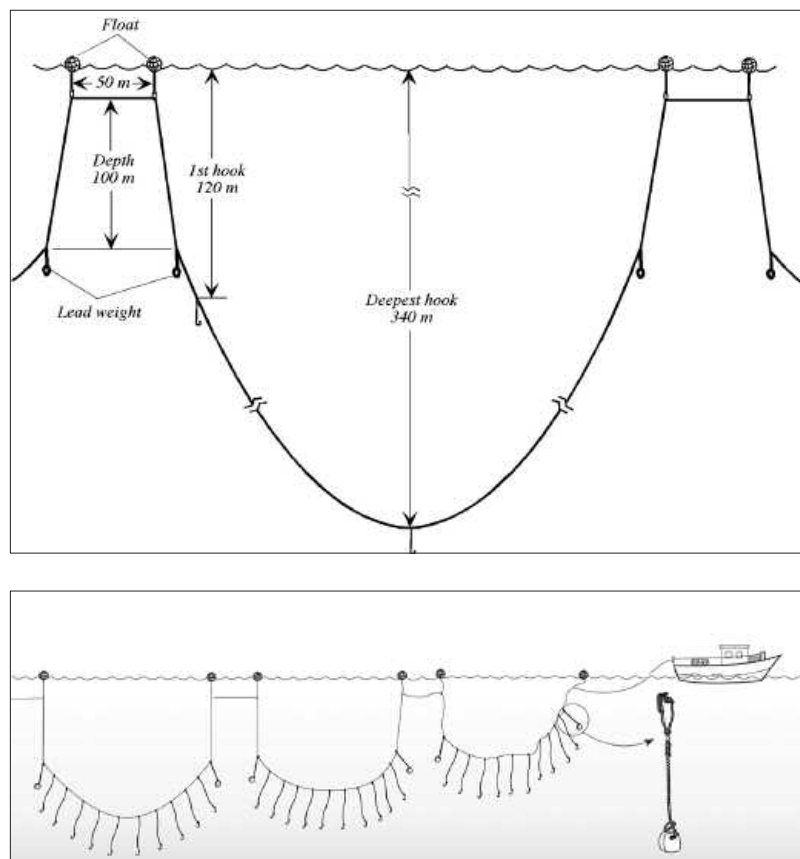


Figure 1 (top). One basket of deep-set gear.

Figure 2 (bottom). Deep-set gear being set from a longline boat (note position of lead weight).

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by sinking the entire fishing portion of the line below the target depth of the shallowest hook (100 m). Except for additional lead weights, floats and floatlines, which the project provided, only very slight modification was required of the existing longline fishing gear and methods. The vessel alternated between the deep-setting technique on one day's set and their standard technique (control) on the next day's set. A control set deployed 2000 hooks in 27-hook baskets and a deep-set deployed 2000 hooks in 30-hook baskets. A researcher accompanied the vessel on all trips. The researcher documented catch by gear type and attached temperature depth recorders (TDRs) during every set to determine fishing depth of the gear.

RESULTS OF DEEP-SET TECHNIQUE TRIALS IN HAWAII

The deep-set technique was easily integrated into daily fishing activities with only minor adjustments in methodology. The main drawback for the crew was the increase in time to both deploy and retrieve the gear. The deep-set technique added about 30 minutes to deployment operations and approximately 2 hours to hauling operations. Catch totals on the deep-set gear were greater for both bigeye tuna (*Thunnus obesus*) and moonfish (*Lampris guttatus*); whereas catch of less valuable incidental fish (e.g. striped mar-

lin, *Tetrapturus audax*) and wahoo, *Acanthocybium solandri*) was lower. Figure 3 shows percentages of catch of 14 species on both gear types (Beverly et al.

unpublished). TDRs placed on the gear verified that the deep-set method achieved the goal of ensuring that all hooks sank to below 100 m. The first and last

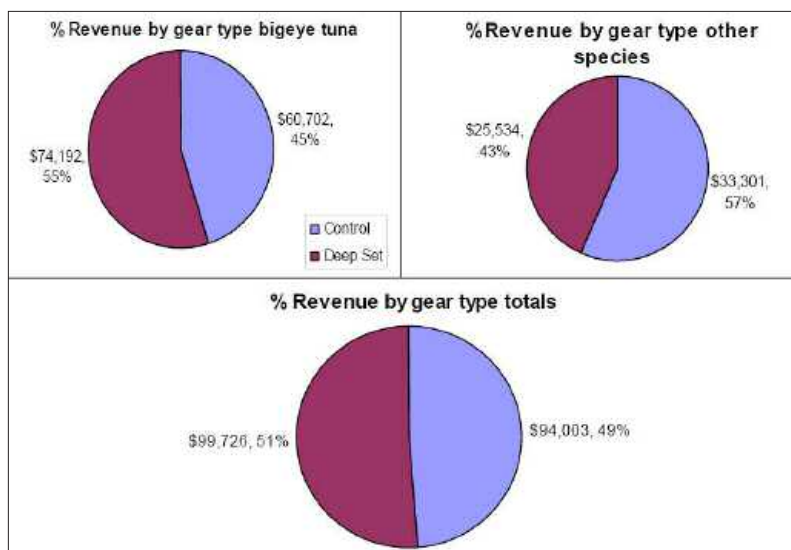
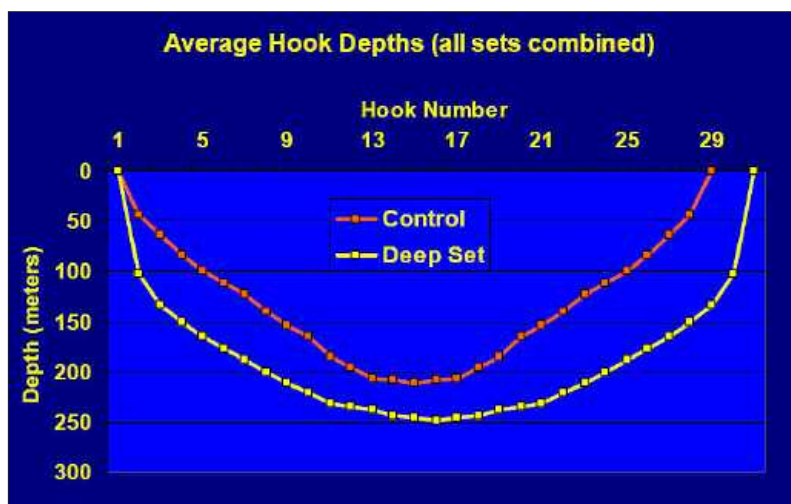
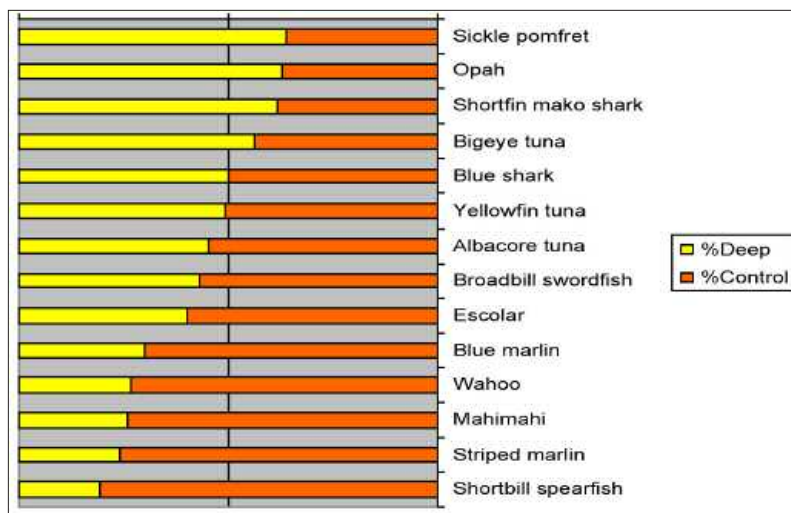


Figure 3 (top). Percentages of catch (% total number of fish caught) from 45 deep sets and 45 control sets in the Hawaii tuna longline fishery.

Figure 4 (middle). Average hook depths for control baskets and deep-set baskets.

Figure 5 (bottom). Percent revenue for bigeye tuna and other species for both gear types and for total gear.

hooks of each deep-set basket of gear consistently fished at just below 100 m (average 1st hook depth for all sets was 105 m), but control set gear consistently fished from about 40 m of depth. The average middle hook depths (assumed to be maximum depths of gear) of each basket were 251 m for deep-set gear and 211 m for control set gear; thus, the deep-set method does not dramatically change the general vertical sag profile of a basket of gear, but simply shifts the whole profile down about 60 m at the first hook and 40 m at the middle hook (Fig. 4). The deep-set method effectively placed all of a set's hooks at depths where bigeye tuna were more likely to be encountered. The results have shown that the deep-set technique does work and would be practical to incorporate into existing fishing practices in Hawaii's tuna longline fleet without jeopardising catch rates

of bigeye tuna. In fact, the revenue from the deep sets was about 6% higher than the revenue from the control sets, based mostly on the increased catch rate for the higher valued bigeye tuna (Fig. 5).

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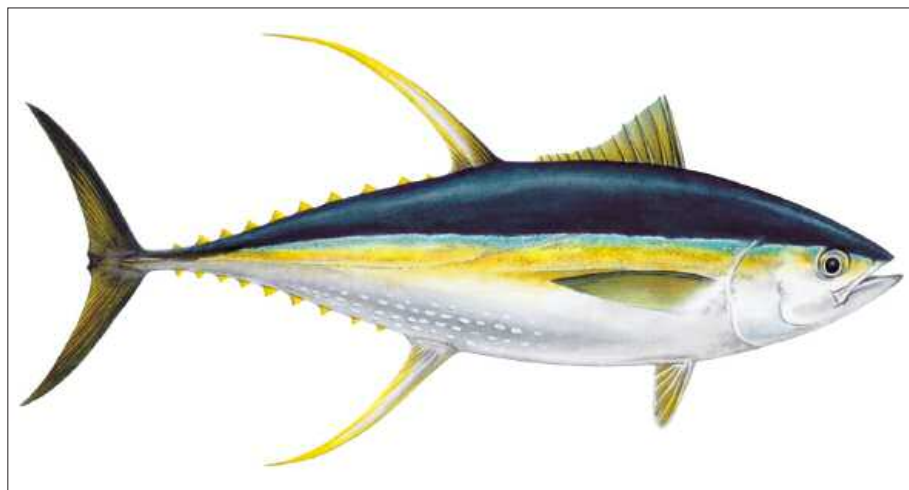
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SPC HOSTS REGIONAL MEETING ON AQUATIC BIOSECURITY

WHAT IS BIOSECURITY?

When hearing the term “aquatic biosecurity”, the first question many people may ask is “What is it?” There is no simple answer. Aquatic biosecurity encompasses a range of concerns relating to the responsible quarantine and translocation of marine aquatic plants and animals, the protection of important ecological and cultural aquatic species, managing aquatic disease outbreaks, safeguarding public health, and abiding by international trade standards.

While the introduction, cultivation, genetic improvement and mass production of aquatic species is integral to development in the region, they also necessitate that safety measures be addressed. Some key concerns include unexpected outcomes arising from the introduction of a new species, particularly if it becomes invasive; the spread of pathogens such as viruses that have can serious economic and environmental consequences; and maintaining the national health status as a prerequisite for trade and export.

Fortunately, risk assessment can minimise the likelihood and consequences of an undesirable biosecurity impact. Risk assessment is a key decision-making tool in biosecurity because managers need to manage risks — a zero tolerance approach to risk is not always practical.

BIOSECURITY NEEDS ASSESSMENT

In 2004, SPC’s Aquaculture Adviser visited several Pacific

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Island countries to assess the needs and capacity for aquatic insecurity. It was immediately apparent that many countries lacked the basic expertise to address aquatic insecurity. Also lacking was cross-agency collaboration, especially between fisheries, quarantine, environment and veterinarian services. It was also noted that the driving force behind aquatic insecurity issues was often related to aquaculture. Support at a regional level was seen as part of the solution to overcoming the challenges facing the Pacific.

PACIFIC ISLANDS REGIONAL BIOSECURITY MEETING

The recent SPC regional aquatic biosecurity meeting — held at SPC’s headquarters in Noumea from 31 October–2 November 2007 — was a small milestone for the regional development of aquatic biosecurity measures. Instead of the usual fisheries-focused forum, a broader spectrum of personnel from government agencies — fisheries, environment, quarantine and veterinarian services — attended the meeting. SPC’s Land Resources Division was a key resource partner, drawing on its knowledge of plant and animal biosecurity. Other participating organisations included the Pacific Regional Environment Programme (SPREP), the World Animal Health Organisation (OIE) and FAO.

The major objectives of the SPC regional aquatic insecurity meeting were to:

- develop a common understanding of the key principles,
- identify the status of aquatic insecurity in the region, and
- identify a framework for regional cooperation.

Conference participants included senior representatives from fisheries, quarantine, environment and veterinarian services. It was perhaps one of the most diverse range of participants to an SPC fisheries conference.

Presentations and group exercises centered on several key themes. The main outputs of each theme are highlighted below.

Theme 1: Understanding common principles of aquatic biosecurity

Because aquatic biosecurity has only recently begun to emerge as an overarching concern and is a relatively new field, it was important for participants to understand the general principles for and definitions of biosecurity, as well as the institutional arrangements affecting it.

- Melba Reantaso, aquaculture pathologist at FAO Rome, gave an overview of biosecurity and its implications for aquaculture, and highlighted various international agreements (and their instruments) governing biosecurity.
- Eva-Maria Bernoth, chief aquatic veterinarian officer for DAFF-Australia (Canberra) and chairperson of OIE’s aquatic standards committee, explained how OIE standards reduce the risk of introducing diseases and its importance to facilitating

international trade. Eva-Maria also represented and outlined the work of the OIE regional office in Tokyo.

Theme 2: Biosecurity in the Pacific Islands

- Ben Ponia, aquaculture adviser for SPC, provided a regional perspective of aquatic biosecurity and its importance to Pacific Island communities for the protection and conservation of ethno-biodiversity, subsistence living and economic livelihoods.
- Dominique Benzaken, manager of a coastal management programme at SPREP in Apia, Samoa, spoke about Pacific-wide ecological concerns from invasive pests that can be introduced through fisheries and aquaculture activities.
- Roy Masamdu, biosecurity specialist with SPC Suva, gave an overview of the biosecurity and trade programme within SPC's Land Resources Division in Fiji. He outlined how an aquatic biosecurity programme could be integrated with SPC's current animal and plant biosecurity programmes.
- Isabelle Mermoud, pathologist with the *Direction des Affaires Vétérinaires, Alimentaires et Rurales* in Noumea, described the stringent shrimp biosecurity in New Caledonia, which enables the country to maintain its international trade in high quality shrimp products to niche markets in Japan and Europe.
- Tim Pickering, aquaculture lecturer at the University of the South Pacific in Suva, Fiji, gave a broad overview of how biosecurity could impact on aquaculture and

fisheries activities in Fiji. He described the risk to the fledging shrimp industry from diseases introduced through Asian shrimp imports.

- Hervé Bichet, veterinarian with Service de la perliculture Tahiti, explained how national biosecurity programmes for pearl culture were established in French Polynesia in order to control the domestic transfers of pearl oysters between atolls to minimise the risk of pathogens and pests.

Theme 3: Risk assessment and risk management

Managing seemingly complicated aquatic biosecurity risks can be accomplished through qualitative and/or quantitative processes. The aim of this session was to provide participants with an understanding of the commonly adopted approach (i.e. OIE approach) to biosecurity risk management, and conduct exercises to demonstrate how it may be applied in real life situations.

- Melba Reantaso outlined the risk assessment process adopted by OIE. This process has four main components:
 - 1) hazard identification,
 - 2) risk assessment,
 - 3) risk management, and
 - 4) risk communication.

The inter-relationship between these elements is shown in the figure below.



The principal components of the OIE Risk Analysis Framework.

- Ramesh Perera, chief aquatic veterinarian with the Primary Industries and Resources South Australia in Adelaide, explained how risk assessment was applied in Australia for the quarantine of imports and exports.

Group exercises for risk assessment were performed. Each group was provided with a different biosecurity scenario and tasked with conducting a hazard identification and risk assessment for their respective scenario.

- Group 1 reviewed an application for the transfer of adult giant clams from Asia to a hotel resort in Micronesia. Hazards identified were pathogenic viruses, introduced invasive snails, and genetic pollution. The risk was considered unacceptable and the application was rejected.
- Group 2 reviewed the transfer of pearl oyster shells from Australia to a Pacific Island country, and focused on pathogenic hazards, especially the Akoya and Oedema virus. After conducting a release assessment (i.e. determining the likelihood of disease being present) and an exposure assessment (i.e. determining whether the disease could spread to other oysters in the wild), the Group concluded that risk management through quarantine restrictions could reduce the risk of disease —

from imported oysters and the risk of disease spreading into the wild — to an acceptable level.

- Group 3 considered a proposal to import thousands of juvenile grouper fingerlings for cage culture. The Group considered the major hazards to be pathogenic (i.e. nodavirus), ecological (i.e. escapees becoming a pest) and environmental (i.e. impacts from culture).
- Group 4 reviewed the introduction of an exotic freshwater prawn species (*Macrobrachium rosenbergii*) for farming. The key hazard that the group focussed on was a pathogenic risk from white-spot and whittail disease. After a release and exposure assessment of the disease, it was determined that the chances of this disease being introduced could be reduced to an acceptable level of risk through risk management. Some of the suggested risk management measures included: making the importation a one-off occurrence; limiting the number of prawn imports to a small quantity; the provision of a health certification by an exporting country's official veterinarian; proper treatment of importing materials and water; and permanent holding of importees in a quarantine facility to be used as adult hatchery broodstock only.

Theme 4: Building a regional aquatic biosecurity framework for the Pacific

It is clear that technical challenges facing the region require regional solutions. The Pacific is fortunate in that neighbouring metropolitan countries such as Australia and New Zealand have fairly well developed national aquatic biosecurity programmes that the region can learn from.

- Ramesh Perera outlined the rationale and application of biosecurity controls in Australia. He provided his perspective of a state government official (South Australia) and also the perspective of the federal government official (i.e. DAFF Biosecurity Australia).
- Brendan Gould, senior policy analyst with the New Zealand Ministry of Agriculture and Forestry in Wellington, outlined New Zealand's aquatic biosecurity programme. He mostly focussed on New Zealand's efforts to control the introduction of exotic species particularly through the shipping industry, noting that this is an issue shared with the Pacific Islands whom receive these same vessels.

The last part of the meeting involved participants designing a framework, outlining the main components for regional collaboration. These issues were summarised in a presentation made by Ben Ponia. Areas where assistance is required are:

- addressing infrastructure (e.g. quarantine) requirements,
- developing expertise,
- cooperation among agencies and countries,
- sharing information (e.g. ecological hazard's database),
- developing policy and legislation,
- ensuring that political will is used responsibly,
- raising awareness about the need for biosecurity among the general public, and
- assessing the biosecure status of our island biospheres.

Noting the urgency of biosecurity, meeting participants reinforced an early recommendation made at the 5th SPC Heads of Fisheries Meeting (Noumea, April 2005) that a regional biosecurity programme be put in place by 2010.

SUMMARY OF MEETING ISSUES

- There is constant movement of aquatic species within and from outside the Pacific Islands region, raising ecological threats to important wild species, and increasing risks from diseases (especially in pearl and shrimp aquaculture). Restrictions on trade are becoming increasingly stringent and more politicised.
- National biosecurity responses require cooperation among agencies such as fisheries, environment, quarantine and veterinarian services, infrastructure (e.g. quarantine facilities), awareness of risks (publically and politically), and more capacity in risk assessment and management.
- Regional biosecurity responses require coordination and harmonisation with plant and livestock sectors, specialist services (e.g. aquatic epidemiology), and science and information (e.g. database of biosecurity hazards).
- Investing in biosecurity programmes is a much more cost-effective solution to dealing with the often severe consequences. For example, the economic costs for a pearl disease monitoring programme pales in comparison to economic loss suffered through disease outbreaks.
- Workshop participants formulated a framework for a regional biosecurity programme that addresses critical areas.

- The region was requested to support SPC in its attempts to have a regional aquatic biosecurity programme in place by 2010.

MEETING POSTSCRIPT

At the SPC governing council meeting (Committee of Representatives of Governments and Administrations, CRGA) and SPC's ministerial conference (Conference of the Pacific Community) held in Apia, Samoa in

November 2007, a summary of meeting outcomes was presented to representatives. CRGA and Conference endorsed the findings of the meeting and tasked SPC with putting in place a regional aquatic biosecurity programme by 2010.

