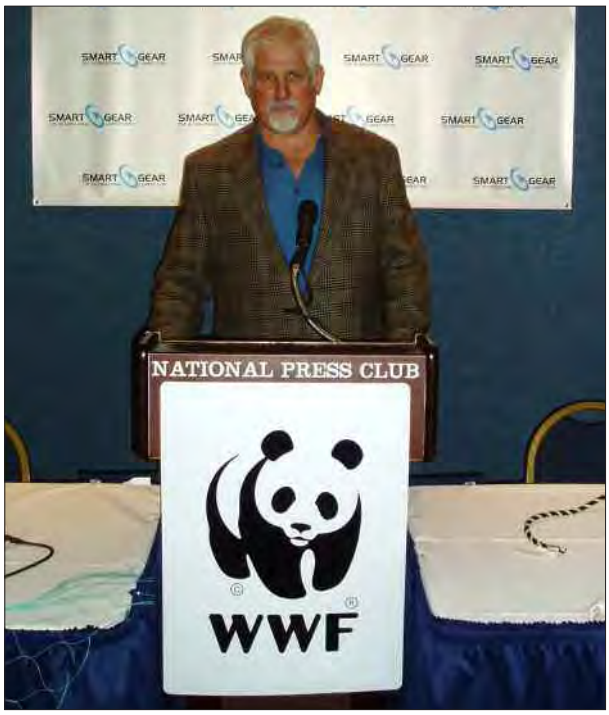
Fisheries Newsletter

Number 113 (April – June 2005)

Editorial

Welcome to this issue of the SPC *Fisheries Newsletter*. In this issue, you will find an article describing the final results of the FAD research project, where community surveys were conducted three times each in Niue, Aitutaki and Rarotonga. The main outcome shows that the benefits of FADs to local small-scale fishermen and local communities far exceeds the cost of the FAD materials. One of the recommendations is that ongoing FAD programmes should be continued by governments as a way to support local communities and the small-scale fishing sector.

Jean-Paul Gaudechoux
Fisheries Information Adviser (jeanpaulg@spc.int)



SPC Fisheries Development Officer, Steve Beverly, wins WWF First prize "Smart Gear" competition.

in This Issue

SECRETARIAT OF THE PACIFIC COMMUNITY
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FISHERIES DEVELOPMENT SECTION

SPC's Steve Beverly wins grand prize in WWF international competition

Fisheries Development Officer, Steve Beverly (Fig. 1), won first prize in the World Wide Fund for Nature (WWF) "Smart Gear" competition to reduce marine fisheries bycatch. Steve submitted his idea for deep-setting tuna longline gear, which reduces the incidental catch of sea turtles, while improving the efficiency of catching target species, such as bigeye tuna.

Figure 1: Steve Beverly at the award presentation

The results of Steve's deep-setting fishing trials were reported in SPC's *Fisheries Newsletter* #109. Fishing trials were successfully conducted off Mooloolaba, Australia, in May 2004 in conjunction with SeaNet *(Note from Ed.: SeaNet is an environmental programme of the Australia Seafood Industry; more info on SeaNet can be found at www.oceanwatch.org.au)*, and two tuna longline companies. Funding was provided by the Australian Fisheries Management Authority. Steve has also tested the new method off New Caledonia with equal success.

Technical assistance to Papua New Guinea's National Fisheries College

The National Fisheries College (NFC) in Papua New Guinea requested assistance from SPC's Fisheries Development Section to prepare a Commercial Fishing Operations 3 (CFO 3) course delivery outline, using existing guidelines. SPC's Fisheries Development Officer, William Sokimi, was assigned to this project. Other activities undertaken as part of this assistance included the preparation of a timetable, study guide, session plans, and course resource list for the CFO 3 course.

The SPC Regional Maritime Programme's Class 5 Master and Engineer course modules were used as the basis for the CFO 3 core modules. A "Fishing Technology" module was then developed to cover offshore commercial fishing aspects of the course. Once the modules were agreed on, William worked on the course outline, timetable, session contents and resource materials list. The National Fisheries College now needs to have the course accredited by the National Training Council through the Fisheries Training Advisory Council, before the course can be implemented.

Technical assistance projects in Nauru

Two projects were undertaken in Nauru. Fisheries Development Adviser, Lindsay Chapman, spent 10 days in April conducting a review of the National Fisheries Corporation (NFC), which is the commercial arm of the Nauru Fisheries and Marine Resources Authority (NFMRA). NFC had been operating at a loss for several years, so the purpose of the review was to identify the main areas where savings could be made. To do this, Lindsay broke down income and expenditure into NFC's three main work areas: fishing operations of the two longline vessels, fish market operations (both buying and selling products), and the management of NFC.

Several key issues were identified during the review, including the limited number of fishing trips undertaken and the low catch rates; high operating cost of the vessels compared with catch value; wages or retainers paid to all skippers, engineers and crew on the vessel (regardless of whether the vessels were at sea or in port);

high cost of operating the fish market; lack of income from ice sales; over staffing in some areas; and commercial accounting practices and the need to identify income and expenditure for each of NFC's three areas. Lindsay presented his findings to the Chairman and Vice-chairman of the NFMRA Board, and senior NFMRA managers. Some of the recommended changes were implemented immediately, while others will be phased in over time.

The second area of assistance was to work with and train skippers and crew of NFC's two tuna longline vessels in order to upgrade their tuna longlining skills. William spent the month of June working on board the NFC's longline vessel F/V *Austin Bernicke* (NF6 — Fig. 2). NFC's second vessel, F/V *Victor Eoaeo* was on the dock at Anibare, undergoing a major refit. These repairs would not be complete until September, as two new generators were on order.

With the NF5 out of operation, NF6 was tasked with carrying out fishing operations to supply fish to the NFC fish market. The vessel's starboard engine room, however, was flooded during its previous fishing trip, causing the starter motor to burn out and the gear box sump to be contaminated. The flooding was caused by a leak in the outlet to the deck working hose. While work was being done to get the problems rectified, William worked with the NFC crew to overhaul their fishing gear to upgrade it for the fishing trip. Once the vessel was operational, tests were carried out and the hydraulic system tuned. The vessel was then loaded and readied for fishing.

During the fishing trip, crew were advised on the correct method of handling bait; preparing for and carrying out line-setting operations (Fig. 3) — the most impor-

Figure 2 (top): NFC's two longline vessels, one operational and the other undergoing a refit
Figure 3 (middle): Line-setting operation on NF6
Figure 4 (bottom): Cleaning and preparing a bigeye tuna for icing

tant stage in the operation because if it is done correctly, it can increase the chances of catching fish; correctly carrying out the hauling operation and arranging the gear for the next setting operation; gaffing, boarding and correct handling of tuna for the sashimi market; bleeding, gilling and gutting of pelagic fish (Fig. 4), and preservation of fish on ice. Aside from learning fishing skills, the crew were given instruction in seafaring, which included watch-keeping procedures, vessel cleanliness, safety awareness and seamanship skills.

Figure 5: Catch from first trip being measured before processing for local sale

Four line sets were made during the first trip, resulting in a total catch of 45 fish with a processed weight of 1051 kg. Most of the catch consisted of high value tunas (Fig. 5), with 9 bigeye tuna weighing 324 kg and 17 yellowfin tuna weighing 523 kg. The rest of the catch consisted of three blue marlin weighing 102 kg, five broadbill swordfish weighing 69 kg, one sailfish weighing 8 kg, and ten skipjack tuna weighing 25 kg. All of the catch was sold through NFC's fish market.

During the fishing trip the hydraulic return line developed a leak while the third set was being hauled in. Despite considerable effort to stop the leak, a lack of spares prevented it from being patched. However, a fourth set was undertaken without the use of the hydraulics by free-spooling the mainline off the reel. When the line was hauled back in, a bucket was placed under the leak to collect the hydraulic oil, which was returned to the holding tank. This recycling was kept up until the hauling operation was completed. At the end of the operation the ice had run low, but was sufficient to preserve the fish until the vessel returned to port.

The repairs to the vessel's hydraulics were completed in two days. Difficulty in accessing the necessary hose fittings contributed to a delay in carrying out this repair. Ice was also in short supply with one of the ice machines not operating to its full capacity. This meant that ice had to be accumulated over several days to get enough for the second fishing trip.

The hydraulic system failed on the second trip during the first set, just as hauling began. As a result, the mainline was hauled by hand. The hydraulic system failed on two other occasions, causing the vessel to return to port for repairs. Only two sets were made during several attempts at a second trip, with a catch of six yellowfin tuna (215 kg), two bigeye tuna (94 kg), two blue marlin (74 kg), two albacore tuna (32 kg), 20 skipjack tuna (103 kg), and one wahoo (8 kg). All fish were sold on the local market.

Technical assistance provided to New Caledonia longline company, Albacore SARL

Fisheries Development Officer, Steve Beverly, accompanied the captain and crew of a New Caledonian longliner on one of their regular longline fishing trips in May this year. The objective of the trip was to assist Albacore SARL with their longline vessel, F/V *Yellowfin* (see *Fisheries Newsletter* #99), in resolving problems in locating fish using sea surface temperature (SST) and remote sensing data; and to offer advice on why F/V *Yellowfin* (Fig. 6) was not doing as well as Albacore's other boat, F/V *Baby Blue* (Fig. 7), even when they were fishing in the same vicinity.

Five sets were made while Steve was on the boat, all in roughly the same area just to the east of Maré in the Loyalty Group of islands (east of the main island of New Caledonia) between 18 and 22 May. During the same five-day period F/V *Baby Blue* fished about 8 nm to the east of F/V *Yellowfin*.

F/V *Yellowfin* typically started setting the line at about 6:30 h,

Figure 6 (left): F/V *Yellowfin*

Figure 7 (below): F/V *Baby Blue*

setting 1750 hooks in 35 hook baskets. The bait was a mix of South African pilchards and California sardines. Line setter speed was 10 kn and boat speed was 5 kn, giving a sagging ratio (SR) of 0.5. Sea surface temperatures were recorded and temperature and depth recorders (TDRs) were attached to certain baskets to monitor depth and temperature at depth. Hauling began at about 15:00 h and continued until all of the line was recovered at about midnight. All target fish were recorded and hook positions noted, but fork lengths were not measured. Temperature and depth data were retrieved immediately after the haul was completed. The following day, catch information was passed from F/V *Baby Blue* to F/V *Yellowfin*, who communicated all catch information to Albacore's office in Noumea via a satellite email connection.

Total catch for F/V *Yellowfin* for five sets was 121 albacore, 34 bigeye, 19, yellowfin, 1 blue marlin, 2 swordfish, 13 opah, 2 mako sharks, and 3 wahoo. Total number of marketable fish was 195 with an estimated weight of 4025 kg (Table 1). Total number of hooks for five sets was 8400. Nominal CPUE for marketable fish was 2.3 fish per 100 hooks and 48 kg/100 hooks. Table 1 summarises the catch and effort results for the two vessels, F/V *Yellowfin* and F/V *Baby Blue*.

All tuna except bigeye were loined, wrapped, and blast frozen for export to Europe (Figs. 8 and 9). Bigeye tuna were chilled in RSW holds for export to Japan. Byproduct fish were chilled for local sales. It can be seen from Table 1 that the two boats had different results. The catch rate for the F/V *Yellowfin* was about 53% of that of F/V *Baby Blue* by numbers of fish and 60% by weight of fish. The albacore catch rate for the F/V *Yellowfin* was only 40% of that for the F/V *Baby Blue* by number of fish and 39% by weight. Bigeye catch rate of the F/V *Yellowfin*, however, was 800 per cent that of for the F/V *Baby Blue* by number and 750% by weight.

Table 1: Summary of catch and effort results of the two boats for the same five-day period

Boat	Total hooks set	Catch		Catch/100 hooks		Albacore/100		Bigeye/100 hooks	
		Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)
F/V *Yellowfin*	8400	195	4025	2.3	48	1.4	21	0.4	12
F/V *Baby Blue*	9000	387	6330	4.3	70	3.5	53	0.05	1.6

Figure 8 (top): Quarter-loining tuna
Figure 9 (bottom): Wrapping a quarter-loin ready for freezing

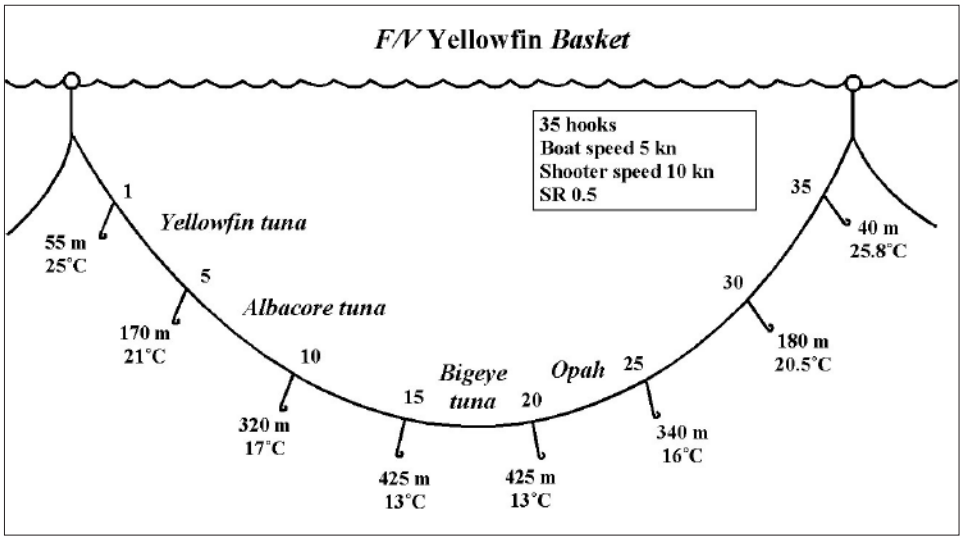


Figure 10: Catch taken on one basket of gear where TDRs were used

In terms of albacore F/V *Baby Blue* outfished F/V *Yellowfin* by a factor of over two-to-one. However, in terms of bigeye tuna, F/V *Yellowfin* outfished F/V *Baby Blue* (at least from the small sample size of five day's fishing) by a factor of eight-to-one. The answer to the question of why they are getting such different results lies in setting strategy, particularly since they were setting in the same area on the same temperature break; set and haul times were similar. F/V *Yellowfin* targeted deeper by setting 35 hook baskets, while F/V *Baby Blue* targets higher up in the water column by setting 30 hook baskets. No TDR results were obtained from F/V *Baby Blue* but by examining catch results — fewer bigeye and more albacore and yellowfin tunas — it can be assumed that the deepest hooks reached depths of no more than about 300 m while the deepest hooks from F/V *Yellowfin* reached down to 425 m. The sets from the F/V *Yellowfin* left fewer hooks within the depth ranges of albacore and yellowfin tunas.

For marketing reasons, the management team at Albacore SARL actually prefers more albacore and fewer bigeye tuna. F/V *Yellowfin* should switch to shallower sets to target greater numbers of albacore and yellowfin tuna. Besides decreasing the number of hooks in a basket they could increase the boat's speed during setting to change the SR. An SR of 0.75 (i.e. boat speed of 7.5 kn and shooter speed of 10 kn) would probably help. Also, it would be a good idea to monitor the measurable

parameters of the sets from F/V *Baby Blue*, such as shooter speed, boat speed, SR, and actual depth using TDRs.

Temperature and depth results for F/V *Yellowfin* were excellent, especially for one basket that was set at 09.30 h on 21 May and hauled at 18.00 h. The TDRs were placed at five hook intervals along the entire 35-hook basket on hook positions numbered 1, 5, 10, 15, 20, 25, 30, and 35. One opah was on hook number 25, and depth of capture was 340 m and temperature was 16 °C. Bite time was not evident on the TDR graph. Three bigeye tuna of around 30–35 kg each were caught on hooks numbered 17, 18, and 19, corresponding to 425 m and 13 °C. Bite time for at least one of the bigeye was 15.00 h. Figure 10 shows what that basket looked like in the water and where the fish were caught.

Follow-up work in Niue

Lindsay visited Niue for 10 days in April to finish the Niue component of the FAD research project, develop a programme for training Niuean fishermen in tuna longlining fishing techniques, and to assist with small-scale tuna fishery development in the country.

The three remaining project FADs off Niue were all on station after 39, 12, and 10 months. At the time of the visit, tuna catches from around the FADs had dropped off compared with earlier in the year. Some fishermen continued to complete their logbooks, while others stopped once the project was formally concluded. It is hoped that some data continue to come in, especially with tuna longline fishing activities about to commence.

The Reef Group Niue's new fish processing facility (Fig. 11) was ready for operation, with several tuna longliners scheduled to arrive from New Zealand and Samoa in May/June to bring fish to the facility. Training Niuean fishermen in tuna longlining is planned for later this year when longline vessels are operating, and small-scale tuna longlining trials begin.

Figure 11: Reef Group Niue's fish processing facility nearing completion in September 2004

Regional meetings attended

Fisheries legislation and community-based management (Hawaii, 4–8 April 2005)

Steve Beverly attended this meeting, which was jointly organised by SPC, the Commonwealth Secretariat, the Western Pacific Regional Fisheries Management Council (WPRFMC), and the United Nation's Food and Agricultural Organization (FAO). Steve also presented a paper to the meeting on FADs and coastal fisheries management. The paper covered the possible use of FADs as a management tool to assist fishermen that have been displaced by the establishment of marine protected areas, or to relieve fishing pressure on overfished inshore resources, or to provide an alternative fishery to discourage destructive fishing methods. FADs also assist fishermen by reducing fuel costs while increasing safety.

The workshop was conducted on a participatory basis to cover key areas in fisheries management, community involvement, and the implementation and enforcement of fisheries regulations. Related topics included marine protected areas, ecosystem based fisheries management, community bylaws, and utilisation of alternative fishing methods including fishing around FADs. Participants conducted role playing exercises in analysing fisheries data, advising on community fisheries regulations, and developing fisheries legislation during the workshop.

Technical assistance workshop on sea turtle bycatch reduction experiments in longline fisheries (Hawaii, 11–15 April 2005)

This workshop was sponsored by the National Oceanic and Atmospheric Administration (NOAA), the Pacific Islands Fisheries Science Center (PIFSC), and hosted by WPRFMC. The objective of the workshop was to provide FAO participants with technical assistance on designing programmes to develop and test turtle bycatch reduction methods in their longline fisheries. The workshop started by reviewing worldwide research on turtle bycatch reduction in longline fisheries. It then went on to describe how a bycatch mitigation experiment was designed and implemented.

Steve presented two papers at this workshop, one on New Caledonia's longline fishery and the second on a new deep-setting technique to avoid sea turtle bycatch during longlining. Other presentations looked at the use of a range of mitigation techniques, including blue-dyed bait, different setting configurations, different baits, and different hook designs and sizes. Research results showed that the use of circle hooks greatly reduced the number of interactions with sea turtles. The correct methods for handling hooked sea turtles was also covered, including the use of de-hooking equipment specifically designed for use with sea turtles.

Ship/port interface and flag state implementation/port state control including fishing vessel security (Fiji, 9–13 May 2005)

Lindsay attended this meeting, which was jointly organised by the SPC Regional Maritime Programme and the International Maritime Organization. The meeting looked at the implementation of the International Ship and Port Facility Security (ISPS) Code, which covers new security measures under the Safety of Life at Sea (SOLAS) Convention. The ISPS Code is applicable to all cargo ships of 500 gross tons and larger, and all passenger ships on international voyages, as well as port facilities serving such ships. It does not apply to fishing vessels or merchant vessels of less than 500 gross tons.

Figure 12: Niue wharf closed to fishing vessels under the port security plan while cargo vessel is alongside the wharf

All Pacific Island countries and territories (PICTs) are in compliance with the ISPS Code. However, there is an issue of non-application of the security measures to fishing vessels and how this can be addressed. The main concerns relating to fishing vessels are piracy, the smuggling of people and/or illegal goods (drugs, firearms, alcohol, etc.), and stowaways.

Some PICTs have fishing vessels covered under their maritime legislation (including the ISPS Code), which is now causing some concern. The issue for PICTs is to ascertain ways to apply either the Code or alternatively some other security arrangement that will be agreeable to their fishing industry, as well as other fishing vessel Flag States. For more information on this topic, see the feature article on page 24.

Manuals

The English version of a "Manual of fish aggregating devices (FADs): lower-cost moorings and programme management" (Fig. 13) was completed in June 2005 and distributed within the region.

This manual summarises the design work undertaken during the three-year FAD research project, and provides detailed information on the new SPC-recommended FAD designs.

The French version of this manual is now also available.

Progress was made on two marine species identification manuals, which were described in the last issue of the *Fisheries Newsletter* (#112). The tuna longline species identification manual will be completed in the third quarter of this year.

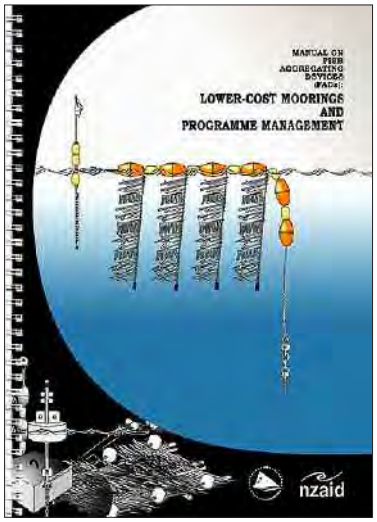


Figure 13: New FAD manual

COASTAL FISHERIES MANAGEMENT SECTION

Newcomer to the Pacific

Officials from the government of Iceland and the Commonwealth Secretariat visited SPC in the last two weeks of June to hold discussions concerning Iceland's assistance to Pacific Island countries in the area of coastal fisheries. The visiting team comprised Dr Tumi Tomasson, Programme Director of the United Nations University – Fisheries Training Programme (UNU-FTP), Mr Semisi Fakahau, Chief Programme Officer of the Commonwealth Secretariat, and the team leader Mr Geofrey Martin from the Political Division of the Commonwealth Secretariat. The visit was prompted by the value placed by Iceland and the Commonwealth Secretariat on the "Strategic plan for fisheries management and sustainable coastal fisheries in Pacific Islands — the plan". The plan, consisting of national and regional needs, was developed by the Pacific Islands to help them resolve problems encountered by the managers of coastal fishery resources in the Pacific. The plan was endorsed by the Heads of Fisheries at its meeting in August 2003. Since then, the priority needs identified under the plan were funded by Australia, New Zealand, France, Commonwealth Secretariat, FAO, US Western Pacific Regional Fisheries Management Council, and the French Pacific Funds. Iceland – a new member of the team is offering:

- Six-month training courses for two Pacific Islanders in areas identified under the plan at the United Nations University (UNU) in Iceland. While the team was at SPC, interviews were held to select two candidates to attend the first training. Arrangements are in process to dispatch the first two successful candidates to the UNU-FTP in the coming September. The candidates will focus their training in stock assessment and statistics. Iceland intends to provide this training for the next several years.
- Development of short courses for Pacific Islanders identified under the plan. This will involve two Pacific islanders to work together

with staff of the UNU-FTP for two to three weeks to develop such courses. The first short course will focus on the "Assessment of fish stocks using statistics/indicators". Selection of Pacific Islanders to work with the UNU-FTP is in process.

- Delivery of short courses. Iceland is prepared to assist in the delivery and funding of short courses. SPC, Iceland and USP will hold consultation on the best way to deliver these courses, although SPC's Coastal Fisheries Training Adviser feels that such short courses are better delivered by USP for many reasons. The first course is planned for delivery in mid-2006.

FISHERIES TRAINING SECTION

Seafood processing workshop

A seafood processing workshop was held at the Marine Studies Programme at the University of the South Pacific, Suva Fiji, from 14–24 June 2005. The workshop was made possible with the joint support and collaboration between the Japan International Cooperation Agency (JICA), Secretary of the Pacific Community (SPC) and the Marine Studies Programme (Postharvest Fisheries Section) of the University of the South Pacific (USP).

Six participants attended the workshop: one from Central Pacific Producer Limited (CPPL) of Tarawa, Kiribati; four from the Fisheries Department of Fiji; and one from the Marine Studies Programme (MSP).

The workshop was conducted by Takuya Shiotsiku (Katsuobushi Expert) of Japan and Gabriel Victor Titili who is Postharvest Fisheries Lecturer at MSP. The workshop ran for two weeks and included both theory and practical components. Product developed during the workshop included: sweet smoked chub mackerel (Salala), bula smoked wahoo in sweet and sour sauce, sweet chub mackerel in sweet and sour sauce, steamed wahoo pate, wantok smoked red snapper in sweet and sour sauce, bula smoked wahoo, Pacific smoked tuna, citrus smoked tuna, wantok smoked red snap-

Six participants attended the workshop.

The workshop included a practical component on product development

per, honey cured smoked parrotfish, katsuobushi soup with wakame (seaweed) and smoked wahoo spread. All products were taste tested using the "Hedonic Scale" method by a 20-member panel (comprising USP, Fiji Fisheries Division and JICA representatives) at the closing of the workshop. The results of the taste test indicated that 95% of the taste panelists liked all the products.

At the end of the workshop, participants were given certificates of attendance for two weeks of full-time training. The certificates were handed to the participants by the resident representative of JICA during the closing ceremony.

Participants felt that more such workshops should be conducted in the future. They also felt that this type of workshop is long overdue for Pacific Island countries, especially, when one is involved in the actual development of a product.

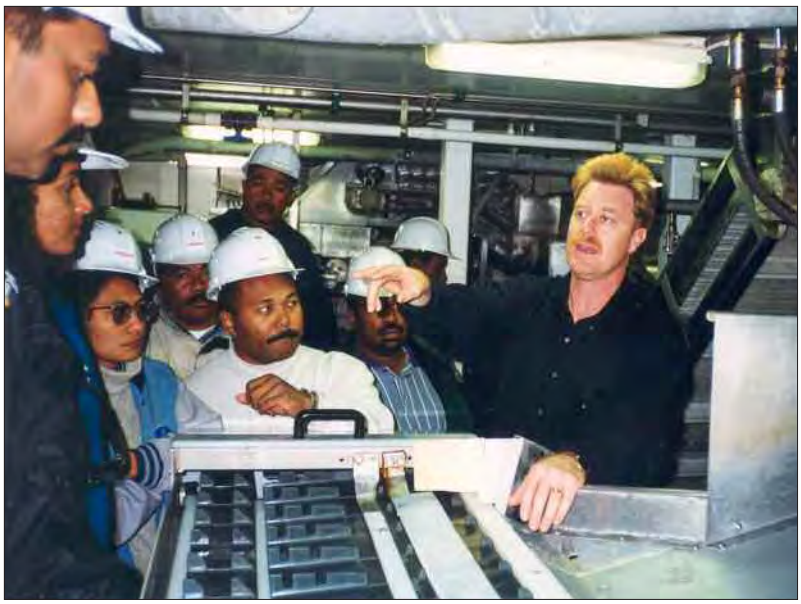
(Contributor: Gabriel Victor Titili)

Regional course for enterprise managers – 4th edition in October

With the aim of assisting an emerging regional fishing industry, the SPC Fisheries Training Section and the New Zealand School of Fisheries launched, in the mid-1990s, a series of short (two to four weeks) training programmes targeting commercial fisheries enterprises in the Pacific. From 1997 to 2002, 8 regional courses have been run and 99 enterprise managers, assistant managers, fishing skippers and vessel engineers trained. Those courses were innovative because they addressed issues not usually covered by established training institutions: hydraulic and refrigeration systems for engineers, vessel management and electronic aids for skippers, and management tools and practices for managers. In addition to addressing those "non-conventional" training areas, the courses have also provided participants with an in-depth exposure to New Zealand's modern and innovative fishing industries.

No courses of this type have been held since 2003, due to funding difficulties. A new approach to the financing of the Section's training activities, funded by the governments of New Zealand and New Caledonia, will enable SPC to continue offering courses for fisheries enterprises on a biennial basis. These will be held alternately with the SPC/Nelson Fisheries Officers training programme, the next of which is scheduled for 2007.

The fourth regional course for managers of medium-to-large fishing enterprises will be offered at the New Zealand School of Fisheries, in Nelson, from 10–21 October 2005. Its objective will be to provide managers of Pacific Island fisheries enterprises with a unique learning experience that will upgrade their management skills and assist them in developing strategies to enhance the commercial viability of their business. The background and needs of participants, and the scale and nature of the enterprises represented at the training, will be wide-ranging. As a consequence, the course will be operated in a participatory manner and formal lectures will be kept to a minimum. Most sessions will include presentations by guest speakers with extensive experience in the seafood industry; learning will be achieved through the sharing of experiences, small-group discussions and relevant site visits. If required, the course content can be altered at short notice to take into account participants' specific training needs, although the general theme of the programme will be "Building and maintaining successful relation-



John Cleal (Amaltal operations manager) shows previous course participants the fish processing factory on board FV *Amaltal Atlantis*

ships in seafood businesses", using examples of management practices from Nelson-based seafood companies.

This training programme will be coordinated by the New Zealand School of Fisheries at Nelson, the heart of New Zealand's seafood industry. There, participants will be in direct contact with various institutions and seafood businesses: the Nelson Marlborough Seafood Cluster, the full spectrum of port-based support industries, a range of aquaculture and fishing companies from small-scale to giant ones, and some of the most experienced leaders of the local seafood scene. A once-in-a-lifetime training experience for 12 lucky Pacific Island fisheries enterprise managers!

"Start Your Fishing Business" training in the Solomon Islands and Vanuatu

A training programme on how to "Start Your Fishing Business" will be offered in Solomon Islands and Vanuatu. As part of an ongoing collaboration between several regional organisations and institutions — the Secretariat of the Pacific Community (SPC), the Small Business Development Centre (SBDC), the Papua New Guinea National Fisheries Authority (NFA), and the Commonwealth Secretariat — a training course that was originally developed for Papua New Guinea (PNG) will soon be adapted for the Solomon Islands and Vanuatu. The Start Your Fishing Business (SYFB) course and materials, based on the International Labour Organization (ILO) "Start Your Business" model, were tailor-made to suit the specific needs of the PNG artisanal fisheries sector and have been successfully delivered in Papua New Guinea since 2003. Acknowledging the success of this innovative programme, SPC and the Commonwealth Secretariat decided in 2004 to facilitate the introduction of SYFB training in Vanuatu and the Solomon Islands, two countries with socioeconomic and cultural situations similar to those of PNG.

With funding support from the Commonwealth Fund for Technical Co-operation (CFTC), SPC conducted a training needs analysis (TNA) in Vanuatu and the Solomon Islands in August 2004. The TNA clearly identified a need in both countries for training fishing communities in small fishing business planning and management. It also reported the commitment of local institutions and governments to sustain training in this area once initial funding support from aid donors terminated. The TNA concluded that a combined training of trainers (TOT) course would be the best option for establishing a network of competent SYFB trainers in both countries.

The initial phase of the project took place in June 2005 at Santo, Vanuatu, where a TOT course was run by SBDC Master Trainers (13–29 June). Eleven future trainers from Vanuatu (Department of Cooperatives, Fisheries Division, Vanuatu Maritime College and the Vanuatu Women Development Scheme (VANWOD) Microfinance) as well as four participants from the Solomon Islands (Fisheries Division and the

The courses have targeted fishermen and operators of small fishing businesses

Small Enterprise and Business Centre) completed the course and received their certificate of attendance. In order to become accredited by ILO as SYFB trainers, each of the four Solomon Islanders are required to deliver one SYFB course to their target audience under the supervision of Master Trainers (phase 2 of the project). Once accredited, the trainers will be available to run additional SYFB courses on their own (phase 3).

As part of the TOT course in June 2005, participants from both countries have produced an action plan for subsequent phases of the project. Their accreditation as ILO/SYFB trainers will occur on completion of the SYFB courses they deliver under the supervision of one PNG Master Trainer. Five courses are scheduled from mid-August to mid-October 2005. The courses will target fishermen and prospective operators of small fishing businesses and will enable the accreditation of future SYFB trainers. As with arrangements made for the TOT course, SPC's Fisheries Training Section will coordinate the implementation of the five initial courses, working closely with focal points in Port Vila and Honiara. The action plan also includes a series of subsequent SYFB courses in most provinces of Vanuatu and the Solomon Islands (phase 3, in 2006).

Relevant institutions in both countries are fully supportive of the present initiative and have agreed to support an ongoing SYFB training programme past SPC/CFTC's assistance. It is envisaged however that SPC and SBDC will monitor the delivery of subsequent SYFB training, acting as facilitators and quality controllers in the process.

SPC is keen to further export the SYFB training concept to its other member countries in the Pacific region. It is envisaged that the present project in Vanuatu and the Solomon Islands will be reviewed in 2006 and, provided its successful outcomes are clearly identified, SPC would approach the Commonwealth Secretariat for an extension of its financial assistance to enable the development of a network of SYFB trainers in other Pacific Island countries.

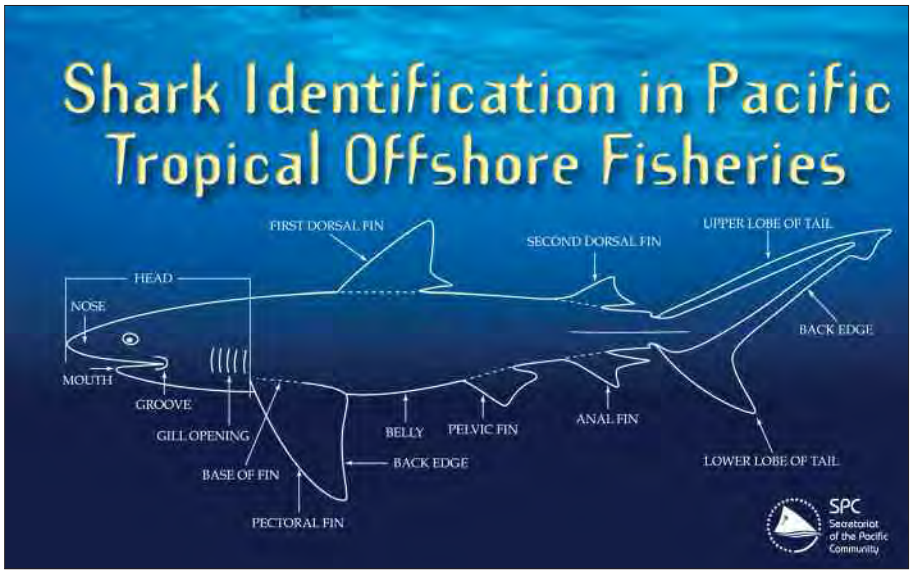
Shark ID cards now available

A tool for identifying sharks in the field — "Shark Identification in Tropical Offshore Fisheries" — is now available at SPC! What was meant to be a straightforward addition to SPC's bycatch awareness campaign took longer than expected, but the wait was worth it. Undoubtedly, the shark ID cards will figure predominantly in the "SPC publication-of-the-year" award!

Twenty-seven shark species have been illustrated by Les Hata. For each species, the common names (English, French, Mandarin and Japanese) as well as the scientific name and the FAO identification code are given. The species' key identification features are clearly shown and, for ease of use, each shark has been grouped by its broad common characteristics (e.g. sharks with bluish colouring, sharks with white tips, hammerheads, etc).

It is hoped that this identification tool will help improve catch data and statistics on sharks that interact with longline and purse-seine fisheries in the Western and Central Pacific. With a better understanding of shark stocks, regional fisheries managers can ensure that sharks are fished in a sustainable manner.

The most likely users of the cards are fisheries observers, fishing masters, and crew on board longline and purse-seine vessels in



the Western and Central Pacific. Fisheries training institutions and fishing communities are other potential users.

The shark ID cards were made possible through the financial assistance by the governments of Australia, France and New Zealand.

For further information or to order these cards, contact SPC's Oceanic Fisheries Programme's Fisheries Monitoring Section or SPC's Coastal Fisheries Programme's Fisheries Training Section (SPC, BP D5, 98848 Noumea Cedex, New Caledonia, cfpinfo@spc.int).

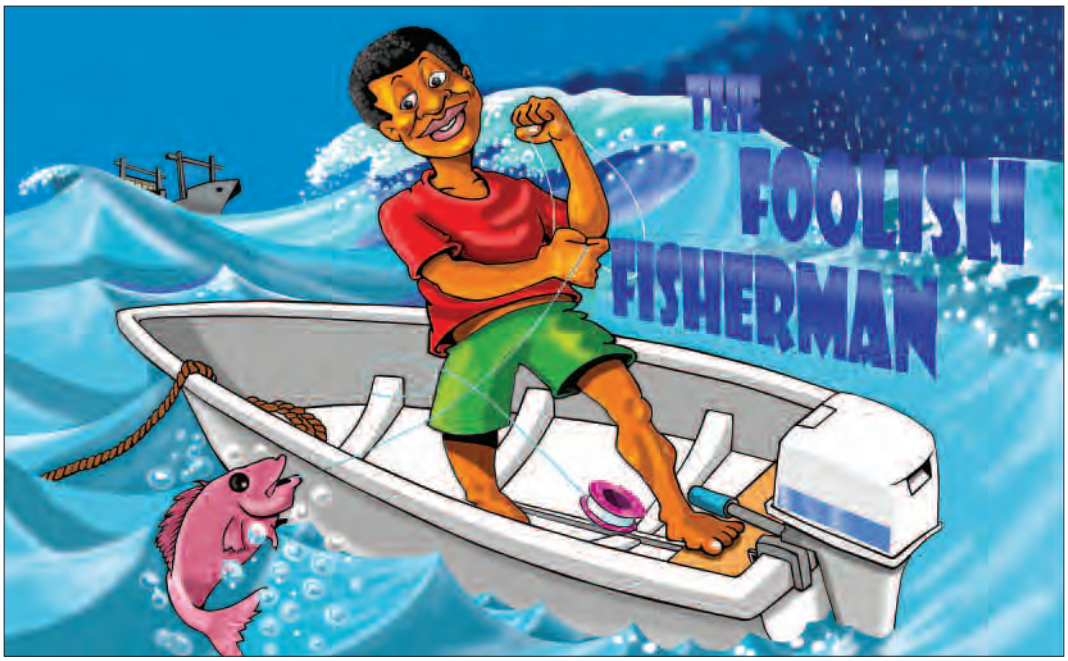
The Foolish Fisherman

A comic book to raise sea safety awareness

As part of the Asian Development Bank's (ADB) Coastal Fisheries Management and Development Project in Papua New Guinea, a comic book aimed at raising awareness on small boat safety has been produced in both English and Tok Pisin. The Fisheries Training Section made a financial contribution to the development of this publication, which will ensure that this important publication is disseminated to target groups in SPC's other member countries and territories.

Two thousand English language copies and two thousand Pidgin copies of the comic have been printed and distributed within Papua New Guinea by the ADB project. SPC is further assisting by printing and distributing an additional 2000 copies, which will be distributed throughout the Pacific Islands region. Reaching community members in remote areas of the Pacific is often a challenge, but it is hoped that this important publication will be effective in communicating with its intended readers, which include small boat operators and school children. At the time of writing, work on a French version of the comic is underway.

If you wish to receive copies of the comic book, please contact the Fisheries Training Section or ask your country's fisheries administration. If you wish to learn more about the fisheries information materials the ADB project is producing, contact the CFMDP office in Kavieng, New Ireland Province, Papua New Guinea at 675-984-2266.



SPC short training videos on DVD

The successful series of SPC short training videos on fisheries topics are now available on DVD. Training videos are a popular and an effective medium for training although their use is restricted to places having electricity and video players. As a follow-up to requests from various users in the region, the dubbing of existing SPC fisheries videos on DVD was necessary. Another advantage is that DVDs can also be played on a laptop in the field. DVDs are suitable for distribution to schools, NGOs and fisheries extension staff.

The 13 fisheries training videos and 1 USP training video have been grouped by topic onto 5 distinct DVDs.

DVD N°1 - Fishing operations
- N° 1 - An Icy Tale: Chilling fish on-board
- N° 2 - Trolling With Natural Bait
- N° 3 - Bottom Fishing With Hydraulics
- N° 4 - On-Board Handling Of Sashimi Grade Tuna

DVD N°2 – Seafood processing
- N° 1 - A Chilling Story: Handling fish in the processing plant
- N° 2 - Tuna Loining: Workshop at Celtrock

DVD N°3 – Seafood business
- N° 1 - Air Freighting Chilled Fish
- N° 2 - A Visit To The Fish Market
- N° 3 - Once Upon A Fish Stall
- N° 4 - Fishy Business

DVD N°4 – Sea Safety
- N° 1 - Better Safe Than Sorry
- N° 2 - Survival At Sea: A Kiritati tale
- N° 3 - Rambo Goes Deep Sea

DVD N°5 – Seaweed farming
- N° 1 - Grow Seaweed, Grow Your Own Money (SPC)
- N° 2 - Seaweed Farming in Pacific Island Countries (USP)

New SPC fisheries DVDs as well as training video tapes (in either PAL, NTSC or SECAM systems) are available from the Fisheries Training Section (SPC, BP D5, 98848 Noumea, New Caledonia).

ACIAR FUNDS TRAINING IN MICROALGAE CULTURE FOR PACIFIC ISLANDERS

The development of sustainable aquaculture in the Pacific is seen by many as having considerable potential for providing not only a source of food, but also a source of income for coastal and inland communities. The Australian Centre for International Agricultural Research (ACIAR) and the Secretariat of the Pacific Community (SPC) recognise that aquaculture development in the Pacific is most likely to succeed if it provides relatively small interventions. As a result, the two agencies have developed a research project that includes "miniprojects" – small, targeted activities to address specific issues and constraints to sustainable aquaculture development in the Pacific.

In the past 12 months, ACIAR has funded 8 "miniprojects" in the Pacific Islands region under the auspices of a new ACIAR Project, "Sustainable aquaculture development in Pacific Islands region and northern Australia". The lead agency is Queensland's Department of Primary Industry and Fisheries (DPI&F), and partner agencies are SPC and the WorldFish Center. The miniprojects promote sustainable aquaculture in the region through a range of research, extension and training activities. When this new ACIAR project began in early 2004, there was a call for miniprojects in the Fisheries Newsletter and at the Fourth Heads of Fisheries meeting in August 2004. In addition to current miniprojects, several more are being developed. This article reports on two of the completed projects that have provided specialised training for Pacific Island government fisheries staff.

Samoan and Tongan fisheries personnel received training in microalgae culture techniques. Microalgae are used as feed for aquaculture species; effective microalgal production underpins successful hatchery production of many commodities in the Pacific. The aim of the training was to support the aquaculture activities in both countries by increasing the capacity of key staff in the area of microalgae culture. Ms Aleliua Taise, a technician from the Samoan Fisheries Division and Mr Siosa'a Malimali, the former head of Aquaculture at Tonga Fisheries, underwent training in Cairns, Queensland and Launceston, Tasmania, respectively.

Samoa currently cultures giant clams, trochus and sea urchins in addition to tilapia. Ms Taise had a three-week attachment at the Live Prey Unit at DPI&F's Northern Fisheries Centre (NFC) in Cairns from 20 April to 10 May. Training was essentially "hands on", focussing on practical skills and problem solving in line with Samoa's hatchery priorities. Ms Taise's training included aspects of laboratory management and hygiene protocol that she felt would be useful for reorganising the algal facility in Samoa and helping with problems the facility has encountered with culture maintenance. Her training also included the basics of rotifer and copepod culture, and a field trip to local hatch-

Siosa'a Malimali practising his algae culture maintenance skills

eries. The latter was a very useful exercise as a number of simple and inexpensive approaches to microalgae production were demonstrated.

Although giant clams have been cultured in Tonga in the past, a current priority is pearl oyster culture, particularly winged pearl oyster, *Pteria penguin*. Mr Malimali's training is closely linked to planned *P. penguin* hatchery production in Tonga in early 2006. Mr Malimali attended a formal training course at the School of Aquaculture, University of Tasmania, in Launceston, from 27 June to 1 July. The intensive five-day course introduced participants to the theory and practice of growing microalgae in large- and small-scale systems. It included theory and practical sessions, with a final problem-solving workshop. Mr Malimali is currently studying for a Master's degree at the Australian Maritime College in Launceston. After completing his degree he will return to Tonga and resume his aquaculture duties.

Despite their different species of interest and style of training, both participants gained new skills that will support aquaculture development in their home country. Specifically, Ms Taise plans to contribute to the development of an algal culture manual and establish improved laboratory protocols, with emphasis on hygiene. Application of Mr Malimali's learning will enhance development of the pearl oyster industry in Tonga by increasing the likelihood of successful *P. penguin* culture while decreasing Tonga's reliance on imported microalgal cultures. The experience of working in other laboratories and exposure to different culturing techniques will stand Samoa and Tonga Fisheries in good stead if they later explore the potential for new aquaculture commodities.

(Contributors: Cathy Hair and Ben Ponia)

US$ 10M PROJECT TO HELP LOCAL FISHERMEN

Coastal fisheries resources contribute significantly to both food security and community incomes throughout the Pacific region. But in places like Papua New Guinea, poor access to seafood markets, a paucity of information and understanding about how to properly manage coastal resources, and a need for training in better management and resource assessment, are further complicated by Papua New Guinea's sheer size and widely dispersed and remotely located communities.

A US$10 million project to promote sustainable development and management of marine resources in Papua New Guinea's coastal waters is well underway, and is already showing positive signs of building the capacity of coastal Papua New Guineans.

Funded by the PNG government through a concessionary loan by the Asian Development Bank, the PNG Coastal Fisheries Management and Development Project (CFMDP) is implemented by the PNG National Fisheries Authority (NFA). The CFMDP works directly with national, provincial and local fisheries administrations, the seafood industry, NGOs, and village communities in four of PNG's coastal provinces.

CFMDP has five main areas of activity: infrastructure development, fisheries assessment and monitoring, strengthening information flows, community-based fisheries management, and institutional strengthening.

Project activities are initially focusing on New Ireland Province because some infrastructure is already in place, and because NFA has good support facilities in that province.

Infrastructure development

Throughout coastal PNG, improved wharves, jetties, and fish freezing and storage facilities are needed. For example, in Daru in PNG's Western Province (one of the project sites), a proper fish landing area and better wharf facilities would not only make it possible for fishing boats to land and offload fish catches more efficiently, but would also improve the sanitation conditions and reduce the turnaround time for users who come from distant islands. The CFMDP will begin construction of a small-boat jetty there later this year.

In places where infrastructure has already been developed, it has changed the way local fishermen operate. In Kavieng (New Ireland Province), where a small boat jetty has been built, fishermen can now offload their catch to nearby market facilities, as well as refuel, buy ice and load cargo, all in one place. Next to the small-boat jetty is a larger-scale wharf that can accommodate commercial tuna fishing vessels. Such a wharf rationalises a facility that allows for cold storage, ice production, air freight and refrigerated shipping. This facility in turn creates opportunities for small-scale fishermen whose catch would otherwise never justify such an infrastructure.

Assessment and monitoring

The CFMDP's one-year programme of sampling fish land-

ings will provide a picture of the pattern of fish landings and use within New Ireland Province. The data will allow the CFMDP team to identify which resources are economically or socially important, and which may require management attention.

A baseline socioeconomic survey to ascertain the economic role of fisheries and the nature of peoples' attitudes to resource use, conservation and management in the province is already providing some interesting indicators of resource management concerns and issues, such as the overuse of *Derris* sp., a poisonous plant that is used to catch fish; dynamite fishing and its impact on reefs and marine resources; illegal fishing in PNG waters; and better management of community reef and mangrove resources.

Some 800 interviews have been conducted and nearly all the data have been entered into the project database. The survey will be repeated in three years and will help to judge the success of the project.

Strengthening information flows

During project scoping meetings, coastal fisheries stakeholders — who included members of the local communities, commercial and subsistence fishers, national and provincial governments, non-governmental organisations and the seafood industry — consistently repeated that they needed better and more regular information on various fisheries-related topics. As a consequence of this demonstrated interest, the CFMDP includes a significant information component, which is currently developing appropriate information products and establishing effective information delivery systems.

A variety of information materials have already been produced, ranging from comic books for primary school children about destructive fishing practices and reef conservation to weekly radio spots with topics that include HIV/AIDS and seafarers, overfishing and safety at sea. Other information materials — such as posters that indicate why mangroves are important to both people and the marine resources they depend on, and video documentary dramas that depict the negative impacts of dynamite fishing and using poisonous plants — are being produced to help reinforce the messages in the comics and radio programmes. The aim is to develop information that is both interesting and readily understood by a range of people, and which reinforces the project's goals.

Community-based fisheries management

The CFMDP has developed course manuals and implemented a one-month training programme for local and provincial fisheries officers in community-based management and communication skills. Following on from this training, the CFMDP is working with a local New Ireland Province NGO, Ailan Awareness, to raise awareness about community-based management through village "roadshows", making use of plays, songs and videos, and radio programmes to deliver their message. Follow-up visits are made to communities that express a keen interest in actively managing their marine resources.

Four communities have been selected for more comprehensive support, and the team is providing them with assistance and technical input in order for them to develop their own fishery management plans. The ultimate goal is to get a significant proportion — approximately 25% of coastal waters around New Ireland Province — under some form of community or customary-based protection.

Two international NGOs directly support the project's community-based management programme by providing funding and helping to carry out activities that support or complement the community-based management programme. For example, Wildlife Conservation Society is undertaking resource monitoring of some of the participating communities' reefs, while The Nature Conservancy is helping Ailan Awareness set up accounting and financial control systems so that the NGO will be self-sufficient before the CFMDP ends in 2007.

Institutional strengthening

One of the key elements of the project is building local capacity to assist with and then take over the fisheries management activities the CFMDP is setting up. In New Ireland Province, several training courses for local fishery officers, observers and port samplers have been run. As a result, there is now a competent and motivated field team whose members are taking responsibility for many aspects of the project's work. Later this year, the project will take the same approach in other target provinces such as Morobe and Milne Bay.

According to Garry Preston, the project's team leader, "The CFMDP project represents a comprehensive, integrated approach to coastal fishery management that is of relevance to other Pacific Island countries and locations. Our project will be happy to share its experience and information with interested parties from countries in the region."

(Source: Islands Business, June 2005 — Kim Des Rochers is the Fisheries Information Adviser for the PNG Coastal Fisheries Management and Development Project)

TSUNAMI-DAMAGED CORAL REEFS SHOULD BE LEFT TO RECOVER NATURALLY, SAY SCIENTISTS

Coral reefs damaged in the Asian tsunami tragedy should be allowed to recover naturally before countries launch into expensive restoration plans, according to some of the world's leading scientists.

The scientists, led by a researcher from the University of Newcastle upon Tyne, and who set out their views in an advisory brief for the World Bank, point to historical records of major coral reef devastation by cyclones and typhoons, which show that reefs recovered without human intervention.

Although the devastation caused by the tsunami was on a much larger scale, the scientists say there is no evidence to suggest that the vast majority of reefs will not recover naturally this time.

They add that governments should be very careful not to commit funds to costly repair programmes that may have little long-term effect.

About 20 per cent of the coral reefs in places such as Thailand and Sri Lanka were badly affected by the tsunami that happened in December last year. The damage was mainly caused by the backwash — waves returning to the sea that sucked back from the shore debris such as trees, cars, sediment and parts of buildings, which broke and overturned corals.

The group recommends that, in most cases, simply removing the debris from the reefs would be sufficient to allow them to repair themselves. Only in areas where corals were more or less wiped out and no healthy reefs remained nearby to provide a source of new coral larvae, would artificial methods such as coral transplantation be clearly beneficial.

Dr Alasdair Edwards, a researcher and senior lecturer with the University of Newcastle upon Tyne, UK, chairs the World Bank's Coral Restoration and Remediation Working Group. He said: "Obviously, immediately after the tsunami, the main priorities have been to address the human toll, the health and sustenance of survivors and the rebuilding of livelihoods in all of the affected nations.

"However, long-term reconstruction efforts will need to examine requirements for rebuilding damaged sectors such as fisheries and tourism, and rehabilitating the natural systems on which they depend, such as coral reefs."

Dr Edwards, of Newcastle University's School of Biology, added: "There are many quick fixes on offer but scientific evidence suggests that in most cases these would not be a good use of scarce resources and could actually harm surviving reefs. We need to find a long-term, sustainable solution for restoration. "We're advocating a cleaning up of the debris in the majority of cases, so as to allow natural recovery processes to take place. Coral reefs have been subject to natural disasters for millions of years, and they have survived and adapted over a long time."

Poorly planned reconstruction programmes undertaken on the land can also adversely affect marine wildlife, say the scientists. Professional environmental impact assessments should be carried out in the first instance so that projects can be undertaken with the minimum of impact.

Dr Edwards added, "For example, many developers like to build right on the coastline but they would be better advised to set back their developments a little to minimise the impact on sea life. Communities that are rebuilding hotels should take advantage of reconstruction funds to make sure there is effective sewage treatment available. And if builders are moving lots of earth around, they should do this in the dry season rather than the wet season to avoid sediment being washed into the sea."

(Source: University of Newcastle upon Tyne public release, 12 May 2005)

COULD BETTER MANGROVE HABITATS HAVE SPARED LIVES IN THE 2004 TSUNAMI?

Accounts of the tsunami that killed over a quarter of a million people in Southeast Asia on the 26th of December, 2004, slowly disappear from the media, but the event is nevertheless heavily burned into the memories of those who are directly involved. In the aftermath of the disaster, academics and politicians alike are trying to investigate how the number of casualties could have been reduced and, more important, how such severe damage can be avoided if a tsunami ever strikes again. In an essay published in the June 21 issue of *Current Biology*, a group of researchers recount the first findings arising from their recent assessment of how mangrove ecosystems might have influenced the tsunami's impacts on coastal communities.

The research represents a collaborative effort, with participants from the Vrije Universiteit Brussel, Belgium; the University of Ruhuna, Sri Lanka; the Kenya Marine and Fisheries Research Institute; and the Institut Français de Pondichéry, India.

Mangrove greenbelts were known to offer some protection against destructive ocean events, such as tsunamis and (far more frequently) tropical cyclones, but they have not always been valued for that function. Economic and political interference, driven by short-term benefit, have been responsible for the destruction of thousands of hectares of mangrove forest (e.g., in East Africa, on the Indian subcontinent, and in Banda Aceh, Indonesia), resulting in the loss of the natural, protective "dyke" function of mangroves in addition to the loss of other services that mangroves provide to local economies and ecosystems. Although many politicians, journalists, and scientists have made post-tsunami statements about the barrier function of mangroves, most have failed to recognize that this function has never actually been investigated in detail.

In their essay, the authors present an account of the first post-tsunami field assessment they've undertaken, in Sri Lanka. The researchers investigated the impact of the tsunami at 24 different mangrove sites, comparing the event's effects to the size, history, and quality of the local mangroves. The researchers found that where mangroves occur, they did in fact offer protection from the tsunami. Mangrove fringes near the water's edge appeared to take most of the energy from the tsunami waves, and they showed evidence of damage in some cases, but the researchers found few examples of mangrove trees actually being uprooted.

However, mangroves at numerous sites had experienced pre-tsunami degradation. This disruption, resulting from human impact, included "cryptic ecological degradation" (see also *Current Biology*, March 29, 2005), which involves subtle changes in species composition. From their assessments of the 24 coastal sites, the researchers concluded that even these seemingly minor alterations, which do not necessarily involve a reduction in mangrove area, have had a profound impact on the damage that the 2004 tsunami inflicted on the coastal zone. This puts the drastic clearing of mangroves, and the conversion of mangrove habitats to shrimp farms in other areas, into even starker perspective.

The authors highlight the urgent need for a union between management-driven research (research that specifically focuses on environmental aspects that need to be managed) and research-driven management (management that is based on facts from scientific research). The team emphasizes that an early-warning system for mangrove degradation should be seen as being as important for future protection as are early-warning systems for tsunami arrivals; the authors contend that if put in place, such ecological warning systems, along with the restoration of mangroves and other natural defenses, could be more effective in saving human lives and property.

(Source: www.current-biology.com)

AN UNDERWATER PLANE FOR OCEANOGRAPHIC RESEARCH

The French Institute of Research for Development (IRD) is playing a part in technological innovation in the southwest Pacific. As part of a Franco-American project, a remote-controlled hydroplane is to be used for research work on the ocean currents between New Caledonia, Solomon Islands and Vanuatu.

After studying the ocean surface from space with satellite technology, oceanographers are now exploring the marine depths. Along with the international network of Argo autonomous floats, a new generation of tools, known as hydroplanes, will make it possible to monitor all the temperature and salinity parameters of

ocean waters along predetermined trajectories.

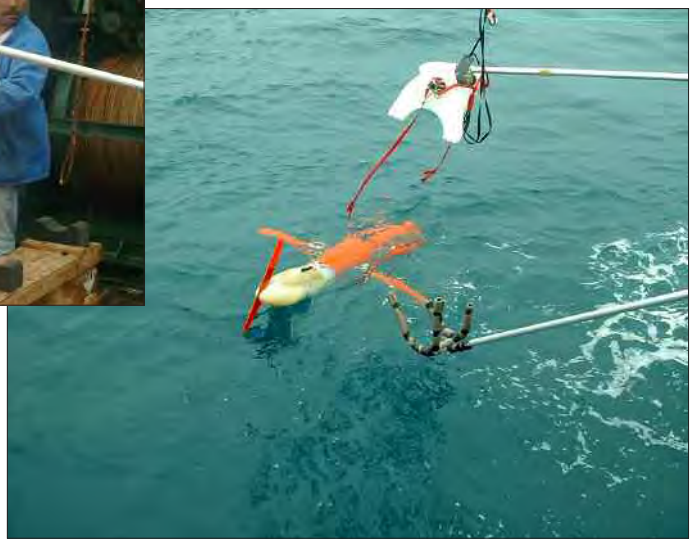
"Argo floats drift with the ocean currents and transmit the information from their recorders by satellite," explains Lionel Gourdeau, an IRD oceanographer. "The hydroplane we will be using during our next cruise on the IRD's oceanographic research vessel, the 'Alis', is a big step forward because its movements can be remotely controlled by GPS (global positioning system) and hydraulic pumps. The system makes it possible to change the plane's density, allowing it to move up or down in the water column and travel in the required direction with the guidance of its wings. As it comes back up to the surface, the plane repositions itself to change direction as required."

"This is the first Franco-American research project in the Pacific region", says with satisfaction William Kessler of the Pacific Marine Environment Laboratory of Seattle. The hydroplane is a prototype designed by Scripps, one of the major American oceanographic institutions. It will allow oceanographers to perform more accurate mapping and research on the ocean currents between New Caledonia, Solomon Islands and Vanuatu.

In the upper 1000 m, ocean water circulation in the southwest Pacific is dominated by the westward movement of the South Equatorial Current. These waters can carry climate signals, like the El Niño/La Niña events, from their contact zone with the atmosphere, around French Polynesia, as far as the Equator, where they emerge. The topographic obstacles around islands such as New Caledonia, Fiji and Vanuatu divide this major current and channel it into a number of branches.

During the SECALIS (*Systèmes d'Informations Scientifiques pour la Mer*) cruise, which will take place in July, scientists will therefore test this hydroplane by tracking these branches while performing the usual physical oceanography measurements on board the *Alis*, IRD's oceanographic research vessel.

(Source: IRD press release, 1 July 2005)



The hydroplane contains sea water temperature and salinity recorders. It climbs and descends through a system of hydraulic pumps and directs itself horizontally with its wings. On the surface it repositions itself with a GPS system.

NOAA'S SEA TURTLE RESEARCH GAINS ADDITIONAL RECOGNITION

Two NOAA Fisheries Service researchers, George Balazs and Yonat Swimmer, both with the NOAA Pacific Islands Fisheries Science Center (PTFSC) in Hawaii, have been recognized for their exemplary sea turtle research and recovery efforts this year. Not only does their research contribute toward achieving one of the NOAA PIFSC's primary goals (to achieve the biological recovery and sustained management of sea turtle populations in the

Pacific Ocean), but it reflects recent trends in NOAA sea turtle research and conservation efforts throughout the world.

Balazs's core sea turtle biology and conservation efforts

On 31 March 2005, George Balazs, a biologist with the Marine Turtle Research Program within the PTFSC's Protected Species Division, was presented with the National Wildlife Federation's prestigious National Conservation Achievement Award for his 34-year commitment to the study and recovery of sea turtles worldwide — and the endangered Hawaiian green sea turtle, in particular. Balazs hopes to see the Hawaii green sea turtle population justifiably removed from the endangered species list before he retires from the federal service.

Balazs helped place the turtles on the federal endangered species list in 1978 and has overseen research on sea turtle biology, ecology and life history throughout his career. Balazs attributes much of the sea turtle population recovery over the last few decades to the Endangered Species Act and education efforts — in which he has played a major role — that have shifted Hawaiian's residents' perceptions of sea turtles from a source of food to a native species they are proud to protect.

His work with radio transmitters — attached to sea turtles that were caught and released from commercial longline vessels — has shown that sea turtles often take long, open-ocean routes from their feeding sites to nesting areas and that they can navigate hundreds of miles without landmarks.

Today, he is recognized as one of the world's foremost sea turtle experts in Hawaii, Japan and many other parts of the world inhabited by sea turtles. His work has been published in numerous scientific publications, and he has served as a scientific advisor on a prestigious list of global turtle conservation groups.

Swimmer's sea turtle behavioral and physiology research

In January of 2005, Yonat Swimmer, a protected species biologist with the Captive Turtle Behavior and Physiology Project within the PTFSC's Fishery Biology and Stock Assessment Division, was granted a Fulbright Scholarship to conduct research on sea turtle bycatch reduction and to teach students involved in sea turtle recovery programs in Brazil — a country that already has a reputation for being proactive in leading Latin America toward responsible fishing methods.

Starting in the fall of 2005, Swimmer will work collaboratively with scientists and students from the *Universidade Estadual de Feira de Santana*, *Projeto TAMAR*, and *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* in Bahia, Brazil. Swimmer's research will focus on determining if large circle hooks or other gear or bait modifications could be used effectively to both increase catch target species, while simultaneously reducing sea turtle bycatch — a practice that has already proven to be successful and is now required by law in the United States. Swimmer also will use state-of-the-art satellite technology to help determine the probability of mortality for sea turtles after their release from longline fishing gear. Using pop-up satellite archival tags (PSATs), which are attached to the shells of incidentally-caught sea turtles, Swimmer will track their movements for close to six months post-release. Rates of post-hooking mortality and morbidity will be correlated with other data collected, such as hook location, severity of injury and a general assessment of each turtle's health. Because PSATs also have sensors that record hourly data on swimming depth, water temperature and geolocation, Swimmer's research also will contribute toward a better understanding of environmental factors that influence turtles' movements. Lastly, Swimmer also hopes to assess the health status of sea turtles following a longline fisheries encounter by analyzing various blood chemistry parameters from incidentally caught sea turtles. In this way, she and her collaborators hope to gain insight into the extent of injury and the probability of survival for turtles subjected to various stressors. In combination with the satellite tracking, this information could prove to be a useful tool in evaluating mortality of sea turtles due to fisheries interactions.

"NOAA Fisheries Service would not enjoy the international clout and reputation as leaders in marine science if we didn't have the world's most capable and dedicated scientists on our staff," said Bill Hogarth, director of the NOAA Fisheries Service. "We are fortunate to have Balazs and Swimmer among our ranks at NOAA Fisheries Service. Their dedication to marine conservation is making a difference as we work globally to rebuild sea turtle populations."

NOAA Pacific Islands Fisheries Science Center

Other sea turtle research and recovery work being conducted by the NOAA PIFSC include sea turtle ecology (by J. Polovina), foreign export of technology/gear trials (by C. Boggs) and sea turtle population demography and modeling (by M. Snover).

The NOAA PIFSC also conducts research on coral reefs, as well as other fisheries and protected marine species issues.

NOAA sea turtle research and recovery efforts

For decades, NOAA scientists have been recognized for their research on the nesting and coastal habitats of sea turtles and — as you can see from the above text — are now shifting their focus toward understanding sea turtles in the open ocean, especially new ways to avoid bycatch or the incidental catch of sea turtles in fishing gear. Because of the global nature of the sea turtle issues, NOAA also has included the international community in its sea turtle research and recovery efforts over the last few decades.

NOAA, in collaboration with partners, has made substantial progress in identifying and reducing human threats to turtle populations in recent years, but there is more work to be done. For example, NOAA has seen how the required use of turtle excluder devices in shrimp fisheries (both in the United States and by countries exporting wild-caught shrimp into the United States) — in conjunction with full protection of nesting beaches in Mexico — is helping in the recovery of endangered Kemp's ridley sea turtle population. Although regulations requiring the use of TEDs was put into place almost 15 years ago, NOAA continues working to improve the TEDs. Just last year, NOAA began requiring larger escape openings to allow even the largest turtles out of the nets. These larger openings will be required for foreign producers starting 1 August 2005. NOAA also has made progress in its next biggest challenge, sea turtle bycatch associated with longline fishing.

Sea turtle bycatch associated with longline fishing

In January 2005, NOAA announced that, after three years of extensive research, it had developed gear and techniques to help longline fishermen avoid interactions with sea turtles. American longline fisheries in portions of the Pacific and in the North Atlantic Grand Banks had been closed during those three years at great social and economic cost to the industry. However, NOAA realized that closing these turtle-rich waters to American fishermen was not the best solution because other nations continued longline operations without the use of turtle-friendly gear. So, NOAA worked with fishermen, gear specialists and academic partners to develop new longline fishing practices.

During NOAA's research, scientists found that sea turtle captures and injuries could be substantially reduced by prohibiting the use of traditional "J" hooks, which cause serious harm when swallowed by sea turtles, and replacing them with large circle hooks. Because of their shape, circle hooks are much less likely to catch turtles or to cause serious injury if a turtle does try to take the bait. Furthermore, because many sea turtle deaths occur when commercial fishing gear is not removed (or removed improperly) from the sea turtle, NOAA researchers and private industry also developed dehookers and line cutters — so that fishermen could remove longline gear when it was safe to do so without further injury to the sea turtle. Removing gear is believed to decrease post-release mortality. This research was such a success that, as of 5 April 2005, the NOAA Fisheries Service now requires the use of these new technologies in U.S. longline fisheries in both the Atlantic and Pacific.

"I am pleased that we found a solution that allowed NOAA to both reopen the Pacific and Atlantic waters to American longline fishermen and promote sea turtle conservation," said Bill Hogarth, director of NOAA Fisheries Service." Hogarth added, "It is now critical for NOAA to demonstrate to other countries that longline fisheries could use these tangible and effective methods of protecting turtles and still remain profitable."

NOAA's international sea turtle efforts

As evidenced by Balazs's and Swimmer's sea turtle research and recovery efforts, the NOAA Fisheries Service and its partners also have launched educational initiatives to share the results of their work with the international fishing community and invite them to utilize these new technologies in an effort to protect sea turtles by making all fishing operations more selective worldwide. Assistance activities already have been completed (or are currently underway) in many Pacific regions (i.e. Federated States of Micronesia, Papua New Guinea and the Republic of the Marshall Islands) and will soon begin in the Solomon Islands. NOAA also has held education workshops in Ecuador, Costa Rica, Peru, Mexico, Guatemala and has one scheduled for Panama in the fall of 2005. There also has been a growing interest for similar efforts in other countries, such as Japan and Taiwan.

(Source: NOAA Magazine, 2 June 2005)

INTERNATIONAL SHIP AND PORT FACILITY SECURITY (ISPS) CODE — WHAT DOES IT MEAN FOR FISHING VESSEL SECURITY?

John P. Hogan[1] and Lindsay Chapman[2]
Secretariat of the Pacific Community

Introduction

The International Maritime Organization (IMO) has introduced a range of security measures under the Safety of Life at Sea (SOLAS) Convention, through amendments that establish an international framework by which ships and port facilities can detect and deter acts that threaten maritime transport security. SOLAS regulations include the International Ship and Port Facility Security (ISPS) Code. This code applies to all cargo ships 500 gross tons and larger, all passenger ships on international voyages, and to the port facilities serving such ships. It does not apply to fishing vessels or to merchant vessels less than 500 gross tons.

The ISPS Code has been in force since 1 July 2004 for those states that are parties to SOLAS. While the ISPS Code is designed to deal with maritime security, it is not about responding to terrorist incidents. Rather, it is a comprehensive preventive regime that takes a risk management approach to protecting ships and port facilities.

All Pacific Island countries and territories (PICTs) are currently in compliance with the Code. They face a challenge, however, in effectively implementing the Code on an ongoing basis, in relation to both port facilities and ships using such ports. One of the concerns raised at the 2004 meeting of the Pacific Islands Forum Regional Security Committee was the fact that the Code's security measures do not apply to fishing vessels. The main concerns relating to fishing vessels include piracy, the smuggling of people and/or illegal goods (drugs, firearms, alcohol, etc.) and stowaways. PICTs are to ascertain ways to apply either the Code or alternatively some other security arrangement that will be agreeable to their fishing industry, as well as other fishing vessel Flag States.

The ISPS Code in a nutshell

The ISPS Code provides a standardised and consistent international framework for identifying and evaluating security risks to ships and port facilities used in international trade, and a means of taking appropriate preventive measures against such risks. The Code is specifically designed to cover security in regard to terrorism or a terrorist threat, and reflects a strong risk management approach. Its fundamental principle is that each ship or port facility faces different types of risks, and these risks must be well understood and an assessment made so that appropriate security measures can be put in place to protect life, property, and the environment.

The ISPS Code is divided into two parts: those that are mandatory and those that are recommended. States that are party to SOLAS decide the extent to which the Code should be applied to those port facilities within their territory that are used primarily by ships engaged on domestic voyages, but which may occasionally serve ships arriving or departing on an international voyage. The Code does not apply to warships, naval auxiliaries or other ships owned or operated by Contracting Governments and used only on non-commercial service. More importantly, the Code does not apply to fishing vessels.

The functional requirements of the Code include gathering and assessing information with respect to security threats and exchanging such information with appropriate Contracting Governments; requiring the maintenance of communication protocols for ships and port facilities; preventing unauthorised access to ships, port facilities and their restricted areas; preventing the introduction of unauthorised weapons, incendiary devices or explosives to ships or port facilities; providing means for raising alarms in reaction to security threats or security incidents; requiring ship and port facility security plans based upon security assessments; and requiring training, drills and exercises to ensure familiarity with security plans and procedures.

Government and shipping company responsibilities

Contracting Governments are responsible for setting the applicable security level; approving port facility security assessments; determining which port facilities will be required to designate a port facility security officer; approving a port facility security plan and subsequent

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amendments to an approved plan; implementing control and compliance measures pursuant to regulation XI–2/9 (amendments to SOLAS); and establishing the requirements for a declaration of security. There are specific responsibilities that cannot be delegated to a recognised security organisation.

Shipping company responsibilities include ensuring the ship security plan contains a clear statement emphasising the master's authority, as well as provisions needed to support the company security officer and the ship security officer in carrying out their duties.

Ship and port security

Both the ship and port facility security sections of the ISPS Code contain requirements and guidance for: security assessments, security plans, records (a paper trail), responsibilities of the port facility security and ship security officers as well as training, drills and exercises with regard to security on either the ship or the port facility.

The Code defines three security levels. Level 1 is the level at which ships and port facilities normally operate, and defines the minimum appropriate protective security measures that should be maintained at all times. Security level 2 corresponds to a heightened risk of a security incident (for which additional protective security measures are required); level 3 is used for an exceptional security risk (a security incident is probable or imminent). Apart from ensuring that all ship security duties are performed, the Code contains provisions regarding the control of access to ships, the control of embarkation of persons and their effects, and the monitoring of restricted areas, deck areas and areas surrounding ships. Additional sections address supervising the handling of cargo and ships' stores, plus ensuring that security communication is readily available.

Part A of the ISPS Code details port facility security requirements to be implemented at various security levels; guidance for extra precautions is provided in Part B. Activities include ensuring that all port facility security requirements are implemented; controlling access to port facilities; monitoring port facilities, including anchorage and berthing areas; monitoring restricted areas; supervising the handling of cargo and ship's stores; and ensuring that secure communication is readily available.

Verification and certification

Ships are subject to security verification, which serves as the basis for issuance of an international ship security certificate. Certificates are valid for not more than five years, and at least one intermediate verification must take place during this time. Flag States are responsible for verification, but this can be delegated to a recognised security organisation.

Part B of the ISPS Code contains very useful advice on the implementation of Part A. Although for guidance only, it is prudent if those responsible for security policies implement Part B recommendations as far as possible.

Can the ISPS Code be applied to fishing vessels?

The 1974 SOLAS Convention specifies the classes of ships to which the ISPS Code applies; these do not include fishing vessels. Nothing prohibits a State from requiring that a fishing vessel flying its flag comply with some or all of the provisions of the ISPS Code, however.

There are over 1000 foreign and several hundred domestic fishing vessels of all classes currently fishing in the Pacific region. The broad policy question is not whether these vessels should be subjected to some form of security regime, but how such a requirement can be administered and enforced. From a legal perspective, security issues fall outside coastal States' fisheries management and enforcement powers; consequently, it would seem out of order to expect PICTs to evoke their fisheries powers to require all fishing vessels to have a ship security system in place. The practical and logistical difficulties that PICTs could face if such a requirement were to be made mandatory would be onerous.

The nature of fisheries presents logistical problems. There is no consistency in how fishing vessels are licensed. Some foreign fishing vessels are licensed as members of an association, with which individual PICTs have standing access agreements. In such instances, the licence and registration applications for the various vessels are undertaken by the association, whose headquarters might be in Tokyo, Kaoshung, or Seoul. These applications are generally submitted simultaneously. The vessels are usually on the fishing grounds, and licences are normally issued to foreign fishing vessels without any physical inspection. It does not make sense, either logistically or economically, to require foreign fishing vessels to enter port before they can be licensed, as most do not make port calls, and have the capacity to spend months at a time at sea before they unload their catch.

Other foreign fishing vessels may be licensed directly by the fisheries departments, but never make any port calls. A third category of foreign fishing vessels operating in the region includes locally based foreign fishing vessels, which usually have an

arrangement with a PICT to be based locally and to land all their catch in that country. Some of these vessels operate under charter to local fishing companies. Although these vessels fly foreign flags, their operations are conducted wholly within the region. Other locally based foreign fishing vessels may take up the flag of the country they are operating from as part of the licensing requirement. Regardless of vessel's flag, the highly mobile and migratory nature of the fishing industry would present immense logistical problems for enforcing the ISPS Code, if the Code was applied to all fishing vessels.

Legally, it may be outside the ability of PICTs to impose such a requirement since the IMO has specifically stated that the Code does not apply to fishing vessels, even though the State whose flag the fishing vessel flies may require their vessels to have a ship security system. It is not clear, therefore, what the legal position would be if PICTs required foreign fishing vessels in the region to have a ship security system. It might not be opposable to the Flag States, as they could argue that legally they are the only competent authority that could require fishing vessels to have a ship security system. This raises an issue: how can the Code be practically applied, in a way that Flag States could not oppose. Some PICTs have already included fishing vessels in their security regulations, but this only applies to vessels flying their flag; furthermore, the requirement is not enforced.

Obviously, there are legal and practical issues that must be considered before the ISPS Code can either be applied directly to fishing vessels, or adapted in some way to address fishing vessel security. In addition to the fundamental legal question of whether application of the code to fishing vessels would not be tantamount to a breach of the Code (insofar as unilateral application of the ISPS Code to fishing vessels would violate the Code's exemption), it should be determined whether a more stringent Code could be developed for the region. Factors to be taken into account in determining whether more stringent measures need to be applied to fishing vessels in the region are the scale of the threat that fishing vessels pose, and more importantly, whether the IMO would sanction such measures. Finally, there is also the issue of whether the IMO has jurisdiction over fishing vessels. In addressing these questions, it is important to determine what is currently being done to address security or criminal concerns.

It would appear that the fisheries provisions on the Law of the Sea Convention do not grant States the power to require foreign fishing vessels to have a ship security system, because this is not a matter that relates to fisheries management and conservation. Consequently, coastal States would have to exercise their general maritime and security powers as a means of requiring fishing vessels to be subject to security checks in port. Under such an option, PICTs could enhance their port State powers (already granted under the Code) and extend these to include fishing vessels as a matter of course.

Conclusions

As outlined above, the application of IMO security measures to fishing vessels, as these currently stand, suffers from legal and practical difficulties. The ISPS Code is specifically designed to cover security in regard to terrorism or terrorist threat, whereas the main concerns relating to fishing vessels appear to be in regard to piracy, the smuggling of people and/or illegal goods (drugs, firearms, alcohol, etc.), and stowaways, which are not primarily terrorism-related issues.

An additional complication is the lack of consistency in how PICTs licence fishing vessels, and the differences that exist between PICTs in terms of their national legislation addressing fishing vessels, and how vessels are addressed. In order to address these issues (and to avoid loopholes whereby fishing vessels move to a particular country or territory in the region where requirements are less stringent), a consistent regional approach to fishing vessel security should be taken. This approach could examine ways to include fishing vessels under the ISPS Code, or examine development of a separate arrangement that addresses the issue consistently across the region. Regardless of which approach is adopted, stakeholder participation will be essential in the development of a regional approach; this should include the maritime and fisheries departments in each PICT and their respective industries, so as to ensure that a workable, cost effective arrangement can be agreed upon.

FAD RESEARCH PROJECT: FINAL RESULTS FROM COMMUNITY SURVEYS, GENDER ASSESSMENT, AND CATCH AND EFFORT DATA ANALYSIS

Lindsay Chapman[1], Ian Bertram[2] and Brendon Pasisi[3]

Introduction

The three-year SPC fish aggregating device (FAD) research project ran from mid-2001 to mid-2004, with a six-month extension until the end of 2004. The project was funded through the New Zealand Pacific Initiative for the Environment (PIE), and was implemented in Niue, and Rarotonga and Aitutaki in the Cook Islands.

In the last issue of *Fisheries Newsletter* (#112), the objectives and outputs of the project were presented along with final project activity results, with respect to FAD designs, aggregator designs and FAD costings. This second article summarises the final results of the project in regards to community surveys, gender assessment of fishing activities, and catch and effort data.

Summary of community survey activities

A coastal community survey questionnaire was developed by SPC in 2001 in consultation with the Fisheries Departments in both Niue and the Cook Islands. The first community surveys were completed in Niue in December 2001, and in March 2002 in the Cook Islands. These surveys were carried out with the assistance of Fisheries Department staff in each location. Table 1 summarises the data. This table and the results were reported in *Fisheries Newsletter* #101 with an explanation of the figures.

The second community surveys were conducted in Niue in March 2003, with Mr Jay Jay Talagi from the Fisheries Department assisting with the work. The surveys were conducted in the Cook Islands in May 2003, with the assistance of Ms Tuaine Turua from the

Table 1: Summary of data collected during the first community surveys (December 2001 in Niue and March 2002 in the Cook Islands)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	27	100	3.7	23	85.20%	17	15	15	55.60%	15	55.60%
Niue	Avatele	27	106	3.9	21	77.80%	29	13	19	70.40%	8	29.60%
Niue	Hikutavake	12	37	3.1	7	58.30%	6	0	3	25.00%	2	16.70%
Niue	Lakepa	22	84	3.8	15	68.20%	7	2	6	27.30%	3	13.60%
Niue	Makefu	20	75	3.8	15	75.00%	12	2	8	40.00%	2	10.00%
Niue	Namakulu	7	9	1.3	4	57.10%	2	1	2	28.60%	2	28.60%
Niue	Selected fishermen	4	21	5.3	4	100.00%	4	7	4	100.00%	4	100.00%
Niue	Tuapa	24	75	3.1	23	95.80%	18	6	12	50.00%	10	41.70%
	Vaiea	11	60	5.5	10	90.90%	6	3	7	63.60%	6	54.50%
	Sub-total	**154**	**567**	**3.7**	**122**	**79.20%**	**101**	**49**	**76**	**49.40%**	**52**	**33.80%**
Aitutaki	Amuri	54	214	4	38	70.40%	28	14	10	18.50%	6	11.10%
Aitutaki	Arutanga and Araura	27	120	4.4	14	51.90%	4	11	4	14.80%	3	11.10%
Aitutaki	Nikaupara	34	143	4.2	26	76.50%	7	21	10	29.40%	8	23.50%
Aitutaki	Reureu	27	125	4.6	15	55.60%	7	7	3	11.10%	2	7.40%
Aitutaki	Ureia	24	95	4	17	70.80%	10	10	8	33.30%	6	25.00%
Aitutaki	Vaipae and Vaipeka	80	375	4.7	53	66.30%	22	26	12	15.00%	11	13.80%
	Sub-total	**246**	**1072**	**4.4**	**163**	**66.30%**	**78**	**89**	**47**	**19.10%**	**36**	**14.60%**
Rarotonga	Aroko and Avana	23	76	3.3	14	60.90%	0	2	0	0.00%	0	0.00%
Rarotonga	Matavera	25	93	3.7	10	40.00%	0	4	2	8.00%	2	8.00%
Rarotonga	Pokoinu to Nikao	77	339	4.4	33	42.90%	2	10	6	7.80%	4	5.20%
Rarotonga	Rutaki and Aroa	43	174	4	24	55.80%	2	3	1	2.30%	1	2.30%
Rarotonga	Selected fishermen	19	85	4.5	19	100.00%	5	21	19	100.00%	19	100.00%
Rarotonga	Titikaveka	34	136	4	16	47.10%	8	5	4	11.80%	4	11.80%
	Sub-total	**221**	**903**	**4.1**	**116**	**52.50%**	**17**	**45**	**32**	**14.50%**	**30**	**13.60%**
	Total	**621**	**2542**	**4.1**	**401**	**64.60%**	**196**	**183**	**155**	**25.00%**	**118**	**19.00%**

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Fisheries Department, with several other fisheries staff assisting from time to time in each location. Table 2 summarises the data. This table and the results were reported in *Fisheries Newsletter* #106 with an explanation of the figures.

The third community surveys were conducted in the Cook Islands in June 2004, with the assistance of Mr Ngametua Tangatakino in Rarotonga and Mr Richard Henry in Aitutaki, with several other fisheries staff assisting from time to time in each location. The surveys were conducted in Niue in July 2004, with Mr Jay Jay Talagi from the Fisheries Department assisting in this work. Table 3 summarises the data from the third survey.

Table 2: Summary of data collected during the second community surveys (March 2003 in Niue and May 2003 in the Cook Islands)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	26	76	2.9	15	57.70%	10	7	7	26.90%	7	26.90%
Niue	Avatele	28	89	3.2	21	75.00%	24	12	15	53.60%	11	39.30%
Niue	Hikutavake	14	36	2.6	9	64.30%	8	1	4	28.60%	2	14.30%
Niue	Lakepa	22	76	3.5	18	81.80%	7	3	4	18.20%	2	9.10%
Niue	Makefu	21	63	3	16	76.20%	14	2	7	33.30%	4	19.00%
Niue	Namakulu	8	6	0.8	3	37.50%	2	0	1	12.50%	1	12.50%
Niue	Selected fishermen	4	23	5.8	4	100.00%	9	8	4	100.00%	4	100.00%
Niue	Tuapa	28	59	2.1	13	46.40%	8	2	8	28.60%	7	25.00%
	Vaiea	11	55	5	10	90.90%	5	6	7	63.60%	7	63.60%
	Sub-total	**162**	**483**	**3**	**109**	**67.30%**	**87**	**41**	**57**	**35.20%**	**45**	**27.80%**
Aitutaki	Amuri	54	175	3.2	37	68.50%	22	19	14	25.90%	9	16.70%
Aitutaki	Arutanga and Araura	27	89	3.3	17	63.00%	8	9	4	14.80%	3	11.10%
Aitutaki	Nikaupara	35	140	4	27	77.10%	8	20	9	25.70%	7	20.00%
Aitutaki	Reureu	27	107	4	19	70.40%	2	8	5	18.50%	2	7.40%
Aitutaki	Ureia	24	95	4	21	87.50%	6	12	11	45.80%	7	29.20%
Aitutaki	Vaipae and Vaipeka	80	306	3.8	49	61.30%	15	19	11	13.80%	6	7.50%
	Sub-total	**247**	**912**	**3.7**	**170**	**68.80%**	**61**	**87**	**54**	**21.90%**	**34**	**13.80%**
Rarotonga	Aroko and Avana	24	63	2.6	8	33.30%	0	0	0	0.00%	0	0.00%
Rarotonga	Matavera	25	73	2.9	10	40.00%	0	3	1	4.00%	0	0.00%
Rarotonga	Pokoinu to Nikao	77	317	4.1	31	40.30%	0	4	3	3.90%	2	2.60%
Rarotonga	Rutaki and Aroa	43	156	3.6	24	55.80%	2	2	1	2.30%	1	2.30%
Rarotonga	Selected fishermen	19	96	5.1	19	100.00%	1	22	19	100.00%	18	94.70%
Rarotonga	Titikaveka	33	81	2.5	7	21.20%	0	5	1	3.00%	1	3.00%
	Sub-total	**221**	**786**	**3.6**	**99**	**44.80%**	**3**	**36**	**25**	**11.30%**	**22**	**10.00%**
	Total	**630**	**2181**	**3.5**	**378**	**60.00%**	**151**	**164**	**136**	**21.60%**	**101**	**16.00%**

Table 3: Summary of data collected during the third community surveys (June 2004 in the Cook Islands and July 2004 in Niue)

Island	Village	Number of h/holds covered	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue	Alofi North	27	86	3.2	16	59.30%	8	7	6	37.50%	6	37.50%
Niue	Avatele	28	98	3.5	22	78.60%	24	9	14	63.60%	11	50.00%
Niue	Hikutavake	14	33	2.4	9	64.30%	4	0	4	44.40%	3	33.30%
Niue	Lakepa	22	68	3.1	15	68.20%	3	3	2	13.30%	2	13.30%
Niue	Makefu	21	56	2.7	13	61.90%	6	1	5	38.50%	5	38.50%
Niue	Namakulu	8	8	1	3	37.50%	1	0	1	33.30%	1	33.30%
Niue	Selected fishermen	4	16	4	3	75.00%	3	5	3	100.00%	3	100.00%
Niue	Tuapa	28	49	1.8	12	42.90%	3	1	2	16.70%	2	16.70%
Niue	Vaiea	11	54	4.9	5	45.50%	4	3	3	60.00%	3	60.00%
	Sub-total	**163**	**468**	**2.9**	**98**	**60.10%**	**56**	**29**	**40**	**40.80%**	**36**	**36.70%**
Aitutaki	Amuri	54	167	3.1	33	61.10%	17	11	12	36.40%	6	18.20%
Aitutaki	Arutanga and Araura	27	89	3.3	13	48.10%	4	9	4	30.80%	3	23.10%
Aitutaki	Nikaupara	35	140	4	22	62.90%	10	13	7	31.80%	5	22.70%
Aitutaki	Reureu	27	107	4	16	59.30%	3	7	4	25.00%	3	18.80%
Aitutaki	Ureia	24	95	4	17	70.80%	6	5	7	41.20%	4	23.50%
Aitutaki	Vaipae and Vaipeka	80	342	4.3	46	57.50%	16	21	8	17.40%	5	10.90%
	Sub-total	**247**	**940**	**3.8**	**147**	**59.50%**	**56**	**66**	**42**	**28.60%**	**26**	**17.70%**
Rarotonga	Aroko and Avana	24	72	3	10	41.70%	2	0	0	0.00%	0	0.00%
Rarotonga	Matavera	25	86	3.4	11	44.00%	1	2	2	18.20%	1	9.10%
Rarotonga	Pokoinu to Nikao	77	288	3.7	36	46.80%	1	4	3	8.30%	3	8.30%
Rarotonga	Rutaki and Aroa	43	163	3.8	25	58.10%	1	4	0	0.00%	0	0.00%
Rarotonga	Selected fishermen	19	87	4.6	18	94.70%	4	21	17	94.40%	15	83.30%
Rarotonga	Titikaveka	35	122	3.5	13	37.10%	1	3	1	7.70%	1	7.70%
	Sub-total	**221**	**818**	**3.7**	**113**	**50.70%**	**10**	**34**	**23**	**20.40%**	**20**	**17.70%**
	Total	**633**	**2226**	**3.5**	**358**	**56.60%**	**122**	**129**	**105**	**29.30%**	**82**	**22.90%**

The same survey form was used for all three surveys and, when possible, the same person interviewed from each household. This made the survey process lengthy, as the same households needed to be found. In places such as Rarotonga, both parents were often working, which necessitated that surveys be conducted in the evening or on weekends.

Care is needed when examining the data in Tables 2 and 3, as the number of households covered is different, which alters other figures in the table such as boat and canoe numbers. Table 4 breaks down this figure into the number of households that were interviewed in each survey, and those that were surveyed once, twice or three times.

Table 4: Summary of the households surveyed to identify the number of households that were interviewed once, twice and three times in each location

Island	Village	Number of h/holds covered (first survey)	Number of h/holds covered (second	Number of h/holds covered (third	Number of new h/holds surveyed three times	Number of new h/holds surveyed twice	Number of h/holds surveyed once
Niue	Alofi North	27	26	27	19	5	3
Niue	Avatele	27	28	28	24	1	3
Niue	Hikutavake	12	14	14	9	3	2
Niue	Lakepa	22	22	22	19	2	1
Niue	Makefu	20	21	21	15	2	4
Niue	Namakulu	7	8	8	3	3	2
Niue	Selected fishermen	4	4	4	3	1	0
Niue	Tuapa	24	28	28	12	5	11
Niue	Vaiea	11	11	11	7	4	0
	Sub-total	**154**	**162**	**163**	**111**	**26**	**26**
Aitutaki	Amuri	54	54	54	39	7	8
Aitutaki	Arutanga and Araura	27	27	27	20	3	4
Aitutaki	Nikaupara	34	35	35	29	1	5
Aitutaki	Reureu	27	27	27	25	0	2
Aitutaki	Ureia	24	24	24	22	2	0
Aitutaki	Vaipae and Vaipeka	80	80	80	65	6	9
	Sub-total	**246**	**247**	**247**	**200**	**19**	**28**
Rarotonga	Aroko and Avana	23	24	24	15	2	7
Rarotonga	Matavera	25	25	25	18	5	2
Rarotonga	Pokoinu to Nikao	77	77	77	56	13	8
Rarotonga	Rutaki and Aroa	43	43	43	36	4	3
Rarotonga	Selected fishermen	19	19	19	19	0	0
Rarotonga	Titikaveka	34	33	33	24	5	4
	Sub-total	**221**	**221**	**221**	**168**	**29**	**24**
	Total	**621**	**630**	**631**	**479**	**74**	**78**

Table 5: Comparison of community survey data for households that were surveyed three times on Niue

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue-1	Alofi North	19	71	3.7	16	84.20%	12	9	9	56.30%	9	56.30%
Niue-1	Avatele	24	99	4.1	19	79.20%	25	12	17	89.50%	7	36.80%
Niue-1	Hikutavake	9	30	3.3	6	66.70%	5	0	2	33.30%	1	16.70%
Niue-1	Lakepa	19	77	4.1	13	68.40%	7	2	6	46.20%	3	23.10%
Niue-1	Makefu	15	64	4.3	13	86.70%	10	2	7	53.80%	2	15.40%
Niue-1	Namakulu	3	4	1.3	2	66.70%	1	0	1	50.00%	1	50.00%
Niue-1	Selected fishermen	3	18	6	3	100.00%	4	5	3	100.00%	3	100.00%
Niue-1	Tuapa	12	43	3.6	12	100.00%	10	1	6	50.00%	6	50.00%
Niue-1	Vaiea	7	37	5.3	6	85.70%	4	0	4	66.70%	3	50.00%
		111	**443**	**4**	**90**	**81.10%**	**78**	**31**	**55**	**61.10%**	**35**	**38.90%**
Niue-2	Alofi North	19	74	3.9	15	78.90%	10	7	7	46.70%	7	46.70%
Niue-2	Avatele	24	86	3.6	20	83.30%	23	11	14	70.00%	10	50.00%
Niue-2	Hikutavake	9	28	3.1	6	66.70%	4	0	2	33.30%	1	16.70%
Niue-2	Lakepa	19	71	3.7	16	84.20%	7	3	4	25.00%	2	12.50%
Niue-2	Makefu	15	58	3.9	14	93.30%	9	2	5	35.70%	2	14.30%
Niue-2	Namakulu	3	2	0.7	1	33.30%	2	0	1	100.00%	1	100.00%
Niue-2	Selected fishermen	3	18	6	3	100.00%	9	6	3	100.00%	3	100.00%
Niue-2	Tuapa	12	43	3.6	9	75.00%	7	0	6	66.70%	5	55.60%
Niue-2	Vaiea	7	40	5.7	7	100.00%	4	3	4	57.10%	4	57.10%
		111	**420**	**3.8**	**91**	**82.00%**	**75**	**32**	**46**	**50.50%**	**35**	**38.50%**
Niue-3	Alofi North	19	72	3.8	13	68.40%	7	6	5	38.50%	5	38.50%
Niue-3	Avatele	24	95	4	21	87.50%	24	9	14	66.70%	11	52.40%
Niue-3	Hikutavake	9	28	3.1	7	77.80%	3	0	3	42.90%	3	42.90%
Niue-3	Lakepa	19	68	3.6	15	78.90%	3	3	2	13.30%	2	13.30%
Niue-3	Makefu	15	53	3.5	12	80.00%	6	1	5	41.70%	5	41.70%
Niue-3	Namakulu	3	5	1.7	2	66.70%	1	0	1	50.00%	1	50.00%
Niue-3	Selected fishermen	3	16	5.3	3	100.00%	3	5	3	100.00%	3	100.00%
Niue-3	Tuapa	12	45	3.8	10	83.30%	3	1	2	20.00%	2	20.00%
Niue-3	Vaiea	7	46	6.6	4	57.10%	3	3	2	50.00%	2	50.00%
		111	**428**	**3.9**	**87**	**78.40%**	**53**	**28**	**37**	**42.50%**	**34**	**39.10%**

As can be seen from Table 4, 631 households were covered during the third surveys, (163 on Niue, 247 on Aitutaki and 221 on Rarotonga). As with the second survey, however, many households were not located for the interview. In those cases in which households had simply moved to another area, the households were located and interviewed. It should be noted that during the second survey, additional households were surveyed to increase the number for future surveys.

Tables 5, 6 and 7 compare the data collected by area for the households that were surveyed on all three occasions (111 on Niue, 200 on Aitutaki and 168 on Rarotonga). Tables 8, 9 and 10 compare the data collected by area for households that were surveyed on two occasions (surveys 1 and 2, or 1 and 3, or 2 and 3); this includes 26 on Niue, 19 on Aitutaki and 29 on Rarotonga. This left 78 households that were only surveyed once (26 on Niue, 28 on Aitutaki and 24 on Rarotonga); these data are not used in any of the comparative assessments below.

On Niue (Table 5) the number of households fishing has stayed roughly constant (survey 1: 90, survey 2: 91 and survey 3: 87) for the 111 households that were surveyed three times. However, there was a change in fishing activities by village, as Cyclone Heta caused extensive damage to some reef areas, and people did not want to fish in these

Table 6: Comparison of community survey data for households that were surveyed three times on Aitutaki

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Aitutaki-1	Amuri	39	169	4.3	25	64.10%	20	10	8	32.00%	5	20.00%
Aitutaki-1	Arutanga	20	97	4.9	11	55.00%	4	9	3	27.30%	3	27.30%
Aitutaki-1	Nikaupara	29	129	4.4	22	75.90%	5	20	9	40.90%	8	36.40%
Aitutaki-1	Reureu	25	117	4.7	14	56.00%	7	6	2	14.30%	1	7.10%
Aitutaki-1	Ureia	22	92	4.2	16	72.70%	9	10	8	50.00%	6	37.50%
Aitutaki-1	Vaipae and Vaipeka	65	310	4.8	44	67.70%	19	21	10	22.70%	9	20.50%
		200	**914**	**4.6**	**132**	**66.00%**	**64**	**76**	**40**	**30.30%**	**32**	**24.20%**
Aitutaki-2	Amuri	39	163	4.2	34	87.20%	21	17	14	41.20%	9	26.50%
Aitutaki-2	Arutanga and Araura	20	85	4.3	17	85.00%	8	9	4	23.50%	3	17.60%
Aitutaki-2	Nikaupura	29	136	4.7	26	89.70%	8	19	9	34.60%	7	26.90%
Aitutaki-2	Reureu	25	107	4.3	19	76.00%	2	8	5	26.30%	2	10.50%
Aitutaki-2	Ureia	22	93	4.2	20	90.90%	6	12	11	55.00%	7	35.00%
Aitutaki-2	Vaipae and Vaipeka	65	300	4.6	49	75.40%	15	19	11	22.40%	6	12.20%
		200	**884**	**4.4**	**165**	**82.50%**	**60**	**84**	**54**	**32.70%**	**34**	**20.60%**
Aitutaki-3	Amuri	39	158	4.1	31	79.50%	15	11	11	35.50%	6	19.40%
Aitutaki-3	Arutanga and Araura	20	84	4.2	12	60.00%	3	9	4	33.30%	3	25.00%
Aitutaki-3	Nikaupura	29	136	4.7	21	72.40%	10	12	6	28.60%	5	23.80%
Aitutaki-3	Reureu	25	107	4.3	16	64.00%	3	7	4	25.00%	3	18.80%
Aitutaki-3	Ureia	22	95	4.3	17	77.30%	6	5	7	41.20%	4	23.50%
Aitutaki-3	Vaipae and Vaipeka	65	328	5	45	69.20%	16	21	8	17.80%	5	11.10%
		200	**908**	**4.5**	**142**	**71.00%**	**53**	**65**	**40**	**28.20%**	**26**	**18.30%**

Table 7: Comparison of community survey data for households that were surveyed three times on Rarotonga

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Rarotonga-1	Aroko and Avana	15	57	3.8	11	73.30%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Matavera	18	62	3.4	10	55.60%	0	4	2	20.00%	2	20.00%
Rarotonga-1	Pokoinu to Nikao	56	250	4.5	30	53.60%	2	9	6	20.00%	4	13.30%
Rarotonga-1	Rutaki and Aroa	36	161	4.5	23	63.90%	2	2	1	4.30%	1	4.30%
Rarotonga-1	Selected fishermen	19	85	4.5	19	100.00%	5	21	19	100.00%	19	100.00%
Rarotonga-1	Titikaveka	24	104	4.3	12	50.00%	8	4	3	25.00%	3	25.00%
		168	**719**	**4.3**	**105**	**62.50%**	**17**	**41**	**31**	**29.50%**	**29**	**27.60%**
Rarotonga-2	Aroko and Avana	15	60	4	8	53.30%	0	0	0	0.00%	0	0.00%
Rarotonga-2	Matavera	18	66	3.7	10	55.60%	0	3	1	10.00%	0	0.00%
Rarotonga-2	Pokoinu to Nikao	56	303	5.4	28	50.00%	0	4	3	10.70%	2	7.10%
Rarotonga-2	Rutaki and Aroa	36	152	4.2	24	66.70%	2	2	1	4.20%	1	4.20%
Rarotonga-2	Selected fishermen	19	96	5.1	19	100.00%	1	22	19	100.00%	18	94.70%
Rarotonga-2	Titikaveka	24	88	3.7	7	29.20%	1	6	1	14.30%	1	14.30%
		168	**765**	**4.6**	**96**	**57.10%**	**4**	**37**	**25**	**26.00%**	**22**	**22.90%**
Rarotonga-3	Aroko and Avana	15	68	4.5	9	60.00%	2	0	0	0.00%	0	0.00%
Rarotonga-3	Matavera	18	78	4.3	11	61.10%	1	2	2	18.20%	1	9.10%
Rarotonga-3	Pokoinu to Nikao	56	250	4.5	32	57.10%	0	4	3	9.40%	3	9.40%
Rarotonga-3	Rutaki and Aroa	36	159	4.4	24	66.70%	1	4	0	0.00%	0	0.00%
Rarotonga-3	Selected fishermen	19	87	4.6	18	94.70%	4	21	17	94.40%	15	83.30%
Rarotonga-3	Titikaveka	24	100	4.2	9	37.50%	0	3	1	11.10%	1	11.10%
		168	**742**	**4.4**	**103**	**61.30%**	**8**	**34**	**23**	**22.30%**	**20**	**19.40%**

locations. Overall the high percentage of households fishing (roughly 80%) is attributed to the subsistence needs of the community (few job opportunities are available, and cash incomes are limited). In contrast, the number of households fishing outside the reef dropped significantly — 55 (61.1%) in the first survey, 46 (50.5%) in the second survey, and 37 (42.5%) in the third survey. This may be because of the limited market on Niue for fishermen to sell their catch. Additionally, the problems caused by Cyclone Heta and the loss of the crane on the wharf greatly restricted the ability of fishermen to launch and retrieve their vessels; as a result, fishing from boats was restricted, especially during the first four months of 2004.

The number of canoes also decreased significantly in the last survey (78 to 75 to 53), mainly as a result of Cyclone Heta, which washed some away while damaging others. The number of boats also dropped slightly (31 to 32 to 28) over the survey period. The use of FADs has remained fairly constant over the survey period (34 households or around 39%), even though most offshore FADs were lost during the cyclone. Fishermen concentrated on using the inshore FADs, fishing from both canoes and boats.

On Aitutaki (Table 6), the number of households involved in fishing increased from 132 (66%) in the first survey, to 165 (82.5%) in the second survey, and dropped to 142 (71%) in the third survey. This increase from the first to second survey was mainly in subsistence fishing, with collecting on the reef and gillnetting activities increasing. The decline in fishing activities from the second to third survey was more general and included collecting on the reef, gillnetting and fishing outside the reef. Limited markets for selling fish on Aitutaki and a small increase in the incidence of ciguatera, including some parrotfish species, may also have attributed to the decline in fishing activities.

The number of canoes has continued to drop over the survey period (64 to 60 to 53) as people move more towards boats, especially in the lagoon. Overall, boat numbers also dropped (76 to 84 to 65), which can be partly attributed to an overestimate during the first two surveys, in which several people or households were recorded as having a boat, when in fact they used the same boat (either together or at different times). However, there was still a drop in overall boat numbers, as some older boats were in use anymore.

The number of households fishing outside the reef was the same in the first and third surveys (40), while the figure increased in the second survey (to 54 households); this can be partly attributed to the same over estimate of boat numbers, where several households were recorded as separately fishing outside the reef, when in fact they were fishing together. Fishing activities around FADs dropped a little overall (32 to 34 to 26), as either the number of fishermen dropped slightly, or they changed to fishing in the lagoon or close to the reef. Limited markets for fish locally at times, especially tunas, also contributed to the small drop in FAD fishing activities.

On Rarotonga (Table 7), the number of households involved in fishing has fluctuated over the three surveys from 105 (62.5%) in the first survey, dropping to 96 (57.1%) in the second survey, and increasing again to 103 (61.3%) in the third survey. This partially reflects the ability of people to find work; in many cases, households have both parents working. As several households mentioned, they now "fish at the market with 20 dollar bills", rather than with hooks and lines or nets. The increase in the number of households fishing in the third survey is somewhat misleading, and can be attributed to the opening of several *raui* (local marine protected areas), which allowed households that normally don't fish to fish or collect once or twice in an area that has been closed for several years.

Looking more closely at the Rarotonga data, the number of canoes and boats has dropped (17 and 41 in the first survey, 4 and 37 in the second survey, and 8 and 34 in the third survey, respectively). In line with this trend, the number of households fishing outside the reef has dropped from 31 (29.5%) to 25 (26%) to 23 (22.3%), and the number of fishermen going to the FADs has also dropped from 29 (27.6%) to 22 (22.9%) to 20 (19.4%). The main reason for these decreases is the shrinking market for fishermen to sell their fish, and the competition between fishermen for existing markets.

Rarotonga has a developing tuna longline fishery that has only really developed in the last three years. As this fishery developed, a considerable amount of byproduct and non-export quality target species have been marketed locally, with around 100 t sold on the domestic market in 2002 and 200 t in 2003. This has greatly affected small-scale fishermen, who are finding it difficult to compete with longline fishermen. The marketing problem has meant that several fishermen have stopped fishing altogether, and taken employment on shore.

The comparative data presented in tables 8, 9 and 10 are more difficult to interpret, as there is a mix of pairing between surveys one and two, one and three, and surveys two and three. The numbers are also low, so it is dif-

Table 8: Comparison of community survey data for households that were surveyed twice on Niue

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Niue-1	Alofi North	5	16	3.2	5	100.00%	4	3	4	80.00%	4	80.00%
Niue-1	Hikutavake	1	4	4	1	100.00%	1	0	1	100.00%	1	100.00%
Niue-1	Lakepa	2	6	3	1	50.00%	0	0	0	0.00%	0	0.00%
Niue-1	Makefu	2	5	2.5	2	100.00%	2	0	1	50.00%	0	0.00%
Niue-1	Namakulu	2	2	1	0	0.00%	0	0	0		0	
Niue-1	Selected fishermen	1	3	3	1	100.00%	0	2	1	100.00%	1	100.00%
Niue-1	Tuapa	4	10	2.5	4	100.00%	2	3	1	25.00%	1	25.00%
Niue-1	Vaiea	4	23	5.8	4	100.00%	2	3	3	75.00%	3	75.00%
		21	**69**	**3.3**	**18**	**85.70%**	**11**	**11**	**11**	**61.10%**	**10**	**55.60%**
Niue-2	Alofi North	1	2	2	0	0.00%	0	0	0		0	
Niue-2	Avatele	1	3	3	1	100.00%	1	1	1	100.00%	1	100.00%
Niue-2	Hikutavake	3	8	2.7	3	100.00%	4	1	2	66.70%	1	33.30%
Niue-2	Lakepa	2	5	2.5	2	100.00%	0	0	0	0.00%	0	0.00%
Niue-2	Makefu	1	1	1	1	100.00%	1	0	1	100.00%	1	100.00%
Niue-2	Namakulu	3	4	1.3	2	66.70%	0	0	0	0.00%	0	0.00%
Niue-2	Selected fishermen	1	5	5	1	100.00%	0	2	1	100.00%	1	100.00%
Niue-2	Tuapa	3	8	2.7	3	100.00%	1	2	2	66.70%	2	66.70%
Niue-2	Vaiea	3	15	5	3	100.00%	1	3	3	100.00%	3	100.00%
		18	**51**	**2.8**	**16**	**88.90%**	**8**	**9**	**10**	**62.50%**	**9**	**56.30%**
Niue-3	Alofi North	4	14	3.5	3	75.00%	1	1	1	33.30%	1	33.30%
Niue-3	Avatele	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Hikutavake	2	5	2.5	2	100.00%	1	0	1	50.00%	0	0.00%
Niue-3	Makefu	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Namakulu	1	3	3	1	100.00%	0	0	0	0.00%	0	0.00%
Niue-3	Tuapa	3	4	1.3	2	66.70%	0	0	0	0.00%	0	0.00%
Niue-3	Vaiea	1	8	8	1	100.00%	1	0	1	100.00%	1	100.00%
		13	**40**	**3.1**	**11**	**84.60%**	**3**	**1**	**3**	**27.30%**	**2**	**18.20%**

Table 9: Comparison of the community survey data for households that were surveyed twice on Aitutaki

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Aitutaki-1	Amuri	7	20	2.9	7	100.00%	7	3	2	28.60%	1	14.30%
Aitutaki-1	Arutanga	3	7	2.3	1	33.30%	0	0	0	0.00%	0	0.00%
Aitutaki-1	Ureia	2	3	1.5	1	50.00%	1	0	0	0.00%	0	0.00%
Aitutaki-1	Vaipeka	6	21	3.5	2	33.30%	0	1	1	50.00%	1	50.00%
		18	**51**	**2.8**	**11**	**61.10%**	**8**	**4**	**3**	**27.30%**	**2**	**18.20%**
Aitutaki-2	Amuri	4	12	3	3	75.00%	1	2	0	0.00%	0	0.00%
Aitutaki-2	Araura	2	4	2	0	0.00%	0	0	0		0	
Aitutaki-2	Nikaupura	1	4	4	1	100.00%	0	1	0	0.00%	0	0.00%
Aitutaki-2	Ureia	2	2	1	1	50.00%	0	0	0	0.00%	0	0.00%
Aitutaki-2	Vaipeka	3	6	2	0	0.00%	0	0	0		0	
		12	**28**	**2.3**	**5**	**41.70%**	**1**	**3**	**0**	**0.00%**	**0**	**0.00%**
Aitutaki-3	Amuri	3	9	3	2	66.70%	2	0	1	50.00%	0	0.00%
Aitutaki-3	Araura	1	5	5	1	100.00%	1	0	0	0.00%	0	0.00%
Aitutaki-3	Nikaupura	1	4	4	1	100.00%	0	1	1	100.00%	0	0.00%
Aitutaki-3	Vaipeka	3	14	4.7	1	33.30%	0	0	0	0.00%	0	0.00%
		8	**32**	**4**	**5**	**62.50%**	**3**	**1**	**2**	**40.00%**	**0**	**0.00%**

ficult to discern any trends in the data. In looking at the different pairings, it would appear that the same basic trends as reported above for tables 5, 6 and 7 hold true for these tables.

The overall objective of this part of the project was to conduct studies over the three-year life of the project with selected coastal communities, especially in areas where reef and/or lagoon marine protected areas (MPAs) have been declared and FADs deployed, to try to measure any benefits accruing to the communities and the usefulness of FADs as a management tool. As stated above, three community surveys were conducted in selected villages at each project area. In assessing the data, the benefits accruing to the surveyed communities from having FADs adjacent to their villages appear to be in two forms: direct and flow-on. The main beneficiaries are the local fishermen with canoes and boats, who receive a direct benefit. The FADs increased the areal fishing areas open to these fishermen, and increased their catches. Canoe fishermen benefited if the FADs were close enough to shore to access these safely, which was the case in Niue. Because there are very few canoes in the Cook Islands, canoe access was not an issue.

Table 10: Comparison of community survey data for households that were surveyed twice on Rarotonga

Island	Village	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number of h/holds fishing outside reef	Percent of h/holds fishing outside reef	Number of h/holds fishing FADs	Percent of h/holds fishing FADs
Rarotonga-1	Aroko and Avana	2	4	2	1	50.00%	0	0	0	0.00%	0	0.00%
Rarotonga-1	Matavera	5	17	3.4	0	0.00%	0	0	0		0	
Rarotonga-1	Pokoinu to Nikao	13	56	4.3	2	15.40%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Rutaki and Aroa	4	7	1.8	1	25.00%	0	1	0	0.00%	0	0.00%
Rarotonga-1	Titikaveka	5	17	3.4	2	40.00%	0	0	0	0.00%	0	0.00%
		29	**101**	**3.5**	**6**	**20.70%**	**0**	**2**	**0**	**0.00%**	**0**	**0.00%**
Rarotonga-2	Aroko and Avana	1	1	1	0	0.00%	0	0	0		0	
Rarotonga-2	Matavera	3	7	2.3	0	0.00%	0	0	0		0	
Rarotonga-2	Pokoinu to Nikao	5	14	2.8	3	60.00%	0	0	0	0.00%	0	0.00%
Rarotonga-2	Rutaki and Aroa	3	4	1.3	0	0.00%	0	0	0		0	
		12	**26**	**2.2**	**3**	**25.00%**	**0**	**0**	**0**	**0.00%**	**0**	**0.00%**
Rarotonga-3	Aroko and Avana	1	4	4	1	100.00%	0	0	0	0.00%	0	0.00%
Rarotonga-3	Matavera	2	8	4	0	0.00%	0	0	0		0	
Rarotonga-3	Pokoinu to Nikao	8	38	4.8	4	50.00%	1	0	0	0.00%	0	0.00%
Rarotonga-3	Rutaki and Aroa	1	4	4	1	100.00%	0	0	0	0.00%	0	0.00%
Rarotonga-3	Titikaveka	5	19	3.8	4	80.00%	1	0	0	0.00%	0	0.00%
		17	**73**	**4.3**	**10**	**58.80%**	**2**	**0**	**0**	**0.00%**	**0**	**0.00%**

Boat fishermen were able to fish both offshore and inshore FADs and increase their catches, while reducing their operating costs (as they used less fuel). They were also able to travel along the coast to target FADs off different villages, whereas canoe fishermen were restricted to the FAD adjacent to their village. In most cases, fishermen kept what they needed from the catch, and sold the surplus. The flow-on benefits were in the form of fish being distributed by the fishermen to family, relatives and friends, especially when good catches were taken.

The success of FADs as a management tool was harder to determine. This was mainly due to the fact that in all locations, marine protected areas (MPAs) were already in place and local communities and fishermen had already changed their activities to account for this. It was expected that new MPAs would be implemented during the course of the project, but this did not occur. In fact, in Rarotonga, several MPAs (*raui*) were opened in the final year of the project, which increased the number of households involved in fishing, although this was limited and only for a short time.

Summary of the gender analysis of fishing activities

The following gender analysis is provided based on the sex disaggregated data collected during the community surveys.

Niue

Figure 1 depicts the proportion of fishing effort attributed to each fishing method in Niue, by survey village, based on the results of the community surveys. Reef fishing and reef gleaning each accounted for over 20% of the fishing effort in each of the three surveys. On average, trolling, baitfishing (mainly fishing for bait species, such as *ulihega* – *Decapterus* spp. outside the reef) and bottomfishing each accounted for around 10% of the fishing effort in each survey. The gender split by fishing activity for Niue is presented in Figures 2 (a) and (b).

Reef fishing was a family activity, with most family members involved. The split between male and female participation varied by village in Niue, but on average more males participated (roughly 60% males and 40% females). Reef gleaning, which is

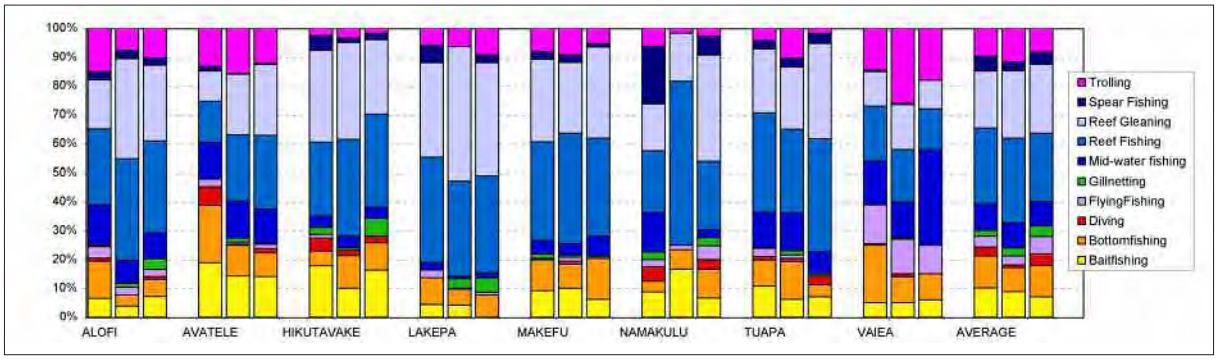

Figure 1: Percentage of fishing effort by method, survey and survey village for Niue

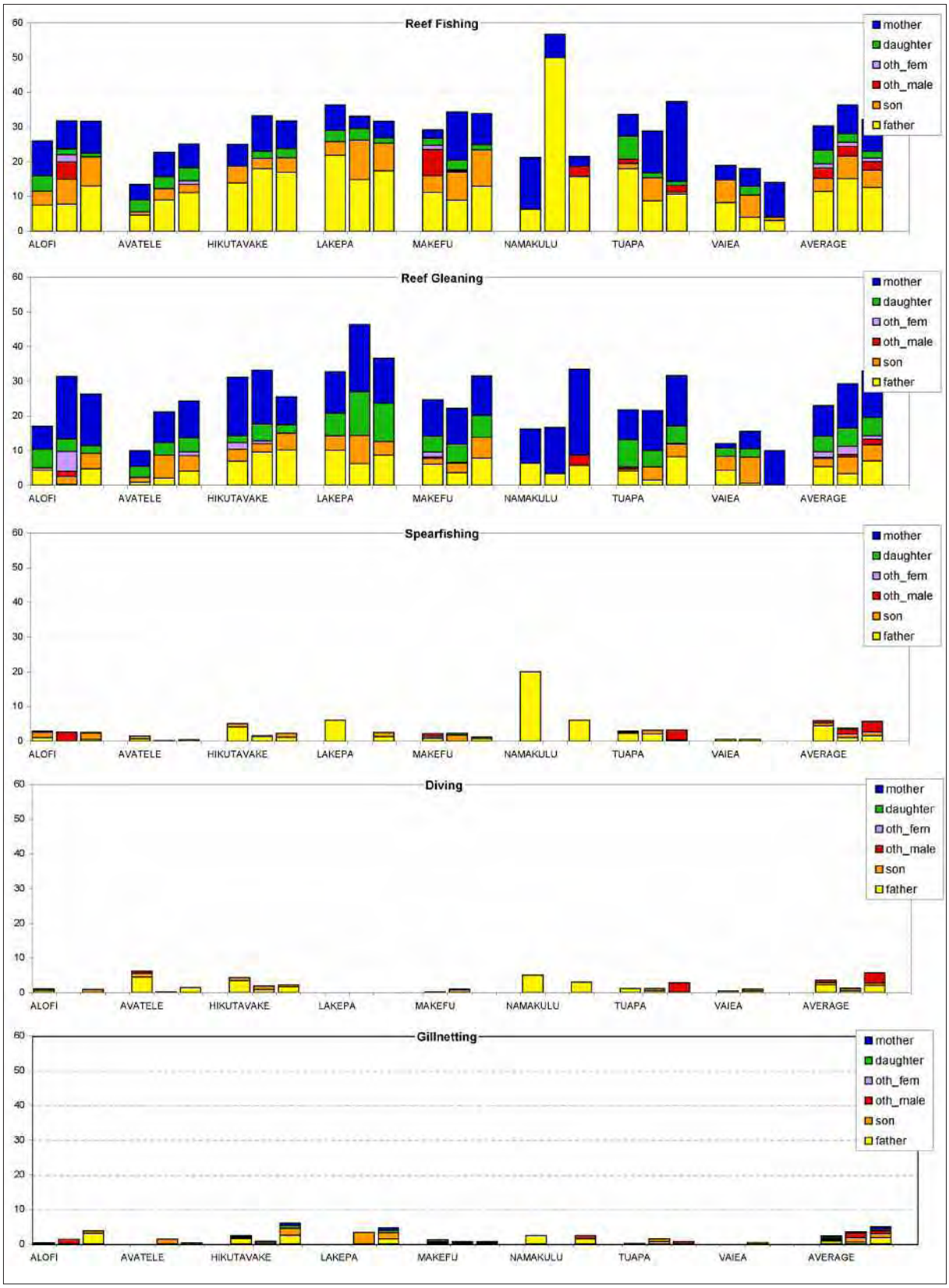

Figure 2 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Niue

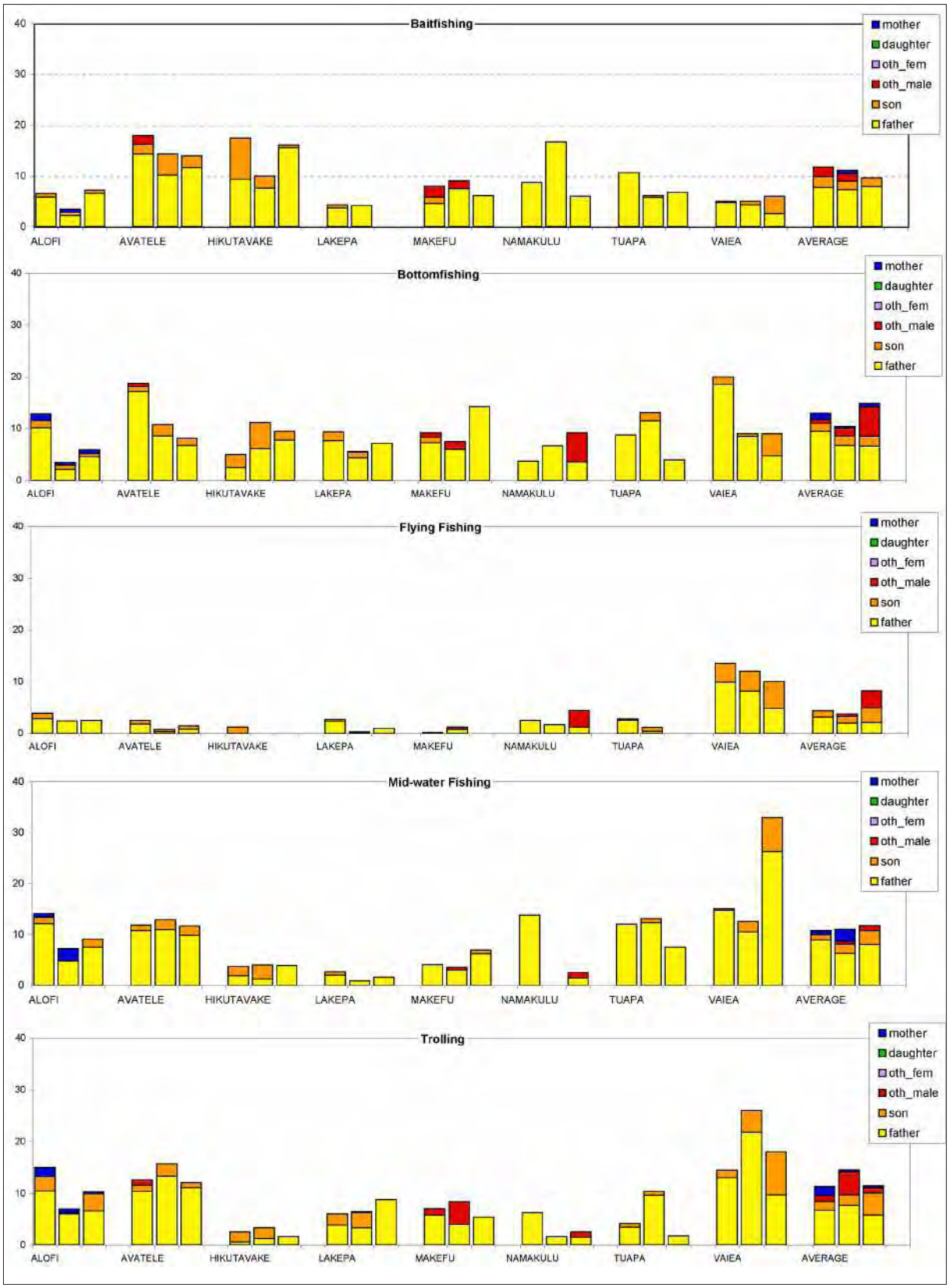

Figure 2 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Niue

also a family fishing method, showed the reverse ratio (about 40% males and 60% females). These two fishing methods accounted for around 90% of the total female fishing effort on Niue.

Spearfishing and diving for clams and crayfish were rarely practiced on Niue, and each accounted for less that 5% of fishing effort. These activities were male dominated, with fathers and sons working together. Gillnetting was not frequently practiced on Niue, mainly because there is limited reef area and the windward side of the island can not be fished very often. When gillnetting activities were undertaken, there was more male effort than female, with the total effort was less than 5% of total fishing effort on Niue.

The fishing methods used outside the reef were male dominated, with some fathers taking their sons out to train them in different fishing methods. Baitfishing is a traditional method practiced from canoes to catch *ulihega*; fishermen use traditional gear and green coconut flesh for bait. This method accounted for around 10% of the total fishing effort, with males accounting for 95% of activity. Bottomfishing and flyingfish fishing were fishing methods undertaken by adult males, sometimes with their sons; very few women were involved in these fisheries.

Trolling and mid-water fishing for tunas were also male-dominated fishing methods, although several fishermen were accompanied by their wives on some trips. Each of these methods accounted for 9–19% of the total fishing effort, with 90% of this being undertaken by fathers and sons. In Vaiea village, which is mainly populated by Tuvaluans who do a lot of fishing, trolling and mid-water tuna fishing make up around 30–40% of the total fishing effort from the village; women do very little fishing of any sort.

Overall, fishing activities around Niue are predominantly undertaken by men, especially those activities that require a canoe or boat, and are undertaken outside the reef. Adult males are the main fishermen, followed by male children. Female fishing activity, especially by adult females, was mainly focused on reef gleaning and reef fishing; women's involvement in gillnetting and trolling was minor.

Aitutaki

The percentage of fishing effort attributed to each fishing method, by survey village and based on the results of the community surveys, is presented in Figure 3. In Aitutaki, gillnetting and reef fishing each accounted for around 25% of the fishing effort in each of the three surveys. On average, spearfishing accounted for around 15% of fishing effort, while trolling and reef gleaning each accounted for around 9–10%. The gender split by fishing activity for Aitutaki is presented in Figures 4 (a) and (b).

Gillnetting in Aitutaki lagoon was the most common fishing method recorded during the community surveys. This activity was mainly undertaken from boats in the lagoon and on the reef flats and passages, and primarily involved adult males, followed by male children. Some women participated in the use of gillnets along the coast or reef flats, which was more of a family activity. Overall, the gender split was roughly 80% males and 20% females, in terms of activity or effort. Spearfishing was also a male dominated fishing activity, with many adult males and male children involved. Spearfishing was undertaken both in the lagoon and along the outer edge of the reef. Female participation in this activity was less than 5% of the total effort for this method.

Reef fishing and reef gleaning are both family fishing activities, with many families practicing these methods when they visit lagoon islets by boat on weekend picnics. Of the two, reef fishing is the main method used, with a 65:35 per cent split between males and females. In contrast, reef gleaning activities were dominated by women

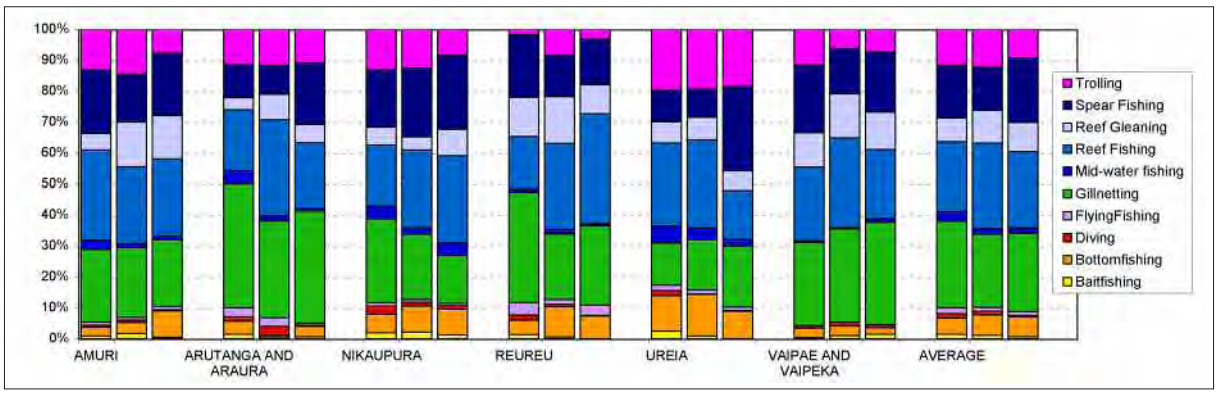

Figure 3: Percentage of fishing effort by method, survey and survey village for Aitutaki

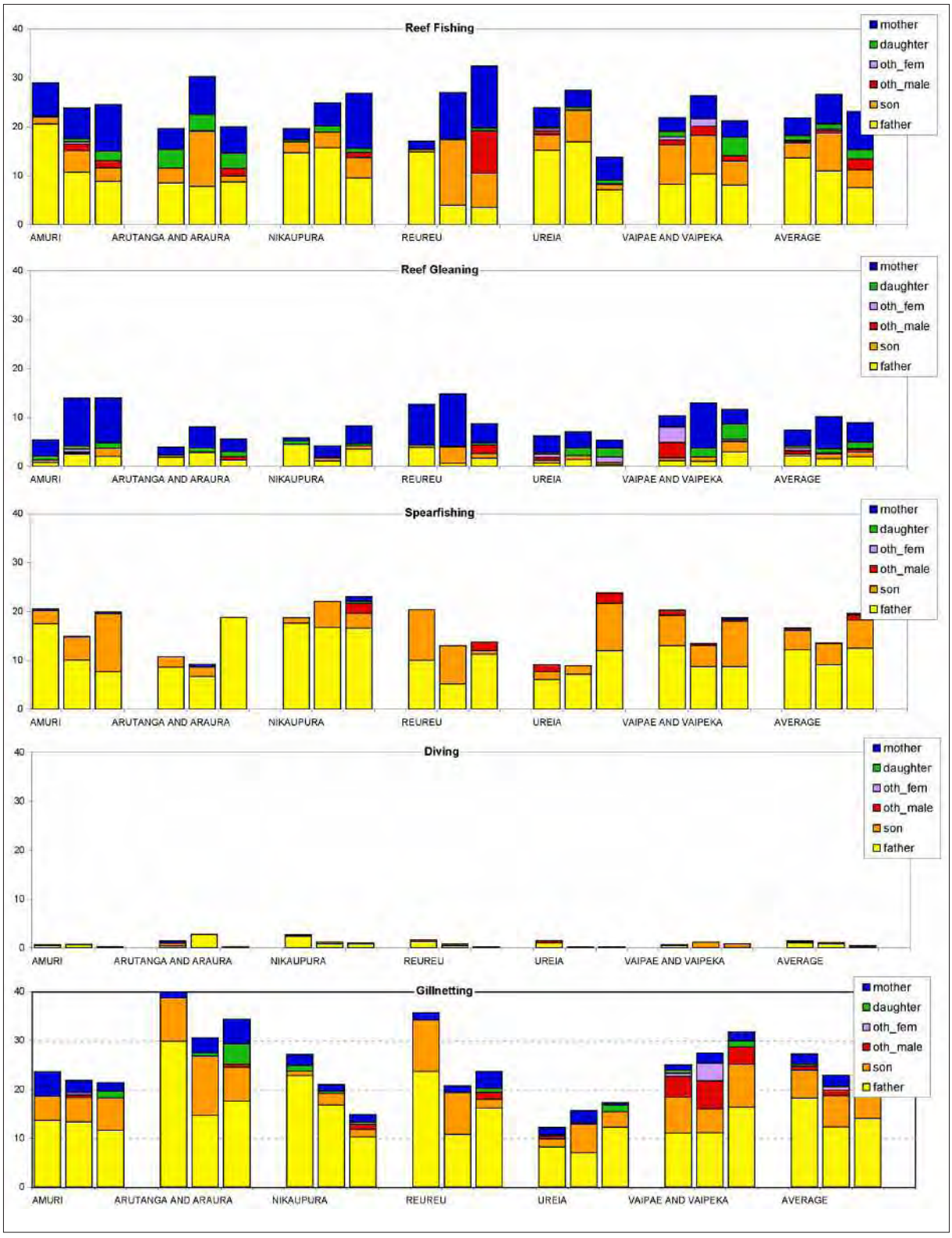

Figure 4 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Aitutaki

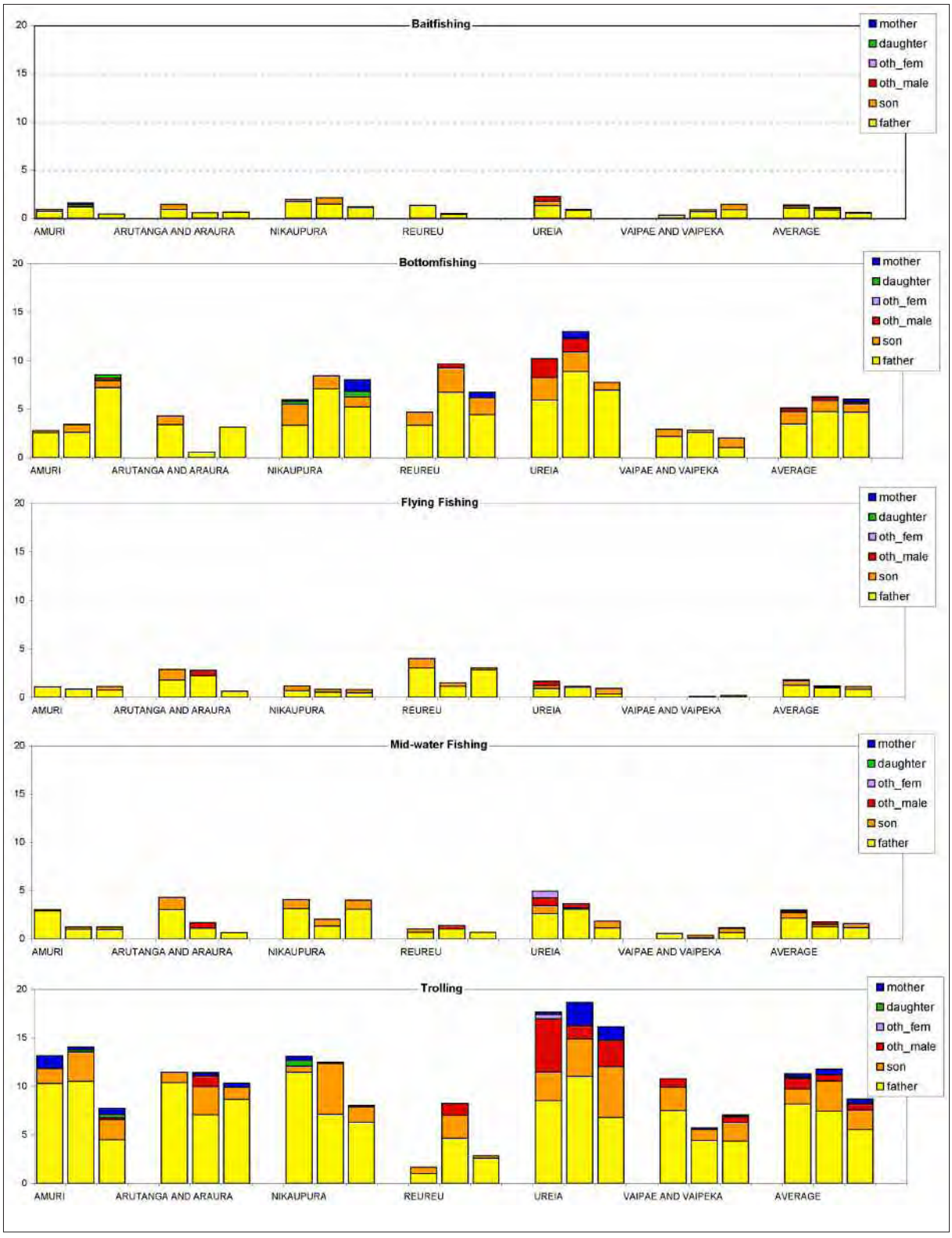

Figure 4 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Aitutaki

(35% males and 65% females), but accounted for only ~10% of total fishing effort recorded.

Trolling and bottomfishing are the next two most important methods, accounting for ~ 10% and 6% of the total effort, respectively. Both methods are male dominated, as they are mainly done from boats outside the reef. Female participation in these two methods accounted for about 10% of total activity in each case.

The remaining fishing methods (diving for clams and crayfish, baitfishing, mid-water fishing and flyingfish fishing) are all done infrequently, making up between 1% and 3% of total fishing effort. These methods are male dominated, with fathers and sons working together in many instances.

Overall, the large lagoon and many boats owned by people on Aitutaki (or available to family members) influenced the fishing activities undertaken. Many fishermen with boats concentrated their fishing effort in the lagoon, and only ventured outside the reef when the weather was calm. Gillnetting was the preferred fishing method as the nets can be set while people do other activities, including both fishing (reef fishing and gleaning), swimming and other recreational activities. Aitutaki's lagoon is fairly rich in fish stocks, although the amount of gillnetting is raising concerns, as parrotfish and mullet catches are declining.

Rarotonga

The percentage of fishing effort attributed to each fishing method (by survey village, based on the results of the community surveys), is presented in Figure 5. Reef gleaning accounted for around 25% of the fishing effort recorded in Rarotonga in each of the three surveys. On average, reef fishing and gillnetting each accounted for around 18% of the fishing effort in each survey. The gender split by fishing activity for Rarotonga is presented in Figures 6 (a) and (b).

Reef gleaning was the main fishing method practised by surveyed households. This was in many cases a family activity, with mothers and daughters the main people involved. Some women went to the lagoon when they wanted to eat seafood, eating what they collected and taking nothing home, as the amount of shellfish available on the reefs around Rarotonga was limited. Around 30% of the reef area was closed to fishing under the local raui system, thus restricting the already limited area available for this activity. It should be noted that several *raui* were opened to fishing prior to the third survey being undertaken, increasing the fishing effort to over 50% of the total effort in the Rutaki area (up from the 40% recorded in the previous surveys).

Reef fishing and gillnetting were the next most popular fishing methods practiced. On average these methods each accounted for about 15–18% of the total fishing effort recorded. Both methods were male dominated (fathers and sons) with only minor female fishing effort.

Spearfishing accounted for around 15% of the total fishing effort recorded for Rarotonga. This method was again male dominated, although several women spearfished for octopus in the Rutaki area, which they then sold. Spearfishing occurred outside the reef, mainly for parrotfish.

Trolling represented around 10% of the total fishing effort recorded. It should be noted that around one half of this effort was recorded by the 19 selected fishermen (see Table 7). The reason for creating this group was to have a representation of commercial fishing in the survey, as it was noted during the first survey that very few fishermen were in the areas surveyed. This method was male dominated, with fathers being the main group followed by sons and other males. Female participation accounted for less than 2% of the activity recorded for this method.

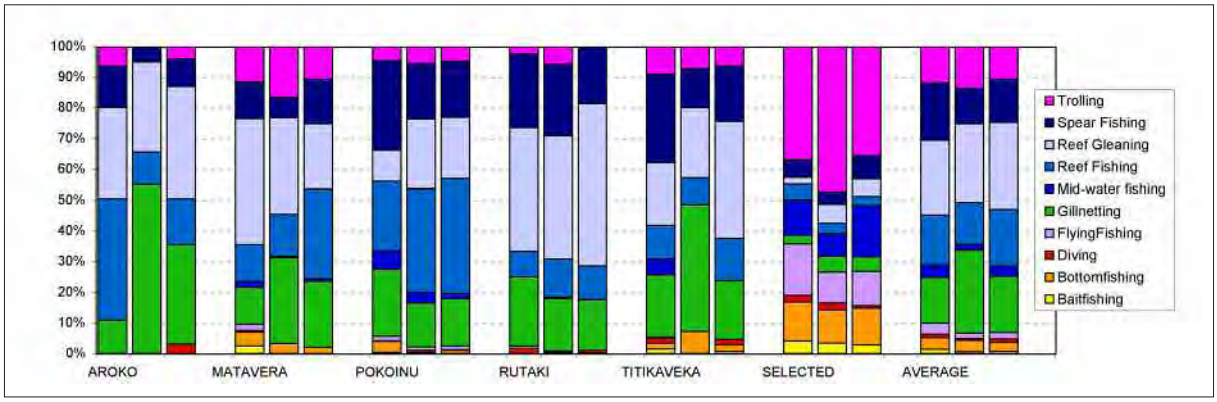

Figure 5: Percentage of fishing effort by method, survey and survey village for Rarotonga

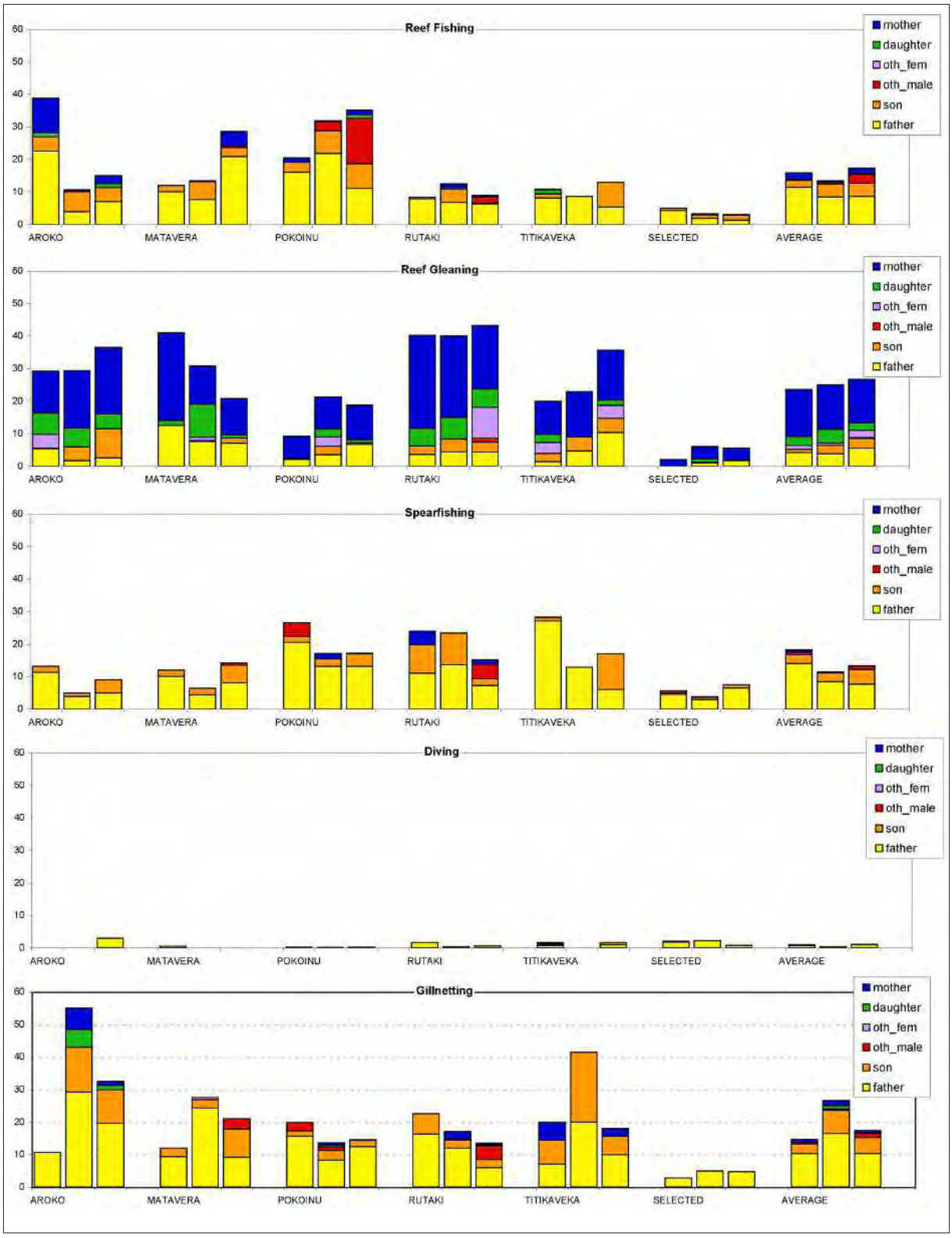

Figure 6 (a): Gender split of fishing effort for reef fishing, reef gleaning, spearfishing, diving and gillnetting by survey and village, with an average per survey for Rarotonga

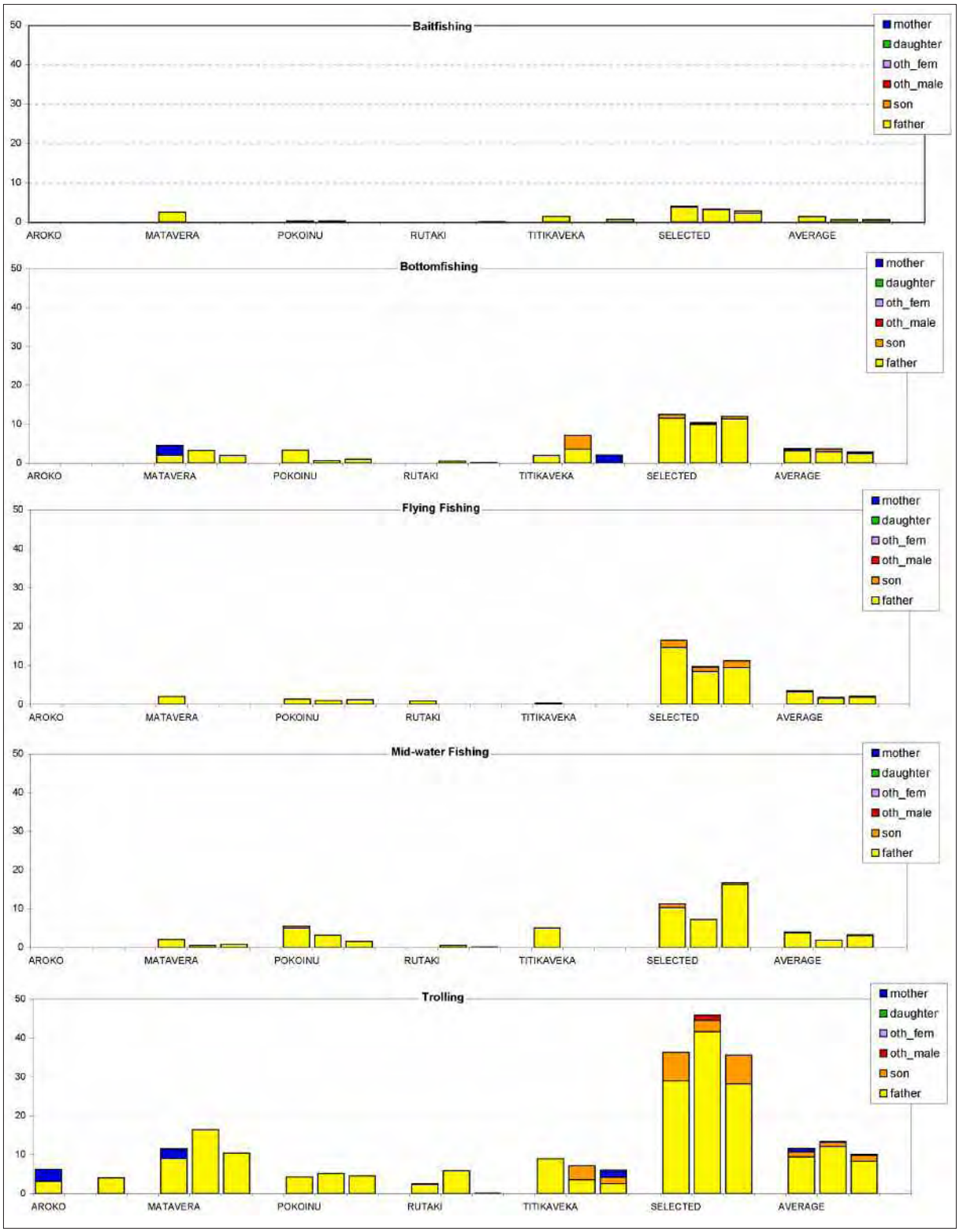

Figure 6 (b): Gender split of fishing effort for baitfishing, bottomfishing, flyingfish fishing, mid-water fishing and trolling by survey and village, with an average per survey for Rarotonga

In looking at the remaining five fishing methods (diving, baitfishing, bottomfishing, flyingfish fishing, and mid-water fishing), each accounted for less than 5% of total participation, and some figures were inflated due to the responses of the selected fishing group (19 selected fisherman group), who focused on bottomfishing, flyingfish fishing and mid-water fishing, as well as trolling. If this group was removed, then the effort recorded for each of these methods would be less than 3%, with several being less than 1%. All of these methods were male dominated, although there was a small amount of female participation (category mothers) in bottomfishing, where wives accompanied their husbands for this activity in times of good weather.

Overall, the fishing around Rarotonga, apart from reef gleaning, is male dominated. This could be partly due to the fact that there is limited reef area open to fishing (in part because of the raui system of marine protected areas), and no real lagoon areas to fish. Rarotonga is the capital, administrative centre and main tourist centre for the Cook Islands, and as such has many employment opportunities; consequently, many people have jobs. The tourist hotels employ many women, who consequently have less time to engage in fishing activities. In addition, ciguatera is a major problem in some areas, and affected the amount of fishing pressure in areas where it is known to occur.

Results of catch and effort data collection and analysis

A major component of the project was the collection of catch and effort data. A catch and effort logsheet was developed in September 2001 in consultation with the Fisheries Departments of both countries. The logsheets were then made into a logbook using carbonised paper, with three copies of each record (one each for SPC, the Fisheries Department and the fisherman), with 30 records per book.

Logbook returns have been slow since the introduction of the system, although this improved over the course of the project, with over 3000 records received by the end of June 2004 (Table 11). Based on the catch and effort data provided, the fishermen from Rarotonga and Niue seem to be the best data providers. Four Rarotongan and five Niuean fishermen in particular have provided excellent data, and they encouraged others to do the same.

In mid-2003, other methods of encouraging fishermen to complete the logbooks were explored. During meetings with fishermen on Rarotonga and Aitutaki, six T-shirts and caps were given as an incentive to the fishermen who were providing the most consistent data (four on Rarotonga and two on Aitutaki). This created some interest, and a local businessman donated a rod and reel to be given to the fisherman on Rarotonga who provided the most consistent data over the next 12 months as an incentive for fishermen to complete their logbooks. The project then expanded on this and sought sponsorship from Gourock in New Zealand to provide some fishing gear as prizes for a fishing competition for data providers in Rarotonga and another in Niue. Gourock provided a selection of fishing gear in late 2004 for the fishing competition in each location. The fishing competitions (Rarotonga and Niue) were held in early 2005.

In looking at the catch and effort data, Table 12 provides a summary of the trolling catch for all locations by year, with Table 13 providing a summary of the catch by other mid-water fishing techniques. A preliminary analysis of the catch and effort data on hand at the end of June 2004 was also conducted and provided to the Fisheries Department in each country to disseminate to local fishermen.

As seen from Table 12, the trolling catch off Niue was split roughly 50/50 between open water trolling and trolling around FADs. However, in 2003, the catch split was 60% from trolling FADs and 40% for open water trolling. In 2004, with the loss of four offshore FADs on 5 January due to Cyclone Heta, fishermen changed their fishing practice, and mainly trolled in open water. It should also be noted that there is a marked season for trolling for wahoo (*Acanthocybium solandri*) along the coast (Fig. 7), and this accounted for the main part of the open water trolling effort and catch.

Little is known about the trolling catch from Aitutaki, due to the lack of data and the lack of cooperation by fishermen. The data from Rarotonga clearly shows the reliance of fishermen on FADs, however, with roughly 66% of the trolling catch taken from FADs. There is also a marked wahoo trolling season off Rarotonga (Fig. 7), and this

Table 11: Summary of logbook returns by location and year to 30 June 2004

Year	Niue	Aitutaki	Rarotonga	Total
2001	8	1		9
2002	425	274	443	1142
2003	693	34	731	1458
2004	267	0	165	432
Total	1393	309	1339	3041

species accounted for most of the open water trolling catch.

In looking at the seasonality of the catch (Fig. 7), the main wahoo catch was taken by open water trolling along the coast off both Niue and Rarotonga from August to October each year. In contrast, the trolling catch around FADs extended throughout the year, although reported catches during the months of August and September were low, possibly as a result of fishermen concentrating on wahoo fishing along the coast.

The main species caught around the FADs off Rarotonga were yellowfin tuna (*Thunnus albacares*) and skipjack tuna (*Katsuwonus pelamis*), which made up around 71% and 17%, respectively. Wahoo and mahi mahi (*Coryphaena hippurus*) were also common in the catch, making up around 5% each of the FAD trolling catch. The catch off the Niue FADs was more evenly

Table 12: Summary of trolling catch by location for the different areas fished

Island/ year	Total effort (h)	Inshore FADs		Offshore FADs		Open water		Total	
		No.	Kg	No.	Kg	No.	Kg	No.	Kg
Niue									
2001	28	3	30	2	14	23	307	28	351
2002	1,749	258	2,181	1,958	6,986	1,042	10,731	3,258	19,898
2003	2,638	184	1,651	3,822	12,365	859	8,196	4,865	22,212
2004	767	61	641	95	644	833	6,480	989	7,765
Sub-total	**5,182**	**506**	**4,503**	**5,877**	**20,009**	**2,757**	**25,714**	**9,140**	**50,226**
Aitutaki									
2002	1,057	222	1,126	876	4,878	404	3,505	1,502	9,509
2003	85	0	0	121	721	54	316	175	1,037
Sub-total	**1,142**	**222**	**1,126**	**997**	**5,599**	**458**	**3,821**	**1,677**	**10,546**
Rarotonga									
2002	2,433	99	433	2,819	10,809	436	4,007	3,354	15,249
2003	4,459	399	1,761	4,526	18,807	1,260	9,916	6,185	30,484
2004	650	7	52	360	2,259	218	1,686	585	3,997
Sub-total	**7,541**	**505**	**2,246**	**7,705**	**31,875**	**1,914**	**15,609**	**10,124**	**49,730**
Total	**13,865**	**1,233**	**7,875**	**14,579**	**57,483**	**5,129**	**45,144**	**20,941**	**110,502**

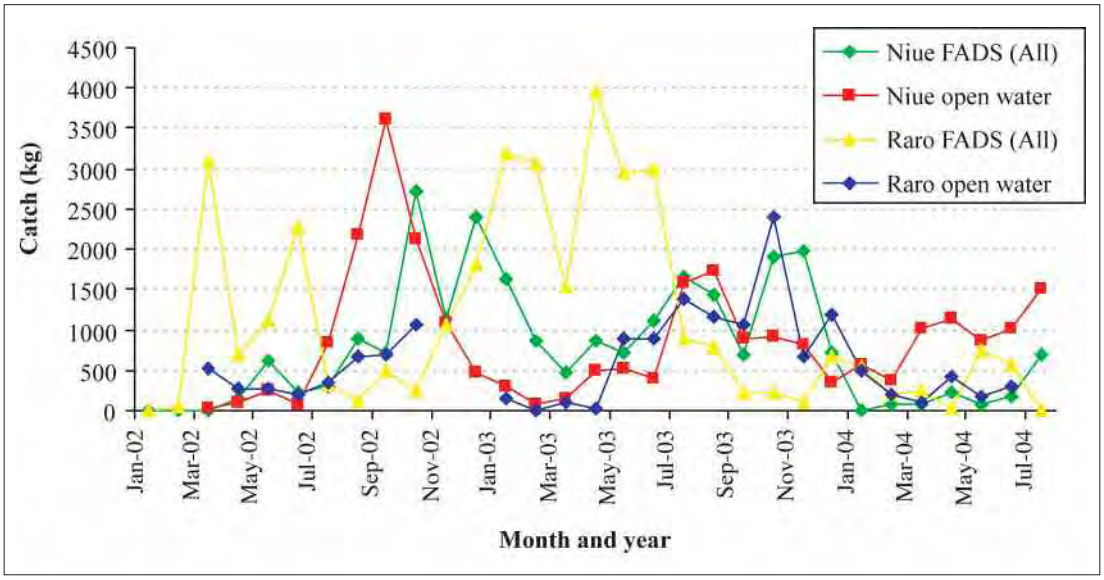

Figure 7: Trolling catch (all species) for Niue and Rarotonga by month

spread amongst the same four species. Most common was yellowfin tuna (31%), followed by skipjack tuna (30%), with wahoo and mahi mahi each making up around 16% of the catch.

Overall, the trolling effort in both locations moved between the FADs (for the four species mentioned above) and open water trolling (primarily for wahoo in season). This indicates that FADs play an important role in the fishing activities that occur in both locations. The FADs provide a known fishing location that can be targeted in the early morning and late afternoon, which are the two main feeding times for tunas, when fish concentrate or aggregate around the FADs. Fishermen cut their running costs by going to FADs and not searching for tuna schools off the coast. The data indicate that the two types or areas of trolling complement each other and increase the number of areas available to fishermen, while also increasing their chance of having a good catch.

Limited fishing effort was devoted to mid-water fishing techniques of using vertical longlines, single-hook drift lines, or mid-water handlines (drop-stone and palu-ahi). Yellowfin tuna was the main fish caught by these methods off both Niue and Rarotonga (71% and 76%, respectively). Mahi mahi was the next most common fish, making up around 17% of the mid-water catch from FADs off Niue, and around 18% off Rarotonga. Wahoo and skipjack tuna caught by these methods made up only a small percentage of the catch in both locations.

The catches from mid-water fishing techniques around FADs are relatively small at present, although the methods becoming more popular. Use of these methods decreased the amount of fuel used, thus cutting operational costs. It is anticipated that more fishermen will use these methods in the future as fuel prices in the Pacific increase.

Cost benefit analysis of the project FADs

One of the main objectives of this FAD research project was to conduct a cost-benefit analysis of the catch and effort data to estimate the benefits or otherwise to the use of FADs. The analysis is based on the catch and effort data collected from small-scale commercial or part-time fishermen's logbook returns. In both Niue (Table 14) and Rarotonga (Table 15), a price has been applied to the catch by species, with the value being an estimated average based on the actual fish prices fishermen received during 2003 and 2004 in each location for these species.

This analysis is based only on the actual data collected. In reality, it is estimated that the catch and effort data collected in both Niue and Rarotonga represents just 20–40% of the commercial and part-time fishing effort in each location. Therefore, the data presented in Tables 14 and 15 represent about one-third of the total catch in each location, meaning that these figures could conservatively be multiplied by three to equal the total catch from small-scale commercial and part-time fishing in each location (note the resultant figure would still not account for recreational fishing).

The two main components to the commercial and part-time fishing activities conducted in Niue and Rarotonga are fishing around FADs and fishing in open water. Trolling is the primary open water fishing method, although some bottom-fishing and catching of flying-fish occurs at night. The Niue catch (Table 14) from FADs was 27,468 kg of fish over the course of the project life, with a value of

Table 13: Summary of catch by other mid-water fishing techniques by location

Island/ year	Total effort (h)	Vertical longline		Drop-stone		Palu-ahi		Single hook line		Total	
		No.	Kg	No.	Kg	No.	Kg	No.	Kg	No.	Kg
Niue											
2002	152	36	486	75	246	0	0	10	149	121	881
2003	286	136	1,253	88	476	0	0	0	0	224	1,729
2004	52	23	340	0	0	0	0	6	23	29	363
Sub-total	**490**	**202**	**2,079**	**163**	**722**	**0**	**0**	**16**	**172**	**374**	**2,973**
Aitutaki											
2002	55	6	104	12	49	0	0	1	38	19	191
Sub-total	**55**	**6**	**104**	**12**	**49**	**0**	**0**	**1**	**38**	**19**	**191**
Rarotonga											
2002	389	56	928	164	866	24	266	5	67	249	2,127
2003	386	61	745	113	743	41	323	1	12	216	1,823
2004	128	72	822	38	272	2	40	1	5	113	1,139
Sub-total	**902**	**189**	**2,495**	**315**	**1,881**	**67**	**629**	**7**	**84**	**578**	**5,089**
Total	**1,446**	**397**	**4,678**	**490**	**2,652**	**67**	**629**	**24**	**294**	**971**	**8,253**

Table 14: Catch weight and value of catch for Niue, based on the following value by species in New Zealand dollars (NZD): yellowfin tuna, 6.00/kg; skipjack tuna, 4.00/kg; wahoo, 7.00/kg; and others, 6.00/kg

Year and method	Yellowfin tuna		Skipjack tuna		Wahoo		Other		Total	
	Kg	Value	Kg	Value	Kg	Value	Kg	Value	Kg	Value
FAD fishing methods										
2001 – trolling	0	0	0	0	10	70	20	120	30	190
2002 – trolling	2,120	12,720	2,173	8,692	2,057	14,399	2,817	16,902	9,167	52,713
2003 – trolling	4,992	29,952	5,244	20,976	1,410	9,870	2,367	14,202	14,013	75,000
2004 – trolling	497	2,982	31	124	434	3,038	323	1,938	1,285	8,082
Sub-total	**7,609**	**45,654**	**7,448**	**29,792**	**3,911**	**27,377**	**5,527**	**33,162**	**24,495**	**135,985**
2002 – all mid-water	655	3,930	0	0	31	217	195	1,170	881	5,317
2003 – all mid-water	1,147	6,882	26	104	176	1,232	403	2,418	1,752	10,636
2004 – all mid-water	296	1,776	0	0	10	70	34	204	340	2,050
Sub-total	**2,098**	**12,588**	**26**	**104**	**217**	**1,519**	**632**	**3,792**	**2,973**	**18,003**
Total for FAD fishing	**9,707**	**58,242**	**6,474**	**29,896**	**4,128**	**28,896**	**6,159**	**36,954**	**27,468**	**153,988**
Open-water trolling										
2001 – trolling	0	0	0	0	292	2,044	15	90	307	2,134
2002 – trolling	411	2,466	633	2,532	8,799	61,593	888	5,328	10,731	71,919
2003 – trolling	1,044	6,264	286	1,144	5,381	37,667	1,495	8,970	8,196	54,045
2004 – trolling	1,451	8,706	747	2,988	3,875	27,125	407	2,442	6,480	41,261
Total	**2,906**	**17,436**	**1,666**	**6,664**	**18,347**	**128,429**	**2,805**	**16,830**	**25,714**	**169,359**

Table 15: Catch weight and value of catch for Rarotonga, based on the following value by species in New Zealand dollars (NZD): yellowfin tuna, 6.00/kg; skipjack tuna, 5.00/kg; wahoo, 7.00/kg; and others, 6.00/kg

Year and method	Yellowfin tuna		Skipjack tuna		Wahoo		Other		Total	
	Kg	Value	Kg	Value	Kg	Value	Kg	Value	Kg	Value
FAD fishing methods										
2002 – trolling	7,065	42,390	2,516	12,580	285	1,995	1,376	8,256	11,242	65,221
2003 – trolling	15,376	92,256	3,181	15,905	879	6,153	1,132	6,792	20,568	121,106
2004 – trolling	1,783	10,698	318	1,590	31	217	179	1,074	2,311	13,579
Sub-total	**24,224**	**145,344**	**6,015**	**30,075**	**1,195**	**8,365**	**2,687**	**16,122**	**34,121**	**199,906**
2002 – all mid-water	1,540	9,240	2	10	0	0	585	3,510	2,127	12,760
2003 – all mid-water	1,213	7,278	20	100	16	112	552	3,312	1,801	10,802
2004 – all mid-water	1,084	6,504	0	0	0	0	55	330	1,139	6,834
Sub-total	**3,837**	**23,022**	**22**	**110**	**16**	**112**	**1,192**	**7,152**	**5,067**	**30,396**
Total for FAD fishing	**28,061**	**168,366**	**6,037**	**30,185**	**1,211**	**8,477**	**3,879**	**23,274**	**39,188**	**230,302**
Open-water trolling										
2002 – trolling	1,024	6,144	185	925	1,797	12,579	1,001	6,006	4,007	25,654
2003 – trolling	3,229	19,374	1,220	6,100	4,764	33,348	703	4,218	9,916	63,040
2004 – trolling	565	3,390	284	1,420	509	3,563	328	1,968	1,686	10,341
Total	**4,818**	**28,908**	**1,689**	**8,445**	**7,070**	**49,490**	**2,032**	**12,192**	**15,609**	**99,035**

NZD 153,988. The open water trolling catch for Niue equalled 25,714 kg of fish, with a value of NZD 169,359. It should be noted that some of the open water catch could actually be catch associated with FADs, as fishermen troll past each of the inshore FADs during their open water trolling, and may have caught fish close to the FADs but recorded them as open water catch.

The Rarotonga catch (Table 15) from the FADs was much higher than in Niue: 39,188 kg with a value of NZD 230,302. In contrast, the catch from open water trolling was much lower than in Niue: 15,609 kg, with a value of NZD 99,035.

Table 16 presents a summary of the funding spent on FAD materials, including materials used for the different aggregators being trialled, and the freight costs for getting the materials to each project location. Funding for the

materials was provided primarily by this project, although some complimentary funding was provided by Taiwan/ROC to support project activities. The value of the recorded catch is also provided in Table 16, although as previously stated, this represents an estimated one-third of the actual catch.

The cost of all materials provided to Niue equalled NZD 91,007. This included the cost of the eight original FADs and the three replacement FADs (one deployed in 2003 and two in 2004). In addition, there are materials available in Niue to construct three additional FADs. Unfortunately four of the five project FADs were lost in January 2004, due to Cyclone Heta, which greatly changed the fishing activities of local fishermen. This resulted in fishermen doing more open water trolling, as only one offshore FAD remained in early 2004, which was not very productive.

In Rarotonga, the value of the FAD materials provided came to NZD 90,480. About one-third of these materials were used off Aitutaki, although these fishermen did not provide enough logbook data to allow a meaningful analysis. Therefore, the analysis is based on catch data from Rarotonga alone, although costs include the full cost of all FAD materials. Four FADs were deployed initially off Rarotonga, with one replacement FAD deployed in 2003. In addition, three FADs were initially deployed off Aitutaki, with one replacement in 2003. Enough materials are available in Rarotonga to deploy another three FADs.

In both Niue and Rarotonga, the value of the catch far exceeded the cost of the materials, especially given the fact that there are still materials on hand to deploy three replacement FADs at each location. This will allow the continuation of the FAD programme and provide ongoing FADs for fishermen to fish around, thus increasing the value of the catch taken from them with no additional costs in FAD materials. Therefore, the figures presented in Table 16 reflect only the initial benefits to fishermen from the FADs, as the catches will be ongoing as long as the FADs stay on station. In addition, the value of the catch in Table 16 is estimated to be around one-third of the actual catch (NZD 491,964 for fishing around FADs off Niue and NZD 690,906 for fishing around FADs off Rarotonga); the full cost of the FAD materials is already accounted for.

In examining the overall catch, FADs are a major contributor to the success of small-scale fishing operations in both locations. The social good that these provide for local communities is also very important, as there are many subsistence and recreational fishermen that use the FADs to catch fish for their families or for sport or pleasure. Fish taken by commercial or part-time fishermen are available for sale; the limited market on Niue restricts the amount of fishing and the catch taken at some times of the year, however. Based on the data collected by the project, there is no question that the benefits to local small-scale fishermen and local communities far outweighs the cost of the FAD materials. Ongoing FAD programmes should be continued by governments as a way to support local communities and the small-scale fishing sector.

New FAD technical manual

The final output of the FAD research project was to produce a technical manual covering the new and recommended designs for FADs based on the project results. This output has been completed: the "Manual on fish aggregating devices (FADs): lower-cost moorings and programme management" was produced in English in June 2005. The French version of this manual was completed in July 2005. For more information, please contact the Fisheries Development Section at: Capture@spc.int

Table 16: Value of the FAD materials and the catch taken from FADs and open water in both locations — all values in New Zealand dollars (NZD)

Item	Niue	Rarotonga
FAD materials and freight — New Zealand funded	80,075	82,280
FAD materials and freight — Taiwan/ROC funded	10,007	8,200
Total value of materials and freight	**91,007**	**90,480**
Value of the FAD trolling catch	135,985	199,906
Value of the FAD mid-water catch	18,003	30,396
Total value of the FAD catch	**153,988**	**230,302**
Value of the open water trolling catch	**169,359**	**99,035**

Summary

Community surveys were conducted three times each in Niue, Aitutaki and Rarotonga, at one-year intervals. Over 600 households were interviewed between the three locations, with 479 households (111 on Niue, 200 on Aitutaki and 168 on Rarotonga) being interviewed on all three occasions. A further 74 households were interviewed on two occasions. Benefits accruing to the surveyed communities from having FADs adjacent to their villages appear to be in two forms, direct and flow-on. The main beneficiaries are local fishermen with canoes and boats, who benefit directly. The FADs increased their fishing areas, and increased catches. Canoe fishermen benefited if a FAD was close enough to shore for them to access it safely, which was the case in Niue.

Boat fishermen were able to fish both offshore and inshore FADs and increase their catches, while reducing their operating costs (by using less fuel). They were also able to travel along the coast to fish the FADs located off different villages, whereas canoe fishermen were restricted to the FAD adjacent to their village. In most cases, fishermen would keep what they needed from the catch and sell the surplus. The flow-on benefits were in the form of fish being distributed by the fishermen to family, relatives and friends, especially when catches were good.

Analysis of the sex disaggregated data collected during the community surveys revealed that women in all three locations were mainly involved in reef fishing and reef gleaning. Males conducted the majority of fishing activities, however, especially in terms of fishing outside the reef in canoes or boats. The split of fishing effort varied between the three locations, with gillnetting a main method used in Aitutaki (which has a large lagoon). Baitfishing from canoes was a traditional fishing method that many men were involved in off Niue.

A catch and effort data collection system was implemented in March/April 2002 in each project location. Fishermen were asked to complete a logbook that covered their fishing activities by method used. Some fishermen in Niue and Rarotonga provided excellent data from the outset, but it was difficult to get a lot of fishermen to do this consistently. Over 3000 logsheets were completed, and these showed a marked season for wahoo trolling in open water along the reef (August to October), while catches from FADs were spread more evenly throughout the year. Trolling was the main fishing method, with mid-water fishing methods used around the FADs from time to time.

To conduct a cost benefit analysis in regard to the use of FADs, a dollar value was assigned to the catch by species, based on the average price fishermen received in 2003 and 2004. The Niue catch from FADs was 27,468 kg of fish over the project, with a value of NZD 153,988. The open water trolling catch for Niue equalled 25,714 kg with a value of NZD 169,359. The Rarotonga catch from FADs (39,188 kg) was much higher than Niue's, and had a value of NZD 230,302. In contrast, the catch from open water trolling in Rarotonga was much lower than in Niue (15,609 kg, with a value of NZD 99,035). The reported catch figures are estimated to be around one-third of the actual catch; this would increase the value of the FAD-related catch to around NZD 491,964 in Niue and NZD 690,906 in Rarotonga.

The cost of all FAD materials provided to Niue equalled NZD 91,007. This includes the cost of eight original FADs, the three replacement FADs that were deployed, and the materials still available in Niue (sufficient for three additional FADs). The cost of the materials for Rarotonga FADs equalled NZD 90,480. In the case of Rarotonga, four FADs were deployed initially, with one replacement FAD deployed in 2003. In addition, three FADs were initially deployed off Aitutaki with one replacement in 2003. Materials are available in Rarotonga to deploy three additional FADs.

The value of the catch far exceeded the cost of the materials in both Niue and Rarotonga,, especially as there are still materials on hand for three replacement FADs at each location. In terms of the overall catch, FADs are a major contributor to the success of small-scale fishing operations in both locations. These also provide important social benefits for local communities, as there many subsistence and recreational fishermen use the FADs to catch fish for their families or for sport or pleasure. Fish taken by commercial or part-time fishermen are available for sale, although the market in Niue is limited, which restricts the amount of fishing and the catch taken at some times of year. Based on the data collected by the project, it is clear that the benefits to local small-scale fishermen and local communities far exceeds the cost of the FAD materials. Ongoing FAD programmes should be continued by government as a way to support local communities and the small-scale fishing sector.

The FAD research project has been widely publicised, with results published in SPC's *Fisheries Newsletter* on a quarterly basis. Two major articles appeared in the *Fisheries Newsletter* (#105 and #106) that presented the results as of the end of the project's second year. *Fisheries Newsletter* #112 provided the final results of the project in regard to FAD mooring designs, aggregators and costs. The production of a technical manual with recommended FAD designs was completed in English in June 2005, and in French in July 2005.

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