Fisheries Newsletter

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Editorial

Welcome to the latest issue of the SPC *Fisheries Newsletter*. I would like to draw your attention to the recent SPC publication "Horizontal Longline Fishing manual". The main purpose of this manual is to introduce the horizontal longline fishing method to Pacific Island fishermen, and assist those currently involved to improve their fishing success, particularly in commercial or semi-commercial situations. This manual is intended to act as a guide to the principles and techniques of good horizontal tuna longline fishing. Environmental and conservation issues and concerns have also been included to raise awareness and to present ways to minimise impacts on unwanted species or the environment as a result of horizontal tuna longline fishing activities.

Michel Blanc presents on page 33 the results of the review of the SPC/Nelson Polytechnic Pacific Island Fisheries Officers Training Course. It was considered essential by fisheries administrations that a comprehensive review be undertaken, with regards to the major changes fisheries in the Pacific have undergone over the last two decades with the development of subsistence, artisanal and industrial sectors.

Jean-Paul Gaudechoux
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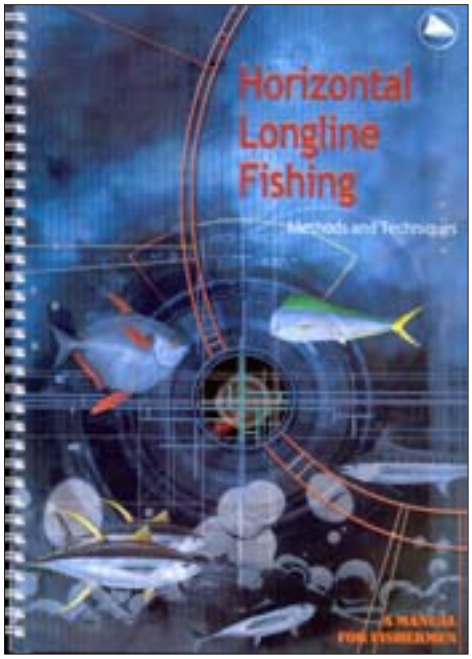


in This Issue

The long awaited tuna longline has now been printed. It illustrates all the different aspects of tuna longlining and the gear used. It is available for download on the SPC website or as a hard copy from the Fisheries Development Section

SECRETARIAT OF THE PACIFIC COMMUNITY
Prepared by the Information Section of the Marine Resources Division and printed with financial assistance from France.

FISHERIES DEVELOPMENT SECTION

During the second quarter of 2003, Fisheries Development Officer Steve Beverly spent two weeks in Honolulu, Hawaii, to renew his US Coast Guard master's certificate for operating motor vessels of up to 100 gross tons and to do a course for STCW-95. The STCW-95 course included firefighting, personal survival, personal safety and social responsibility, and first aid and CPR.

Marshall Islands longlining training

Fisheries Development Officer William Sokimi has completed his assignment in the Marshall Islands where he worked with staff of the Marshall Islands Marine Resources Authority (MIMRA) and local fishermen.

The assignment was to train MIMRA staff and interested local fishermen in tuna longline fishing gear and techniques using a monofilament set-up on the MIMRA training vessel, FV *Wa-Bal*.

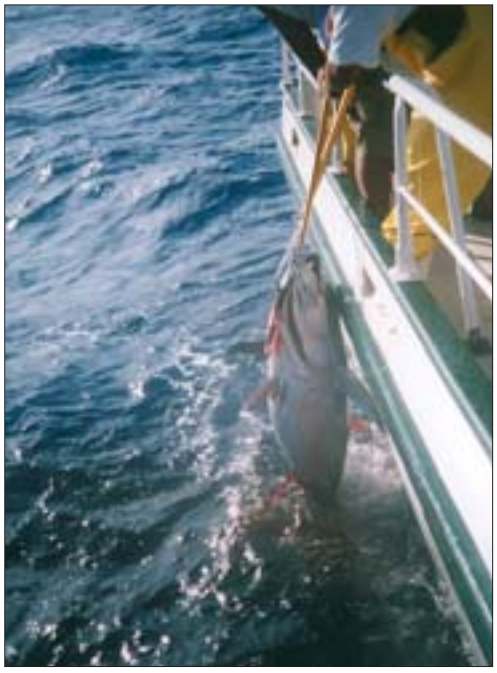
Other aims of the project included assessing of the FV *Wa-bal* as a tuna longliner, making suggestions on what would be a suitable vessel or vessel parameters for developing a local fishery, and training all participants in the correct on-board handling and preservation of the catch.

MIMRA had 32 participants organised for the workshop on tuna longlining, but the number dropped to 23 in the early stages of the project. The first sessions covered the different tools and fishing gear to be used during the project, and the theory of the fishing technique. Participants were then divided into three groups for practical training.

Each group completed two, six-week-long fishing trips. In total, 40 sets were made of the 200-hook longline over 26 fishing days. As the longline was short, two sets were generally made per day, one in the morning and one in the evening. Fishing was not great — only 270 fish of all species were taken during the workshop. The main saleable species were bigeye tuna (18 fish weighing 451 kg), yellowfin tuna (20 fish weighing 259 kg), blue marlin (14 fish weighing 432 kg), mahi mahi (48 fish weighing 305 kg), and wahoo (14 fish weighing 209 kg).

Export trials were undertaken through the Marshall Islands Fishing Venture (MIFV) company. A 39 kg bigeye tuna was exported to Japan after the first trip. Bigeye tuna and blue marlin from subsequent trips were exported to the US.

The total exported bigeye tuna was 272 kg, while exported blue marlin weighed 184 kg. Byproduct species and other tunas were either sold to the MIMRA fish market, donated as payment for services rendered,



Top: Gaffing and landing a good size bigeye tuna
Bottom: Setting the longline

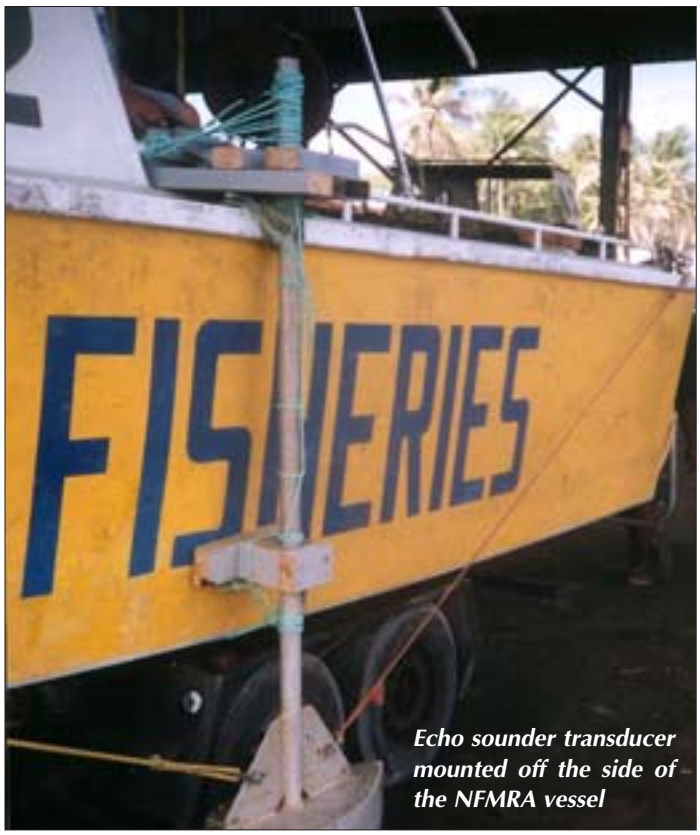
provided as customary acknowledgement to dignitaries, or eaten by the crew.

The FV *Wa-Bal*, was assessed as being marginally suitable as a tuna longline vessel, provided several improvements to working conditions were made. The stability of the vessel in moderate to rough sea conditions needs to be improved. The electrical system on the vessel needs modifying, including the installation of a small generator to keep the batteries charged. Another limiting factor is the small size of the fish hold which hold around 1.5 to 2 mt of fish in ice.

***Cleaning the fish hold on FV* Wa Bal**

FADs off Nauru

In late June, William travelled to Nauru to assist the Nauru Fisheries and Marine Resources Authority (NFMRA) with their FAD programme. NFMRA had materials for three FADs. They asked the Section to assist with the deployment of the FADs and to train local staff in all aspects of the work, including site surveys, selecting suitable FAD sites, and rigging and deploying FADs.



Echo sounder transducer mounted off the side of the NFMRA vessel

The Section's deepwater echo sounder was used for the site surveys, with the transducer mounted on the side of one of NFMRA's vessels. Three site surveys were conducted to fill in the gaps from previous survey work by SPC. While the site surveys were being done, two spar buoys were being fabricated on-island at the NFMRA workshop.

Once the sites were identified, three FADs were rigged, two spar buoys and one modified Indian Ocean design. Two FADs were rigged for 2500 m and the other for 1500 m, allowing for a 20 per cent scope in the rope length.

All the materials for the three FADs, including three tonnes of 16 cm reject mooring chain for use as FAD anchors, were loaded onto a barge for deployment. The barge was towed to the deployment sites by a tugboat. At each side, the buoy system was deployed and the rope paid out as the barge was towed in a circle, dropping the FAD anchor as it came back to the deployment site.

Left: Fabricating a steel spar buoy
Right: Materials for three FADs being loaded onto a barge

Tokelau needs assessment

Fisheries Development Adviser, Lindsay Chapman, travelled to Tokelau in early April as part of an SPC mission. The journey to Tokelau via the local cargo/passenger vessel MV *Tokelau* from Samoa took around 30 hours. Passengers (and cargo) were ferried ashore in a flat-bottom aluminium outboard-powered work skiff through a channel to the atoll. Lindsay spent one day on each of the three atolls, travelling between atolls on MV *Tokelau* at night.

Lindsay met with various groups, including the Aumaga (able-bodied men's group) on each atoll. Each Aumaga had the same basic interests — developing domestic tuna fishing operations to create employment and income generating opportunities.

During the discussions it became clear that the approach to development needed to cover not only employment and income generation but also food security. It came out of the meetings that the subsistence tuna fishery needed a FAD programme. Proposals were discussed for commercial longline tuna fishing conducted from an alia-type vessel on each atoll. The longline-caught fish would be frozen onshore, and transported via MV *Tokelau* to buyers in Samoa or American Samoa.

The Fisheries Development Section is working with Tokelau in identifying funding for this work. The plan is to work with and train men from each atoll to work as crew on the vessels, and develop and implement a FAD programme. The Section also will be working with the Forum Fisheries Agency later in the year on a national tuna development and management plan for Tokelau.

***MV* Tokelau**

Work skiff used to transport people and cargo between MV **Tokelau** *and shore*

Alia-type catamaran longline vessels in Tokelau

Update on the FAD research project

Fisheries Development Adviser, Lindsay Chapman, conducted a second round of community surveys in Rarotonga and Aitutaki in the Cook Islands with assistance from Ms Tuaine Turua (Tutu) from the Ministry of Marine Resources. The aim was to resurvey the same households (and same person if possible) as were surveyed 12 months earlier using exactly the same survey sheet, to see if there had been any changes in the fishing practices over the 12-month period, especially in relation to fishing outside the reef and fishing around FADs. Finding the same households proved to be challenging for Lindsay and Tutu, as people had moved around considerably. Some households were on holidays and some households had departed permanently.

In Rarotonga and Aitutaki, 221 and 246 households respectively were surveyed in 2002. In 2003, the number of households found and surveyed dropped to 180 in Rarotonga and 211 in Aitutaki. Where possible, the reasons for households not being found was documented so that these households could be surveyed during the third survey, scheduled for 2004. The survey data collected will be analysed and reported on in the next issue of Fisheries Newsletter.

Fisheries Development Officer Steve Beverly went to Niue and the Cook Islands to assist the Niue Department of Agriculture, Forestry, and Fisheries and the Cook Islands Ministry of Marine Resources in rigging and deploying FADs to replace

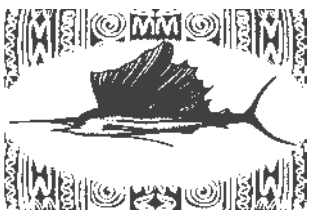
Pig wire aggregator with plastic strapping

those that had been lost. Steve also experimented with new aggregator designs on new and existing FADs.

In Niue, a FAD was deployed to replace the one that broke loose off Limufuafua village. The position of the replacement FAD is 19°11.000'S, 169°51.600'W in 900 m. The original FAD was lost due to failure of the galvanised wire in the top section of the mooring. The replacement was rigged with more traditional components: three-strand nylon and polypropylene ropes. A cage aggregator made from pig wire and plastic strapping material was attached to a purse seine float in the buoy system.

A second FAD to replace a FAD that was lost off Lakepa village on the windward side of Niue will be deployed by Niue Fisheries when weather permits. The Lakepa FAD has been rigged with lead-core polypropylene rope in the top section. It will have an aggregator made from shade cloth strung on 12 mm polypropylene rope attached to the mooring line below the raft. Two non-project FADs were also deployed during Steve's visit to Niue.

In the Cook Islands, two project FADs were rigged and deployed, replacing FADs that had been lost from the previous deployments. At Matavera village on Rarotonga, the FAD was rigged with lead-core polypropylene rope, replacing the failed galvanised wire cable in the upper section of the mooring. It was deployed using Ports Authority's tugboat, MV *Toa*.



Shade cloth aggregator being trialled

***Deployment of the Matavera FAD using tugboat MV* Toa**

The new position for this FAD is 21°12.925'S, 159°42.950'W in approximately 650 m. The Matavera FAD will also have a cage aggregator made from pig wire and plastic strapping material. One of these aggregators attached to an existing project FAD offshore of the Rarotongan Hotel was observed to have small fish living inside the cylinder just one week after it was deployed. It is hoped that these small fish will attract larger fish such as tuna and wahoo.

A second FAD was rigged and deployed off Aitutaki north of Arutanga, to replace one that had sunk due to failure of the large plastic mussel float. This FAD had nylon rope as the upper mooring line and polypropylene rope as the lower mooring line. The replacement raft was an Indian Ocean raft. The new position of this FAD is 18°48.750'S, 169°48.000'W in 1000 m.

Steve also assisted Ministry of Marine Resources staff in conducting bottom surveys around Rarotonga, to fill in blank spots that had not been previously surveyed.

Horizontal longline fishing, methods and techniques
A manual for fishermen

The long awaited tuna longline manual is complete and available in English on the SPC website at:

http://www.spc.int/coastfish/publications

or as a hard copy from the section. The manual has six easy-to-follow chapters covering different aspects of tuna longlining.

Chapter 1 provides some background on tuna longlining in the region with basic information on the target, byproduct and bycatch species, safety appliances and longline boats in general.

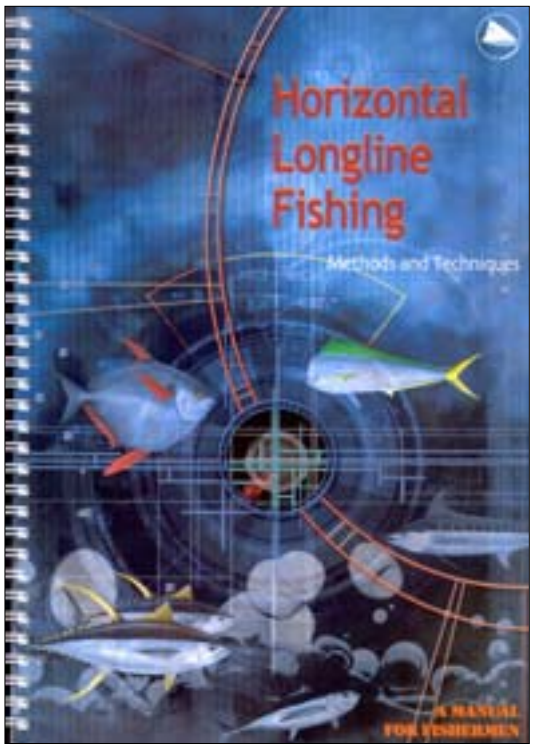
Chapters 2 and 3 look at fishing gear and equipment, and the fishing operation, including the location of suitable fishing sites setting and hauling the gear, and some problems that may be encountered.

Chapter 4 looks at the catch: how to land it, process it, and preserve it using ice, refrigerated sea water, chilled sea water or freezing it.

Chapter 5 covers the marketing and business operations of tuna longlining, while chapter 6 focuses on responsible fishing practices, including the issues of marine debris and bycatch, avoiding seabirds and bait loss, as well as record keeping and working with observers.

The manual concludes with several appendices that cover weather conditions, important radio frequencies, nautical terms, longline species commonly caught, a sample predeparture checklist and a copy of the regional tuna longline logsheet.

The manual has over 300 line diagrams to illustrate the different aspects of tuna longlining and the gear used. It is expected that the French version will be available by November 2003.



AQUACULTURE SECTION

Pearl farming attachments involving the Cook Islands, Tonga and Kiribati

The Cook Islands pearl industry has been a source of regional cooperation recently, with two Tongan fisheries officers being attached to the industry in Cooks and a Cook Islander being attached to the Kiribati industry. Funding for these attachments was provided by the European Union Rural Development project in Vava'u, the ACIAR funded Black Pearl project, and SPC.

The attachments involved the Ministry of Marine Resources in the Cook Islands, the Ministry of Fisheries in Tonga and the Ministry of Fisheries and Natural Resources Development in Kiribati.

Poasi Fale, from Sopu hatchery in Tongatapu, visited the Tongareva Marine Research Centre's pearl hatchery at Penrhyn Atoll in the Cook Islands. Poasi spent a number of weeks familiarising himself with the pearl hatchery protocol, working side by side with the Penrhyn hatchery staff. According to Poasi the experience has given him a tremendous boost and he is now planning to do a spawning of blacklip pearl oysters at Sopu hatchery sometime later this year.

Vea Kava, the head of research for Vava'u fisheries department in Tonga, was attached to pearl farms on Manihiki in the Cook Islands. Vea's experience was designed to give him first-hand knowledge of what pearl farming actally involves. On Manihiki he worked at various pearl farms. Some of the tasks included constructing and deploying spat collector lines, preparing oys-

ters for conditioning, and assisting a local seeding technician. The pearl industry in Vava'u is still in its fledgling stages, and having this practical experience will enable Vea to guide the Vava'u industry.

Mataora Masters, the hatchery manager of the Tongareva Marine Research Centre in Penrhyn, Cook Islands, carried out a one-month attachment with the fledging pearl industry in Kiribati. Most of Mataora's time was at spent at Abaiang Atoll where the ACIAR/ MFNRD pearl farm is located. About 8000 adult oysters reared at the fisheries pearl oyster hatchery at Tarawa were being prepared at the Abaiang farm for seeding. Mataora was able to bring his experience as a hatchery technician, pearl farmer and oyster biologist to improve the farming techniques being adopted in Abaiang. According to the Fisheries staff they have thoroughly benefited from Mataora's inputs.

Marine ornamental consultancy under way

SPC has commissioned a consultancy to examine the marine ornamental trade. The Pacific is an important source of marine ornamental species such as giant clams, corals and fish for the aquarium trade. The extent of the trade in the Pacific has not been fully documented. The role of aquaculture and the cost-effectiveness of its application has yet to be properly assessed, particularly from a marketing and economic point of view.

A regional team of consultants from the northern and southern Pacific has been awarded an SPC contract to conduct a study of the marine ornamental trade. The consultancy will examine the status of marine ornamental culture within the Pacific, assess the marketing demands, and make a detailed evaluation of the major ornamental species, cost–profit comparisons of extensive and intensive aquaculture culture systems, and an assessment of the potential economic trends of the ornamental industry.

All SPC member countries will be reviewed by the consultancy. Up to six countries within the region will be visited for an in-depth analysis. The task is expected to take four to six months and will be completed in the last quarter of 2003.

New Caledonia update

Prawn farming in New Caledonia

New Caledonia's booming prawn farming industry is expected to double its production within the next five years. The industry currently produces 1800 tonnes of western blue prawn *Litopenaeus stylirostris* annually. Most of the prawns are sold to Japan and France under the "Paradise Prawn" label. The New Caledonian prawns are a high-grade product that is highly appreciated in restaurants and sushi bars.

There are 12 farms, with an average pond area of 30–40 hectares. A dozen smaller farms are developing, mainly in the south of the main island along the western coast. The farms are supplied by four hatcheries, which produce more then 100 million post-larvae per year.

Specially formulated feed is provided by two local feed mills. The industry provides 900 full-time and part-time jobs. The value of exports generated by prawn farming is USD 22 million dollars (XPF 2.5 billion). The expected increase in production will consolidate its rank as New Caledonia's second

New Caledonian blue prawn,
Litopenaeus stylirostris

highest export revenue earner, after nickel.

Styli 2003 conference

The Styli 2003 conference was a milestone to recognise 30 years of aquaculture of *L. stylirostris* in New Caledonia and the effective partnerships formed between industry, the French government, the provinces of New Caledonia and IFREMER (one of the French government research agency). The objectives of the conference were to: 1) review the current status of the industry, 2) stimulate collaborative research programmes and, 3) reinforce partnerships between research institutions and industry.

The conference was arranged in three segments. A one-week technical workshop and roundtable discussion of technical issues (hatcheries, grow-out, nutrition and product quality) was held at SPC's conference centre. This was followed by a two-day symposium at the IRD amphitheatre with sessions devoted to current status of the industry, shrimp biology, pond environment and pathogens. Following the symposium participants travelled to Koné, the capital of the Northern Province. During the trip, field visits were made to prawn farms. At Koné a review of session results were presented. The final day was dedicated to a sub-conference on the topic of aquaculture diversification for New Caledonia.

Several hundred persons participated in conference activities. Many of the scientific presentations were by New Caledonian or Metropolitan France-based IFREMER staff. Significant contributions by all industry stakeholders (academics, farmers and government) were made. Australian scientists from the Australian Institute of Marine Science (AIMS), Queensland Department of Primary Industries (QDPI) and James Cook University were also invited as guest speakers. Honoured guests included the Mayor of Nouméa and the President of the Northern Province government. Yves Harache, the head of IFREMER in New Caledonia, was the main organiser of the event. His tireless efforts were commended by everyone.

Field visits

IFREMER Saint-Vincent laboratory

The Laboratoire Aquacole de Calédonie in Saint-Vincent is the IFREMER's main centre for prawn research and development. The facilities include a prawn hatchery, grow-out ponds with water quality moni-

Top: Styli 2003 conference participants were treated to curried and sushi prawns at Moindou village
Bottom: IFREMER scientists at work

toring sonde deployed in-situ, and modern laboratory facilities for conducting oyster physiology, pathology and genetic research. The Saint-Vincent station is manned by about 40 staff and students.

La Pénéide de Ouano

The Ouano prawn farm is considered to be one of the model farms for the New Caledonian industry. Not only is it a highly productive farm but it is integrated within an extensive mangrove area. The New Caledonia industry has demonstrated that by situating the farm behind the mangroves they are able to use the natural ecosystem as a biofilters and a nutrient sink. In 1994, three years after the farm began operations, it was the site of an intensive environmental impact assessment that found the farm had no detrimental impacts. In 2004, 10 years after commencement of operations, a follow-up survey will be conducted. The farm has 30 hectares of surface area and 4 hectares of ponds. It produces 150–180 tonnes per annum.

SODACAL

The SODACAL farm is the largest farm. It has a surface area of 131 hectares. It initially began as a joint commercial operation with government and IFREMER, and has slowly been privatised to the public sector. The manager of the SODACAL farm, Regis Bador, is highly respected by his peers. One interesting aspect of the SODACAL farm is the attempt to value-add to the farm operations by utilising the fauna that naturally settle in their farm ponds, such as crab and seahorse.

SODACAL has found that costs of farming seahorses on-site are easily assimilated into the overheads involved in prawn farming. Since at various times of the year some ponds are not fully utilised, the seahorse work provides ongoing employment opportunities. With its high degree of aquaculture specialisation on-site, the farm has quickly been able to develop techniques for seahorse hatchery rearing. Hatchery success rates of 10% are common, and up to 30% has been achieved. Using their marketing expertise, the company has identified niche opportunities for the aquarium and medicinal trade.

Webuihoone SA

The prawn farm at Webuihoone is located in the Northern Province. It is operated under joint custody of the government and the local tribe. This is an effort to help the local community to share in the economic benefits of prawn farming.

Top: Ouano prawn farm, considered to be one of the model farms in New Caledonia
Bottom: SODACAL prawn farm is New Caledonia's largest farm and has a surface area of 131 hectares

Blue Lagoon Farm

At Blue Lagoon Farm (85 hectares surface area) we were able to witness a harvest of prawns. The entire prawn industry has adopted a voluntary code of very strict quality controls in every step of farming, from the feed mill, to the culture techniques, harvesting and processing. The harvest (in the evening) was a highly coordinated affair to ensure that the prawns would be delivered to the processing factory in the Southern Province and sorted and processed within a certain time frame.

Top: Webuihoone SA prawn farm in the Northern Province
Bottom: Sorting the prawn harvest at Blue Lagoon Farm

Diversification of aquaculture in New Caledonia

To set the stage, the first presentation for the diversification conference was a regional perspective on aquaculture in the Pacific presented by Ben Ponia from SPC. This was followed by presentations led by Warwick Nash of the WorldFish Center and Dennis Coatanea from IFREMER, who gave an assessment of other types of aquaculture being pursued by their respective institutions.

Following this, various entrepreneurs gave reports on their efforts to develop alternative types of aquaculture, aside from prawn.

Oysters are a favourite in French cuisine and a highly developed aquaculture industry in France. A farm in New Caledonia is raising the Pacific oyster *Crassostrea gigas*, targeting the domestic food market in Noumea. About 70,000 dozen per year are farmed from oyster spat imported from overseas, but even this amount cannot meet the demand, which is about 200,000 dozen per year.

The farm would like to invest in a hatchery to ensure a stable and high quality source of spats Triploid progeny was suggested.

Giant clams are also being cultured in the Northern Province. The operation involves the collection of clams from the wild and the subsequent grow-out and fattening in the lagoon shallows. The fast growing and large sized *Hippopus hippopus* are sold for the domestic food market in Noumea. According to the speaker at the conference, his farm has 7000 four-year-old and six-year-old clams. The farm also raises *Tridacna maxima*, targeting the overseas aquarium trade. Some common problems are predation in the nursery phase, tasks such as cleaning and cage maintenance that can be labour intensive.

The freshwater crayfish red claw (*Cherax quadricarinatus*)

has been introduced to New Caledonia. This type of crayfish is popular in French cuisine. The provincial government have been encouraging red claw farming in the rural areas, as the species is easy to breed and low inputs for farming are required. In 2001 there was 6 tonnes of commercial production and it is expected to grow to 23 tonnes within several years. The size of the local market is 50 tonnes.

Small-scale trials of various aquaculture species are also being conducted. Experiments to assess the feasibility of larval ranching for fish species, particularly for the ornamental market, are being carried out along the coastline. New Caledonia is one of the few places where mozuku seaweed (*Cladosiphon* sp.) occurs naturally. There is interest in farming it for export. Mozuku seaweed is popular in Japanese dishes such as sushi and soup.

TRAINING SECTION

Specialised training for fishing vessel engineers

In 2000, the SPC Fisheries Training Section undertook a survey to assess engineering training needs among Pacific Islands fishing companies. The purpose of the survey was to identify the skills that engineers were lacking and to develop training strategies to address those needs.

The survey results clearly indicated that fishing companies in the region are concerned about the shortage of competent and certified engineers. Companies often must hire expensive foreign engineers. There is an urgent need to promote marine engineering as a career in the Pacific and to train new entrants in the fishing industry. Since 2001, the SPC Fisheries Training Section has been seeking funds from aid donors to develop a foundation course that will give new entrants the necessary basic skills to start a career in marine engineering. Unfortunately, the duration of the course, and thus its cost, are obstacles and to date the section has had no luck in its quest for money.

Engineers currently in the industry often have comprehensive experience and several years of sea time. Some, however, lack a proper certificate or their certificate, or need to upgrade their certificate to meet the new international standards set by the STCW-95 convention of the International Maritime Organization. SPC's Regional Maritime Programme, with funding from the UK aid agency DFID, has been sponsoring upgrading courses in the region to help deck and engine officers obtain those internationally recognised certificates.

The New Zealand School of Fisheries engineering workshop

Common to most of the companies surveyed was a training need in engineering areas specific to fishing vessels, such as refrigeration, hydraulic and electrical systems. Those skills are not presently taught at national training institutions as part of their STCW-95 compliant certificate courses for marine engineers.

SPC took the survey results on board and developed an outline for a training course. Funding was sought from a range of donors. Eventually our proposal was approved by NZAID, early this year.

A five-week specialised course for fishing vessel engineers will be run at the New Zealand School of Fisheries from 29 September to 31 October. Its purpose will be to provide 12 engineers the necessary skills to safely and efficiently operate the refrigeration, hydraulic and electrical systems found on medium to large size fishing vessels.

While most of the selected participants come from the private sector, two are engineering instructors from training institutions (Fiji School of Maritime Studies and Papua New Guinea National Fisheries College). This will achieve a train-the-trainer objective, as those institutions are planning to introduce a similar course to address the needs of their local fishing industry.

More on this innovative training course in the next issue of the Fisheries Newsletter.

Safety at sea remains high on SPC's agenda

Developing a sea safety culture in the Pacific is a long and sometimes repetitive process! It is nevertheless an important objective for the SPC Coastal Fisheries Programme.

Mike McCoy's *Survey of Safety at Sea Issues in Pacific Island Artisanal Fisheries* report for FAO (1991) recommended "education through publicity campaigns, repeated and reinforced over a long period of time" as a means to improve the safety of artisanal fishermen. This recommendation was taken on board by the Fisheries Training Section, which launched the SPC "Think Safety at Sea" campaign in 1995. For eight years, the section has produced and distributed a range of educational materials, from posters to videos through trainers' guides and booklets for vessel crew. While the outcomes of such a campaign are difficult to quantify (how many fishermen has SPC saved?), it is generally recognised that the wide distribution of SPC materials has had a positive impact on fishermen's attitude and has contributed to the progress made in sea safety during the last few years.

Another FAO survey of fisheries-related sea safety in the region was completed by Bob Gillett early in 2003 (see Fisheries Newsletter #104). The consultant noted that, while such safety awareness work should continue, more efforts should be made to get the awareness message to remote communities where it may be the only practical mechanism for improving safety. Suggestions for future interventions that may work for remote communities include the expanded use of radio programmes, extension visits, and greater production of materials in local languages. In fact, SPC started the translation of its sea safety materials back in 2000, with the Bislama version of the safety equipment (see illustration) and five-minute checklists, widely distributed in Vanuatu and the Solomon Islands (two posters, A4 size laminated card and sticker). Since then, the Fisheries

Training Section had planned to translate the same materials into other Pacific languages but funding was lacking. Thanks to SPC's Executive and the governments of France and Taiwan/ROC, the section now has some money to cover three more countries where small boat safety is a concern. Discussions with Heads of Fisheries at the recent August meeting showed that Tokelau, Niue and Kiribati were very interested in being part of the project. Those three countries will be served first.

As a follow-up to the 2003 FAO survey, SPC and FAO will be jointly organising a regional sea safety workshop in 2004. This short technical workshop will focus on small fishing vessels and will be attended by motivated individuals from several relevant disciplines. Participants will brainstorm on selected challenging issues with the intention of developing national as well as regional strategies for improving sea safety. It is expected the outcomes of the meeting will be widely promoted in the region, including at high-level fora such as the SPC Conference in November.

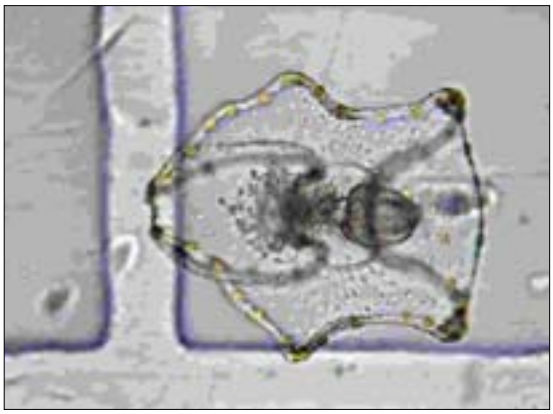
WORLDFISH

New Caledonia sea cucumber success

Success has been a prevailing theme for sea cucumber research in New Caledonia. The World Fish Center, in partnership with the SPC, is now into the second year of the project to develop strategies for restocking sea cucumbers. Last year was used to get the project into gear and build a hatchery north of Noumea. Breeding of sandfish sea cucumber started in October 2002.

In this first season, the team produced 100,000 juveniles, which were far more than needed. Several thousand that grew to finger size were used for the experiments. Six key research studies have already been successfully completed. These include a study to reveal the genetic structure of sandfish stocks in New Caledonia, an experiment to see how to grow them with shrimp, and experiments on the best transportation methods, habitats and times of the day to release the juveniles into the wild to get high survival rates. Juveniles released into enclosures placed in seagrass beds have to be vacuumed out of the sand at the end of each experiment in order to show how they survived and grew under the different conditions. The overall aim is to find out how Pacific Island countries can most effectively replenish natural populations of sea cucumbers that have been overfished.

Recently, the work at the hatchery has shifted focus to a second species. Adult black teatfish sea cucumber were collected from the Loyalty Islands Province and spawned at the hatchery. The last batch of larvae is doing well, and the project hopes to be the first to culture these to the juvenile stage. Let's hope the success continues!



Left: Juvenile sandfish ready for release
Right: Auricularia larval stage of the black teatfish

TROUT FARMING IN PAPUA NEW GUINEA

PNG has an abundance of suitable trout streams in the highlands. These are typically fast-flowing soft-water with rocky and stony river beds and clear water; and usually with no macrophyte growth. In the tropics, rivers at 1500 m above sea level are within the range of 10–15°C and drop as low as 7°C in higher altitudes. In 1949 European settlers stocked highland rivers for game fishing. Since then rainbow trout *Oncorhynchus mykiss* have successfully reproduced in the wild. Small releases of brown trout *Salmo trutta* and brook trout *Salvelinus fontinalis* were also introduced but without success.

The first commercial trout farm began in 1973, but since then production has been sporadic and the industry has struggled to get established. FAO data for trout production in PNG over this period reflects wild-caught fish, as until recently there was no system of data reporting for freshwater fisheries. The first commercial units were reliant on imports of feed and ova that were paid for with a high valued kina. When international exchange rates fell, imports became prohibitively expensive, the industry faltered, and today only one farm is running commercially. Lake Pindi Yaundo Enterprise, also known as "Betty's Place", built on the boundary of the Mount Wilhelm National Park, Simbu Province, started in 1993 and now produces sufficient ova for third-party sales of fingerlings. From this, opportunities have risen for local smallholder farmers to grow trout in earth ponds (commonly 5 m x 10 m), which rarely produce more than 1 tonne per year. The difficult terrain determines pond shapes, which sometimes have to be built around boulders that are too large to move. Farms are built on water supplies that vary from small streams (flow rate of $<1m^3$ per minute) to large rivers. A diverse range of water intake designs are employed, ranging from purely natural bush materials to extensive use of concrete and PVC pipes. Some of the farms could be celebrated as organic excellence: stocking levels are low, presently there are no disease problems, nearly all of the materials used are recyclable, chemicals are not used in the production cycle and the protein source in the feed is a byproduct. Farming practices are often mixed with animal husbandry and coffee and banana plantings next to the ponds attract insects for the trout to feed on. The University of Goroka is working with the Department of Primary Industry (DPI) to establish an organic certification board to endorse organic marketing in PNG.

Trout farming is supported at government level as offering significant economic advantages for smallholders for whom diversifying from agriculture, which supports most highlanders, is difficult. To further this policy, the PNG Department of Trade and Industry requested technical assistance from the Commonwealth Secretariat, who subsequently engaged STAQ (Sterling Aquaculture, based at the University of Sterling, UK) to carry out a two-part study to identify the major constraints that the industry faces, and explore potentials and avenues to assist sustainable development. The initial visit to PNG was made by Jonathan Grubb in early 2002 and involved extensive travel within the country to meet farmers, feed producers, processors, education and training establishments and government officers. Jonathan returned later in the year with Professor Jimmy Young from the University of Sterling, Department of Marketing, to examine specific technical, nutritional, marketing and distribution issues that were identified during the first visit.

The embryonic trout industry faces a multitude of challenges, including a lack of human resource skills, problems in fingerling supply and availability, feed quality and cost, poor infrastructure, lack of financial resources, and difficulties with marketing and distribution.

However, the technical issues that constrain current production are considered to be surmountable. The national market appears to have potential for growth, having suffered from irregular supply rather than any resistance to the product or market saturation per se. The National Fisheries Authority is tasked with coordinating the activities of freshwater fisheries development. About 60 field officers from DPI have been given rudimentary training in trout farming at Betty's under a technical assistance agreement with the Japanese International Cooperation Agency. Local DPI fisheries expert, Peter Minimulu has gained funding from the British Council to attend the Institute of Aquaculture MSc Course 2002–2003. Peter plays a key advisory role in PNG aquaculture development. He has targeted his MSc thesis on a trout related issue. It is hoped that others will take up opportunities for skills training and further education.

As elsewhere, production cost is a key factor in determining the potential size of the industry. The cost of feed is especially significant in PNG, accounting for 80–90% of total cost. A local animal feed mill manufactures a basic trout diet to order, but farmers have complained of

poor fish performance against imported product. The team therefore looked at ways to improve the diet, aiming to satisfy nutrient requirements, minimise feed cost and, where possible, utilise locally available ingredients. The Institute of Aquaculture processed and analysed samples of local feed and raw materials, confirming them to be nutritionally deficient and unlikely to promote commercial growth rates. The low volume of feed required is a substantial disincentive to investment in feed processing. Therefore, maximising the use of imported feed seems to be the best alternative in the short term.

Whilst the national GDP is not drastically low (USD 2367), 37% of the rural population is estimated to live below the poverty level. Migration from rural and urban areas is encouraged by this inequality (average wages in the capital are 10 times higher than in rural areas).

The Simbu Province is the poorest, in terms of natural resources, of the five provinces in the highlands region and has less potential to achieve economic growth than the others. Within PNG there are over 750 tribal dialects, but PNG Pidgin is a widely accepted national language. The wantok system, where kinship dictates that help, physical or financial, must be given to kinsfolk who request assistance, is deep-seated within the local culture, and has both positive and negative benefits.

Over the next three to five years a practical strategy will be implemented encompassing government departments, provincial administrations, commercial organisations and educational establishments. Various models for sector organisation could be adopted; the promotion of "contract production" with linkages to distribution and marketing companies is an attractive option.

(Source: *Aquaculture News*, May 2003, Number 29)

SONAR MAY HELP TALLY POPULATIONS OF RARE FISH

Scientists gather data on bottom-dwelling species in Hawaii with bouncing signals.

Scientists are experimenting with sonar to help them determine the populations of some of Hawaii's favorite fish, such as ehu (ruby snapper, *Etelis carbunculus*), onaga (Flame red snapper, *Etelis coruscans*) and opakapaka (Crimson jobfish, *Pristipomoides filamentosus*).

All three are deep-sea bottomfish, and two of them, ehu and onaga, are endangered. Opakapaka is close to being labelled as endangered.

Working with the Hawaii Undersea Research Laboratory (HURL) submersible *Pisces V*, the scientists measured echo characteristics of various species in waters off Kahoolawe. "We are trying to find out if we can use sonar to identify bottomfish so we can nonlethally survey them," said Kelly Benoit-Bird, of the University of Hawaii Department of Zoology, Hawaii Institute of Marine Biology (HIMS).

"If we go in there with fishing gear to try and figure out what is going on, it's counterproductive," said Chris Kelley, HURL chief biologist and HIMB researcher.

One possible method of assessing the fishery without killing the fish is with acoustics, he said. "Let sonar be your eyes, and you're hoping to get sonar information that's detailed, with high enough resolution that you could actually distinguish different species."

Others working on the project are Whitlow Au, chief scientist for the HIMB Marine Mammal Research Program, and Christopher Taylor, engineer-manager of HURL's remotely operated vehicle (ROV).

Benoit-Bird and Au have been studying the acoustic signature of bottom fish, while Kelley has led a programme to collect information on Hawaii bottom fish populations and habitats.

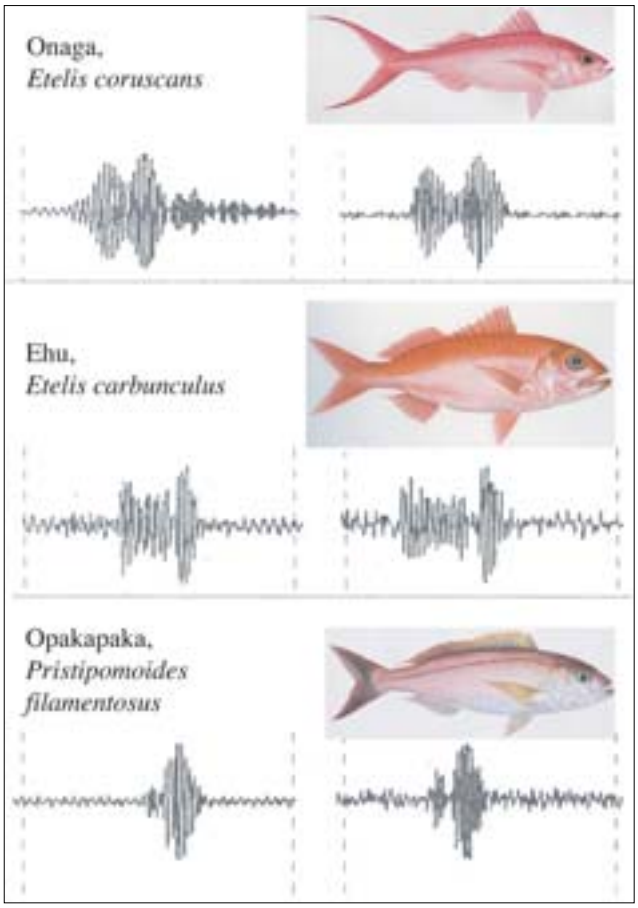
Bottomfish have an air-filled swim bladder that creates an echo, but the amount of air compresses as the fish go deeper, Benoit-Bird said. Swim bladders have complicated shapes that are different for each species, and the shape ultimately will be the key to telling the fish apart with sonar, she said. "We were not sure if under pressure the size of the bladder would change and, if it did change, if it would make all the results at the surface difficult to interpret." Using sonar on the submersible with video and low-light cameras for observations, they found the fish were able to regulate the size and shape of their swim bladders even under huge pressure as they went deeper, she said.

Kelley said the submersible work will help to find more cost-effective methods of sur-

veying the fish, such as sonar with video and low-light cameras. The National Marine Fisheries Service is building a drop camera mounted on a platform that can be put on the side of a small boat, he said. "We have a low-light camera that works really well," he said, explaining that fish will avoid artificial light. The camera takes available light in the deep water and amplifies it and enhances the image, he said.

The fish are drawn to the submersible with bait, then videotaped, while a sonar transducer attached underneath the camera bounced sonar pulses off the fish. "They got really, really good acoustic information from different species," Kelley said. "They could see with the camera exactly what species created the echo, how oriented it was to the sub and how large the fish was."

The scientists' findings were reported in *ScienceDirect*, an information source for scientists worldwide. The article, "Acoustic backscattering by deepwater fish measured in situ (their natural habitat) from a manned submersible", was the first published account of use of a manned submersible to measure fish in their habitat.



Echo signatures: Above are the unique sonar signatures of different species of bottomfish in Hawaii waters. The images on the left were recorded while the fish were anesthetised in controlled conditions at the surface, while the images on the right were recorded as the fish were swimming freely in deep ocean. Scientists hope to use the data to determine the fish populations.

Benoit-Bird said the next step is to measure echoes of live fish swimming in a pen to observe the effects of movements of different fish, groups and mixed species and see if they can tell the difference.

Kelley, who has been studying bottomfish populations to help the Hawaii State Department of Land and Natural Resources improve management of the reserves, said he is about to start another three-year phase of research under a new grant. Kelley said that Au is going to experiment with two methods of monitoring the fish in their natural habitat.

One is to build a torpedo-like device with sonar that can be lowered or towed behind a boat and above the fish looking down, he said.

The other way is to place a mooring at an important fish-aggregating site with a sonar system that looks up at the fish, he said.

It could be left there six months to a year to collect data on the numbers and types of fish going into the area over time.

In the submersible dive this year, Kelley said, they will try to orient the sonar and cameras vertically in the water to get signals from above and below the fish.

(Source: *Honolulu Star Bulletin*, 2 June 2003)

SURVEY SHOWS FREQUENCY OF FISH DIET CONTRIBUTES TO LONGER LIFE SPAN

Japan recorded the world's highest average life expectancy for 2002, at 85.23 years for females and 78.32 for males, according to Japan's Welfare and Labor Ministry. This represented an increase of 0.3 years and 0.25 years respectively over the previous year.

An independent nationwide epidemiological survey has been conducted in Japan on the relationship between frequency of fish consumption and disease and mortality.

A total of 265,118 people surveyed were divided into four groups consisting of those who: (1) eat fish every day, (2) eat fish sometimes, (3) eat fish rarely, and (4) do not eat fish at all. Based on this division, a tracing survey was conducted for 16 years on people aged 40 and over at the start of the survey, regarding mortality rates and cause of death.

The overall mortality rate was the highest for the group who "do not eat fish at all." The mortality rate declined in the order of frequency of fish consumption. As for cause of death, the mortality rate by ischemic heart disease, cirrhosis of the liver, cancer, and cerebrovascular disease was higher for the "do not eat at all" group than those eating fish every day.

It is ideal to consume fish every day. But it has become a common recognition in the world that the consumption of fish two or three times a week reduces risk factors for various types of diseases.

As to the precise reasons for these effects, further studies are currently under way regarding the functions of fishes to maintain health.

(Source: *Isaribi*, No. 37)

FAD RESEARCH PROJECT: SUMMARY OF RESULTS AT THE END OF THE SECOND YEAR (JUNE 2003)

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

Introduction

The three-year SPC FAD research project commenced in mid 2001 after funding was secured from the New Zealand Pacific Initiative for the Environment (PIE) fund. The project is implemented in three locations, Niue, and Rarotonga and Aitutaki in the Cook Islands. The objectives or outputs of this project are to:

1. Develop a more cost-effective FAD mooring design with a average lifespan of at least two years, while reducing costs to a target unit level of NZD 4500 for deep-water FADs (1000 m depth) and NZD 3000 for shallow-water FADs (300 m depth);

2. 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;

3. Collect catch and effort data from fishermen involved in FAD fishing (by fishing technique), and conduct a cost–benefit analysis of the data to estimate the benefits or otherwise of the use of FADs; and

4. Produce a technical manual and other literature, reports and articles to document the findings of the project, with the technical manual covering the new and recommended design for FADs based on the results of the project.

This is the first of two articles to summarise the results and outputs of the project at the end of the second year of operation (June 2003). This article covers the results so far in relation to the first objective or output, FAD designs and costings.

The next issue of *Fisheries Newsletter* (#106) will cover the results so far in relation to objectives and outputs 2 and 3, the community surveys and the catch and effort data collected by the project.

Summary of the first year's activities

Following the commencement of the project in June 2001, FAD materials were purchased in New Zealand and freighted to the three project locations. Once the materials arrived, SPC staff travelled to each location to undertake site surveys (Fig. 1) in November and December 2001

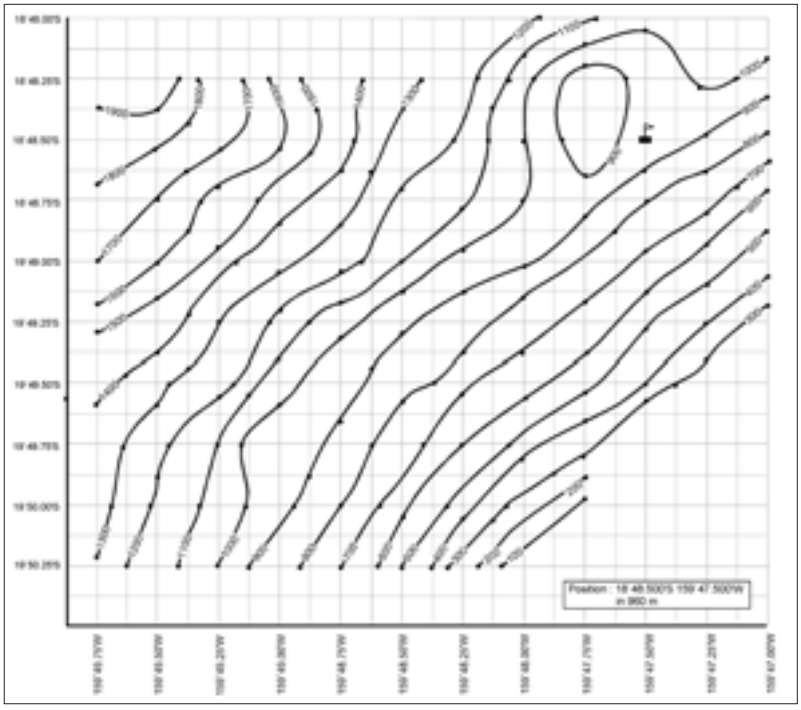


Figure 1: Site survey for north of Arutanga area off Aitutaki with site of FAD deployment

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and rig and deploy FADs to the new designs to be trialled between March and April 2002 (Figs 2 to 4).

Fifteen FADs were deployed in depths from 400 to 1150 m, eight off Niue, four off Rarotonga and three off Aitutaki. All deployments used the straight-line method: the FAD buoy system was released first as the boat steamed toward the intended site, then the mooring was paid out, the boat crossed over the intended site; and finally the anchor was deployed just past the intended site. In all cases the deployment vessel steamed from shallow water to deeper water so that the anchor would swing in towards shallower water upon deployment, decreasing the chance of losing the mooring in deep water. For the first five deployments a 67/33 per cent formula was used. That is, the buoy system was released at a distance away from the intended site equal to 67 per cent of the total mooring length.

The mooring was paid out as the vessel steamed towards the intended site. The site was crossed, and the anchor was deployed at a distance 33 per cent of the mooring length away from the site. This allowed the anchor to swing back, with the pull of the mooring and buoy system, and land very near the intended site. In ten of the deployments a formula of 80/20 per cent was used.

The FAD buoy system was released at a distance equal to 80 per cent of the mooring length away from the intended site and the anchor was deployed at a distance equal to 20 per cent of the mooring length away from the intended site. In all cases the anchor landed near the intended sites, with the 80/20 formula resulted in more accurate deployments.

Figure 2 (top): Rigging the buoy systems in Rarotonga
Figure 3 (middle): Heading to the deployment site off Aitutaki
Figure 4 (bottom): Paying out the rope during one of the deployments off Niue

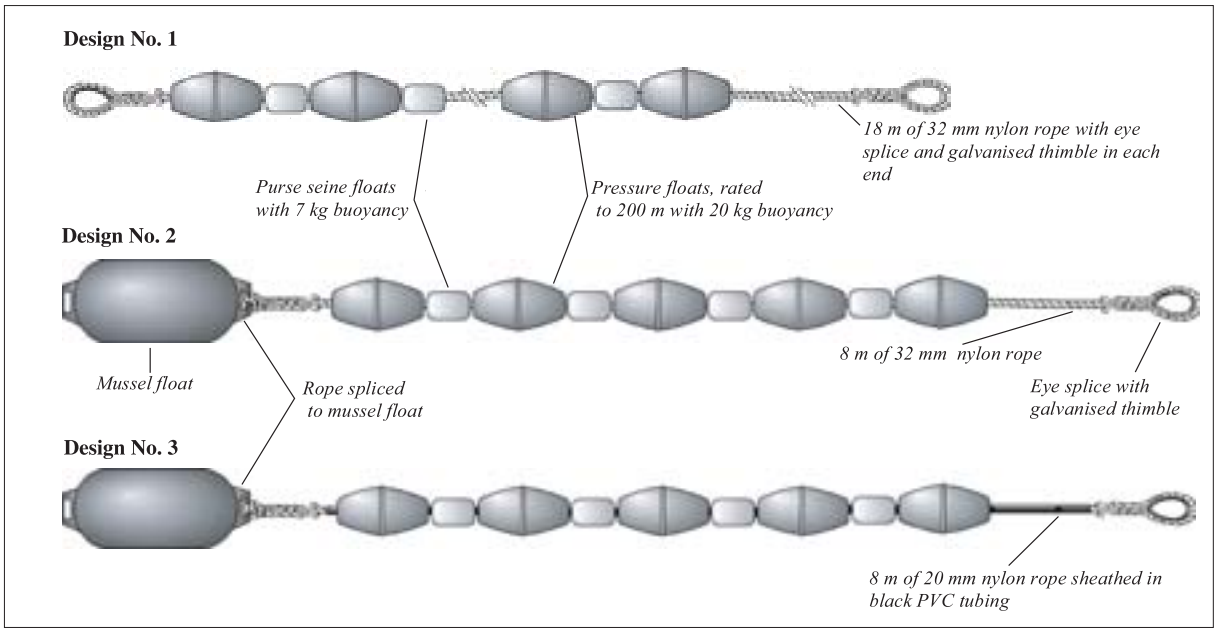


Figure 5: The three designs of FAD buoy systems used by the project

FAD designs

Three types of buoy systems were trialled on the FADs (Fig. 5). The first design used 15 pressure floats and 14 purse-seine floats threaded alternately onto an 18 m length of 32 mm diameter nylon rope with an eye splice at each end. This design was for FADs further offshore in deeper water. The second design used five pressure and four purse seine floats threaded onto eight metres of 32 mm diameter nylon rope, with an eye splice in one end of the rope while the other end was spliced directly onto a mussel float. This design was for inshore FADs so that canoe fishermen could easily find them. The third design of buoy system was very similar to the second, the only difference being the 32 mm rope was replaced with 20 mm nylon rope sheathed with black PVC tubing to protect the smaller diameter rope. Again, this design was for inshore FADs.

Table 1 shows the materials used for different FAD designs, all anchors were concrete blocks, 1.2 x 1.2 x 0.6 m or approximately two tonnes in weight.

Table 1: Summary description of the components used for rigging the project FADs

Component	Materials used
A Buoy system	One of the three buoy system designs in Figure 5 used.
B Connection of buoy system to upper mooring line	25 mm safety shackle, 19 or 22 mm swivel, 22 mm safety shackle (all galvanised) with stainless steel cotter pins and some with a No. 3 nylite rope connector
C Upper mooring line	150 m or 400 m of 9 mm galvanised wire cable with eye splice and tube thimbles each end, or 20 mm diameter nylon or polypropylene or lead-core polypropylene 3-strand rope with eye splice in one or both ends
D Connection of upper and lower mooring lines	Ropes were either spliced together or 19 or 22 mm safety shackles, 19 or 22 mm swivels, 19 or 22 mm safety shackle (all galvanised) with stainless steel cotter pins and No. 3 nylite rope connectors were used
E Lower mooring line	20 mm diameter polypropylene 3-strand rope with eye splice in one or both ends, some with either one or two 12.5 kg lift pressure floats for additional buoyancy
F Connection of lower mooring line to anchor system	No. 3 nylite rope connector, 22 mm safety shackle, 22 mm swivel, 25 mm safety shackle (all galvanised) with stainless steel cotter pins
G Anchor system	2 t concrete block (1.2 x 1.2 x 0.6 m) with 10 m of 20 mm galvanised chain or 10 m of 22 mm galvanised wire cable with eye splice and tube thimble each end and a 25 mm safety shackle

Four basic designs were used, with the main difference being the upper mooring line, which was either 9 mm galvanised wire cable, 20 mm diameter three-strand nylon rope, 20 mm diameter polypropylene rope with counterweight, or 20 mm diameter lead core polypropylene rope (Table 2). All project FADs used 20 mm diameter three-strand polypropylene rope of varying lengths for the lower mooring line.

Results to mid-June 2003

Table 3 summarises the deployment date, location of the deployment site, the depth each FAD was deployed in, the status of the FADs in May and early June, and the losses to date. Five of the original FADs deployed have been lost, from 249 to 415 days after deployment. Four of the five FADs lost were of the same design, using 9 mm galvanised wire rope on the upper mooring. One of the buoy systems with cable was recovered; the bottom eye splice had broken and was the cause of loss (Fig. 7). It is assumed that similar problems were encountered with the other three wire cable FADs that were lost. Unfortunately, two other FADs have the same wire cable, so it is expected that these may part in the near future.

The other FAD loss is attributed to the strong currents in the area of deployment and the type of buoy system used. A fisherman reported the FAD buoy system being underwater one day when he was fishing. The next day the FAD could not be located. It is assumed that the mussel float used on the buoy design imploded when the buoy system was pulled under (this is not a pressure float) and that the other floats had insufficient buoyancy to support the FAD in strong currents.

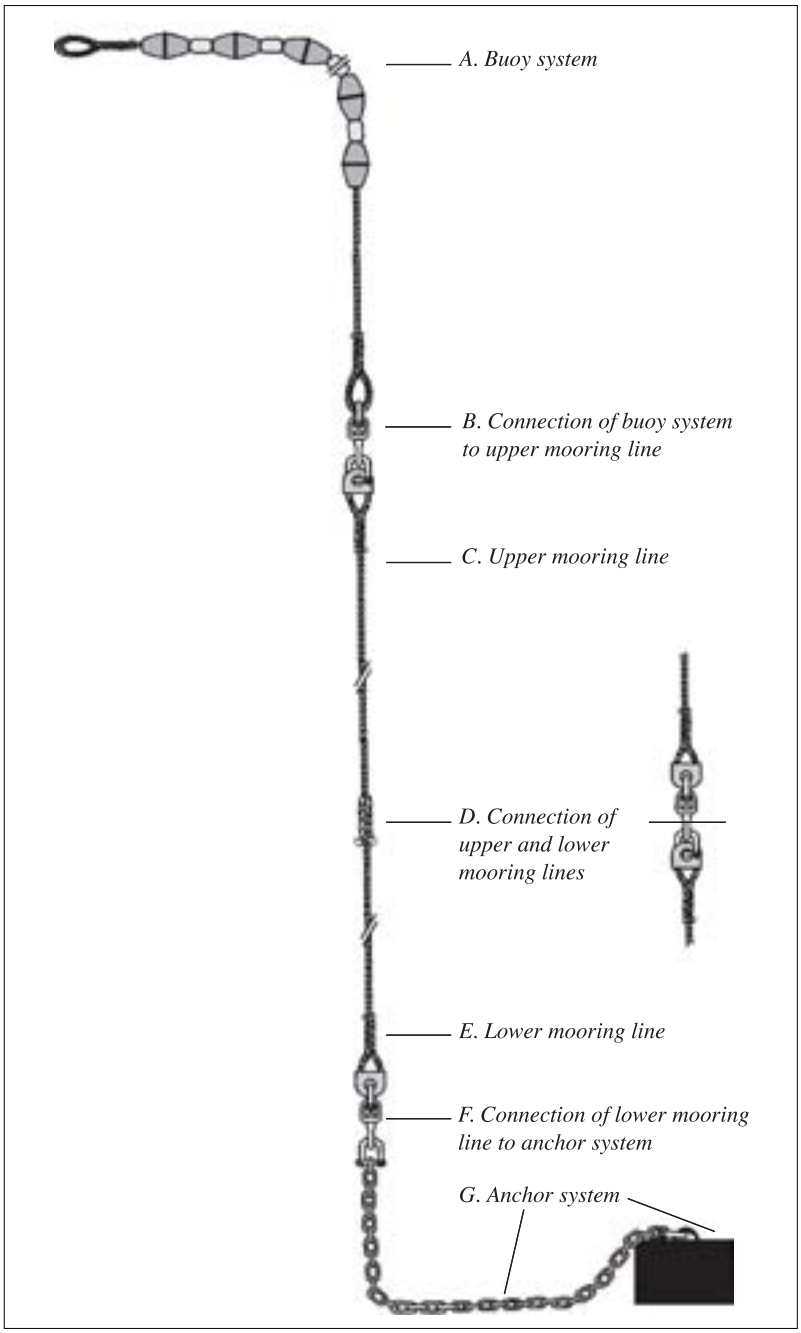


Figure 6: Components that make up the project FADs

Experimental aggregators

All project FADs have aggregators placed on them, although the length of time they last varies based on weather conditions.

A data sheet is completed during each maintenance run or trip to work on the aggregators themselves. Two main types of aggregators have been tried to date, with others being designed and implemented in June 2003.

Niue has been using a bamboo raft aggregator arrangement covered with coconut fronds for many years (Fig. 8). The raft is approximately three metres by four metres and is lashed together with purse-seine twine. Six polystyrene floats are lashed to the bamboo to give the raft

additional buoyancy. A single rope with coconut fronds attached and a weight at the bottom is also attached to the back of the raft. The raft is attached to the very end of the FAD buoy system by a 20 mm diameter polypropylene rope bridle, so it streams behind in the current. The local fishermen in Niue like this type of aggregator, and they feel it is effective in holding fish around the FAD.

The second design of aggregator used in all locations is a simple string of five polystyrene floats threaded on 10 metres of either 18 mm nylon rope or 20 mm polypropylene rope, some with PVC sheathing. The floats are spaced around two metres apart. The original designs had the floats lashed in place to stop them moving along the sheathed rope (Fig. 9), or the rope was tied with a figure of eight knot on each side of the float to stop it from moving on the rope (Fig. 10).

A compromise design has the rope tied with a figure of eight knot on each side of the float to stop it from moving, with the rope between the floats sheathed in PVC (Fig. 11). Coconut fronds and strapping materials are secured to short lengths of 10 mm diameter polypropylene rope, which are attached to the aggregator next to a float (Fig. 11).

Problems have occurred with the rope and float aggregator system tangling and bunching up, and fishermen in Niue do not think these are as effective as the bamboo rafts. At this stage though, new designs of aggregators are being trialled, and a full assessment will be made on these at the end of the project.

Table 2: Type of upper mooring line at each location (number of FADs at location)

Type of upper mooring line used	Niue	Rarotonga	Aitutaki
150 m of 9 mm galvanised wire cable (shallow-water FADs)	1	1	
400 m of 9 mm galvanised wire cable (deep-water FADs)	2	1	1
200 m of 20 mm diameter lead-core 3-strand polypropylene rope	1	1	
20 mm diameter nylon 3-strand rope (length to suit deployment depth)	3	1	1
20 mm diameter 3-strand polypropylene rope with chain counterweight	1		1

Figure 7: Splices in the 9 mm galvanised wire cable, one parted

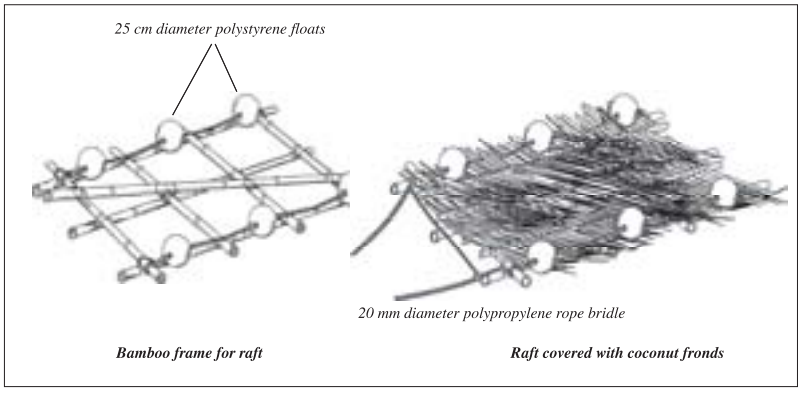


Figure 8: Bamboo raft aggregator design used in Niue

Maintenance of the FADs

A data sheet for recording maintenance activities and repairs to the FADs has been developed and implemented, and is included with the data sheet for the FAD aggregators. These two sheets are completed at the same time, as maintenance runs to the FADs generally include maintenance of both the upper mooring and the aggregators at

Table 3: FAD deployments in Niue and the Cook Islands (February to April 2002) and status of the FADs

Deployment date 2002	Area	Latitude (S)	Longitude (W)	Deployment depth (m)	Status of FAD as at June 2002
	Niue				
8 February	Lakepa	19° 00.000'	169° 47.375'	400	Lost 18/12/02 – 313 days on station
8 February	Avatele	19° 07.125'	169° 56.750'	900	08/06/03 – 485 days on station
11 February	Limufuafua	19° 11.125'	169° 51.875'	900	Lost 01/03/03 – 382 days on station
11 February	Vaiea	19° 08.875'	169° 54.125'	400	11/06/03 – 485 days on station
11 February	Halagigie	19° 04.000'	169° 59.500'	800	11/06/03 – 485 days on station
13 February	Toi 1	18° 56.725'	169° 53.025'	550	13/06/03 – 485 days on station
13 February	Toi 2	18° 56.225'	169° 52.150'	1100	13/06/03 – 485 days on station
14 February	Hikutavake	18° 57.250'	169° 55.375'	650	14/06/03 – 485 days on station
	Rarotonga				
27 March	Matavera	21° 13.000'	159° 43.000'	650	Lost 20/03/03 – 358 days on station
27 March	SE Titikaveka	21° 18.125'	159° 43.750'	1150	10/06/03 – 440 days on station
27 March	Rarotongan Hotel	21° 17.500'	159° 50.250'	1150	10/06/03 – 440 days on station
27 March	N of Black Rock	21° 10.875'	159° 48.250'	550	10/06/03 – 440 days on station
	Aitutaki				
5 April	W of Maina	18° 56.000'	159° 52.625'	950	10/06/03 – 431 days on station
5 April	SE of Motukitiu	18° 59.500'	159° 42.000'	1030	Lost 25/05/03 – 415 days on station
5 April	N of Arutanga	18° 48.500'	159° 47.500'	960	Lost 10/12/02 – 249 days on station

the same time. Maintenance is scheduled for every one to two months. However, adverse weather conditions have made it very difficult to stick to a regular schedule. In fact, several of the FADs on the weather side of an island have only been checked a couple of times in the first 16 months. Records to date show that some wear is occurring in the upper hardware connections, and these parts will be replaced in the near future.

The marker flagpole and light system is an area that needs to be examined closely, as these are being lost or the flagpoles are breaking off in rough weather. These systems have been replaced on several FADs, with the batteries changed regularly in the strobe light to assist fishermen in locating the FADs in the early morning. The project will look more closely at the design of the flagpole and light arrangement over the next 12 months.

Figure 9: Aggregator buoy system with floats lashed in position

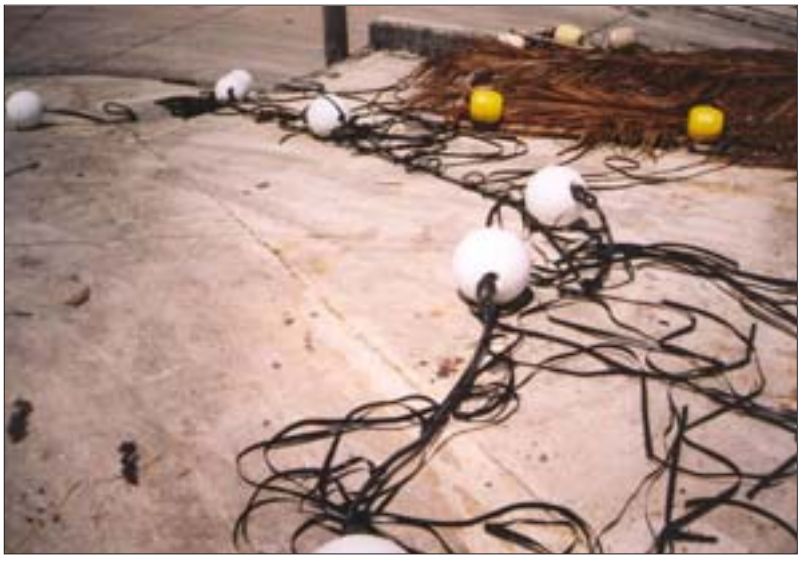


Figure 10: Aggregator buoy system with figure of eight knots used to position floats

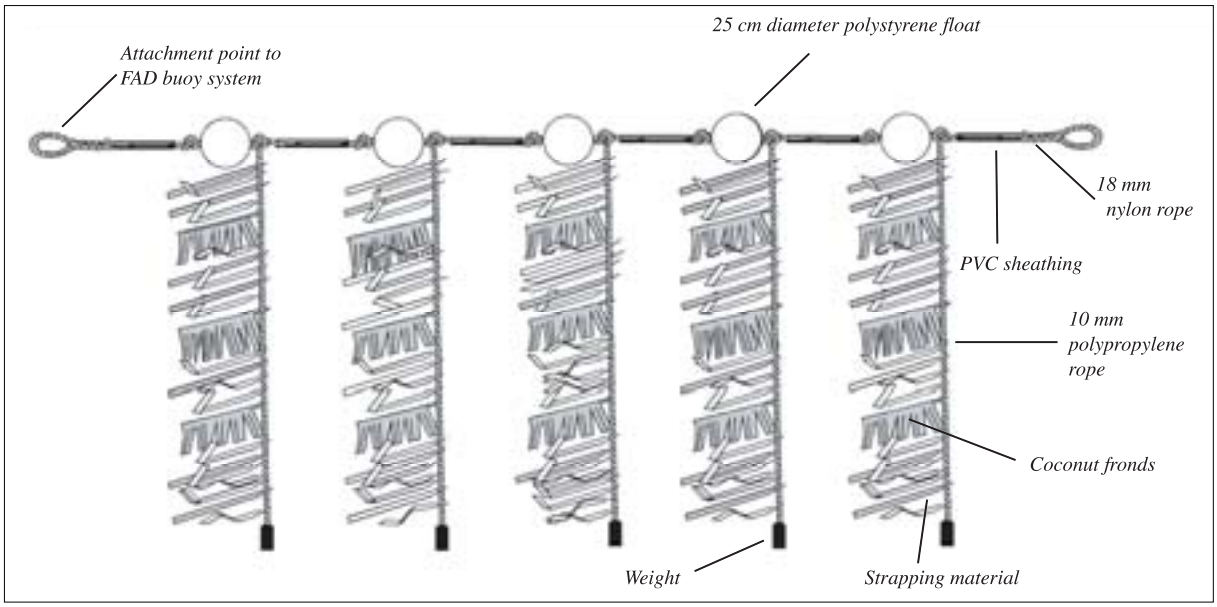


Figure 11: Rope and polystyrene float aggregator being trialled

Costing of the FADs

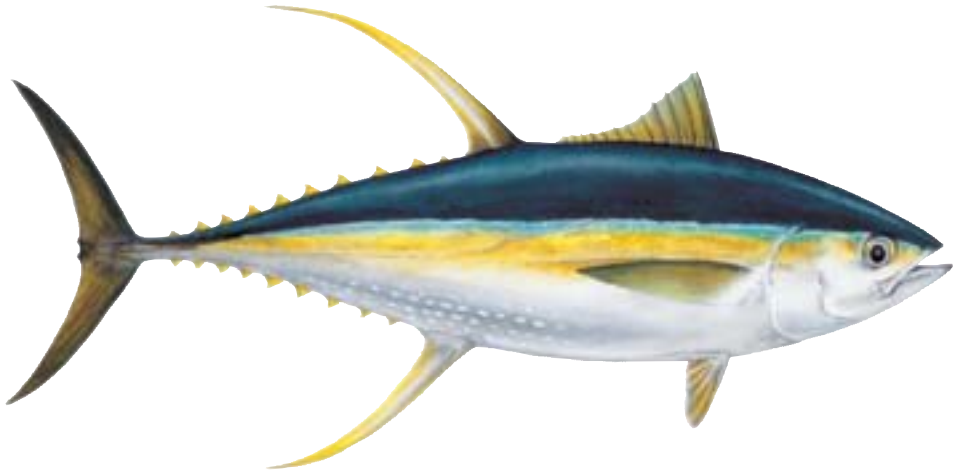
One of the objectives of this project is to develop a more cost-effective FAD mooring design with an average lifespan of at least two years, while reducing costs to a target level of NZD 4500 for deep-water FADs (1000 m depth) and NZD 3000 for shallow-water FADs (300 m depth). Table 4 summarises the cost of each of the 15 FADs deployed to date.

Table 4: Summary of costs for each or the project FADs in New Zealand dollars

Location (depth in metres)	Cost of components (NZD)							
	Buoy system	Mooring system	Anchor block	Sub-total	Freight costs	Sub-total	Deployment costs	Total cost
Niue - shallow								
Lakepa (400)	743	1386	400	2529	520	3049	350	3399
Vaiea (400)	707	1357	400	2464	520	2984	350	3334
Toi No. 1 (550)	743	1469	400	2612	520	3132	350	3482
Sub-total	2193	4212	1200	7605	1560	9165	1050	10,215
Cooks - shallow								
Black Rock (Rar -550)	707	1615	400	2722	430	3152	800	3952
Matavera (Rar - 650)	692	1624	400	2716	430	3146	800	3946
Sub-total	1399	3239	800	5438	860	6298	1600	7898
Total - shallow FADs	**3592**	**7451**	**2000**	**13,043**	**2420**	**15,463**	**2650**	**18,113**
Niue - deep								
Avatele (900)	1377	2105	400	3882	520	4402	350	4752
Limufuafua (900)	1377	2255	400	4032	520	4552	350	4902
Halagigie (800)	1377	1967	400	3744	520	4264	350	4614
Toi No. 2 (1100)	1377	2389	400	4166	520	4686	350	5036
Hikutavake (650)	1377	1889	400	3666	520	4186	350	4536
Sub-total	6885	10,605	2000	19,490	2600	22,090	1750	23,840
Cooks - deep								
Raro. Hotel (Rar - 1150)	1377	2572	400	4349	430	4779	800	5579
Titikaveka (Rar - 1150)	1377	2413	400	4190	430	4620	800	5420
Maina (Aitu - 950)	1377	2199	400	3976	650	4626	150	4776
Motukitiu (Aitu - 1030)	1326	2310	400	4036	650	4686	150	4836
Arutanga (Aitu - 960)	717	2150	400	3267	650	3917	150	4067
Sub-total	6174	11,644	2000	19,818	2810	22,628	2050	24,678
Total - deep FADs	**13,059**	**22,249**	**4000**	**39,308**	**5410**	**44,718**	**3800**	**48,518**
Total FAD costs	**16,651**	**29,700**	**6000**	**52,351**	**7830**	**60,181**	**6450**	**66,631**

One problem that has been encountered in the costing of FADs is actually defining what are the FAD costs? Should deployment costs, the anchor costs, or even the cost of freight on materials be considered actual FAD costs? These can vary quite considerably from location to location. Table 4 splits up the component costs to give a better understanding of where the costs are incurred. However, for this project the FAD costs are considered to be all but the deployment cost. This has been excluded as the cost varied so much between locations, from NZD 150 per deployment at Aitutaki to NZD 800 per deployment at Rarotonga. Note that the maintenance costs have not been included, as the data are incomplete at present. Maintenance costs are considered additional to the actual FAD cost, as these will vary greatly by location and the frequency of the servicing.

The average cost of a shallow-water FAD excluding deployment costs was NZD 3093 (NZD 15,463/5=NZD 3093). This meets the project's objective to reduce costs of FADs to around NZD 3000 per unit, especially given that most FADs were deployed in water deeper that 300 m. The cost of the deep-water FADs excluding deployment costs averaged NZ 4472 (NZD 44,718), which also meets the target cost of NZD 4500. The next test will be the "at least two-year average lifespan" part of the objective; to evaluate which of the new design FADs are cost-effective.



AQUACULTURE UPDATE FOR VANUATU

Up to now, the aquaculture sector in Vanuatu has had a relatively low profile. With recent developments aquaculture may be poised to deliver both extensive farming programmes that will benefit Vanuatu rural areas and also intensive culture programmes of national economic significance. SPC Aquaculture Adviser Ben Ponia recently visited the country and reports on the current status of developments.

by Ben Ponia,
Aquaculture Adviser
SPC, Noumea
New Caledonia

Vanuatu is composed of more than 80 islands arranged in a Y-shaped chain, with a land mass of 12,200 km^2. The islands are mountainous, of volcanic origin with a narrow coastal plain. The main island is Efate where the capital Port Vila is located. The country has a population of 196,000.

The history of aquaculture has been a sporadic development. The farming of Pacific oyster (*Crassostrea gigas*) was attempted in the early 1970s. Experimental culture of *Macrobrachium rosenbergii* was also carried out on Efate Island but was not continued.

The Fisheries department (under the Ministry of Agriculture, Forestry, Fisheries, Quarantine and Inspection Services) is the main agency responsible for aquaculture developments in Vanuatu. The research section based at its headquarters in Port Vila is the aquaculture focal point. Its staff oversee research and pilot trials. Another important section is the extension service, which has staff based in four main provinces. The extension officers have a lot of experience and are very good at focusing on practical outcomes. The Japanese government is also providing some technical assistance with a volunteer for green snail and trochus hatchery spawning in Port Vila and another volunteer on Malakula Island for seaweed farming.

Alongside the Fisheries department are the Quarantine and Environment departments, which also have important roles to play in terms of aquaculture development.

The Quarantine department is responsible for ensuring safe practices in bringing in livestock and the certification of food exports. Like many such departments in the region, there is not a lot of capacity for dealing with aquatic animals, but the department is interested in addressing this gap.

One of the important roles of the Environment department is as the CITES management authority. It issues CITES permits for export, particularly focusing on the ornamental trade. The government has put a ban on *Tridacna crocea* clam exports because the harvest levels were considered by Environment and Fisheries as unsustainable. The Environment department would like to see more aquaculture in the aquarium trade to substitute for harvesting from the wild. Consistent with this, Fisheries has developed a five-year plan to phase in cultured animals.

Seaweed (Kappaphycus *sp.*)

Kappaphycus seaweed (Euchema) is a commodity with potential for coastal inhabitants, particularly on the outer islands where there are fewer opportunities for cash income. Fisheries staff have already conducted extensive growth trials throughout Vanuatu's islands, particularly on Efate, Malekula and Santo. Research and extension staff have a high degree of technical competence and are able to expand seaweed production to commercial levels when necessary. However, Fisheries has resolved not to commit to scal-

Pannangisu village in North Efate. A site where the Fisheries department has conducted seaweed farming trials

ing up production to commercial levels until a stable buyer or market is in place.

One way to view the attractiveness of seaweed for village communities is to look at it as a substitute for copra, or as a commodity that can integrate with the copra marketing network already in place. Currently copra is purchased at a subsidised price somewhere in the range of VUV (Vatu) 15,000–25,000 per tonne. This is compared to about VUV 40,000 per tonne currently paid for seaweed (unsubsidised) in Kiribati, Fiji Islands and Solomon Islands.

At Pannangisu village in northern Efate, SPC Aquaculture Adviser Ben Ponia took part in a village meeting to review the potential of seaweed as a substitute for copra. The common view was that the current price of copra of about VUV 25,000 per tonne was no longer attractive, but a price range of VUV 40,000–60,000 per tonne would rekindle interest. This is in the upper price range of seaweed. However, given that seaweed farming requires less inputs than copra, according to our back-of-the-envelope economics, seaweed could be a viable proposition. Villagers did not see any cultural or social barriers to seaweed farming and thought women would be good seaweed farmers. One possible hurdle is that there is limited access to the micro-financing of VUV 10,000–20,000 that would be required to start up a seaweed farm.

Trochus

Trochus is a valuable source of cash to coastal villagers. It is worth around VUV 400 per kg. Green snail is another highly valued mother-of-pearl ornamental shell. It sells at VUV 1700 per kg.

Batches of trochus for seeding are raised periodically at the Fisheries hatchery in Port Vila. Currently, there about 2 million juveniles in the nursery raceways. A Japanese aquaculture volunteer is based at the Fisheries hatchery to assist with spawning the green snail.

At the time of Ben's visit, Fisheries staff had just returned from seeding trochus broodstock on Malakula, Pentecost and Tanna islands under an ACIAR-funded project. One of the advantages of restocking broodstock instead of using hatchery juveniles is that the offspring from broodstock in the wild have a thicker shell and better survival rates compared to the hatchery juveniles. Research conducted on juvenile grow-out has shown that floating cages produced high survival rates compared to benthic cages, although the benthic cages had better growth rates.

In 2000, 30 tonnes of trochus button blanks and 43 tonnes of trochus scraps were exported, worth about VUV 31 million. In 2001 the export volume was 31 and 57 tonnes respectively, worth at total of VUV 79 million.

Currently the country is experiencing problems with supply of trochus, partially due to unsynchronised harvest moratoriums and overfishing. In 2002, trochus had to be imported from Australia to make up tonnage. The shortage of trochus is reflected in the decline in the number of button factories in the country. At its peak there were four button factories operating but now there are just one or two factories.

Hong Shell Products trochus button factory

The Hong Shell Products factory is an affiliate of a large Asian company. The manager of the factory explained that with less trochus being harvested the factory is looking for alternative sources of mother of pearl. The turban shell (*Turbo sestus*) and large pen shell (*Penna* spp.) are several alternative species being processed. The company is interested in finding sources of mother-of-pearl outside of Vanuatu, for example pearl shell from Pacific countries with a pearl culture industry.

Hong Shell trochus button factory

Freshwater shrimp and marine prawns

There has been a lot interest from the public in farming freshwater shrimp, particularly the Macrobrachium species. The Fisheries department plans to establish a trial farm and a demonstration site for shrimp farming in the near future.

The domestic prices for shrimp are good. The local freshwater shrimps, the Pacific shrimp [FAO: Monkey river prawn] *Macrobrachium lar*, are sold domestically at VUV 1200 per kg while imported marine prawns retail between VUV 2600 and VUV 4500 per kg. In some places, taro farming in the swamps is integrated with shrimp farming. The harvests have reportedly been quite successful.

The Pacific shrimp is widespread. Fisheries extension officers identified 11 islands where it is found, and that have locations where it could be farmed. During a visit to a proposed shrimp farm site in the middle of Efate Island, Ben saw a 15 cm adult among the shrimp traps, not an uncommon size he was told. Since the Pacific shrimp is reputedly plentiful and a good prospect for aquaculture, a good research project would be to undertake some farming trials to assess the basic biological characteristics such as growth rates, stocking densities and feed requirements.

The Fisheries department is also interested in revitalising its *M. rosenbergii* programme. Two fisheries officers Felix N'guyen and Sompert Gerava, recently participated in a training attachment to Fiji where they were able to successfully hatchery rear this species. Since his return Felix has been seeking support for Fisheries to conduct pilot trials.

Fully grown Pacific shrimp (*Macrobrachium lar*) caught in the wild

Teouma Prawns

Teouma Prawns is a partnership between several prominent local businessmen. One of the partners, Robert Monovisin, is involved in cattle farming and heavy industrial engineering works. A second member has experience with farming tilapia in China. The technical partner is David Challenger, who owned a *Penaeus monodon* prawn farm in Solomon Islands.

The area put aside for prawn farming covers 70 hectares of land previously used for cattle pasture. The site can be viewed from the main highway where it begins and extends as far as the coastline. Farm construction began six months ago with an investment of VUV 250 million budgeted for. Already 12 hectares of ponds have been dug with a full time gang of workers and heavy equipment excavating on site. A lot of engineering works have been completed to create the necessary inlets and channels and a large reservoir for the water requirements. On the coast, a prawn hatchery has been built to supply post-larvae. Other infrastructure constructed includes large sheds for mechanical equipment, maintenance, storage and food processing.

The company is willing to sell post-larvae from its hatchery to support local interests who wish to set up their own farms. If developments stay on schedule the farm could be exporting by next year. The Teouma Prawns annual production farm is targeted at 6–10 tonnes of prawns per hectare. This would probably make it Vanuatu's most valuable fisheries export. It is estimated that about 50 local workers will be employed on the farm.

The prawn farm also plans to integrate itself with tilapia fish farming using the water discharge system. This will be a good source of cheap fresh fish for Vanuatu (since reef fish is scarce and expensive). In Fiji about one to two tonnes of tilapia are sold per week on the local market.

Fish farming

Like most of the Pacific, fresh reef fish at the local market is expensive. Cheap imported tinned fish is often more commonly consumed. According to Fisheries, the reasons fresh fish is

not readily available are because at some localities (and islands) the wild stocks are naturally low and in addition only a small portion of the population has access to motorised boats to travel to fishing grounds. Hence fish farming is considered as an alternative and there are regular enquires from the public to Fisheries for assistance. Islands such as Tanna, with its inland lakes, or Santo, which has an abundance of fresh water, are considered by Fisheries as some of the sites suitable for fish aquaculture.

One possible obstacle is the Mozambique tilapia, which was introduced to Vanuatu for mosquito control. This species is now widespread. Because it is such a prolific breeder and omnivorous feeder it could compete with fish aquaculture. The Fisheries department has expressed interest in other types of tilapia such as the GIFT strain, which is a much faster growing species and more suitable for aquaculture then the Mozambique tilapia.

On Santo Island Ben accompanied Clen Alo, the fisheries extension officer, to a number of prospective sites for fish and shrimp farming. Nampauk village was one of the sites visited and typical of the village setting in Santo, with traditional lifestyles still being maintained. Because the village was located quite far inland and unable to go fishing regularly, there was a lot of interest in farming fish. Using their initiative the village were constructing ponds for fish farming amongst the taro swamps in the valley nearby. A total of fifteen ponds were planned. However, the fish that had been trapped from the coast and stocked in a small isolated pond nearby was the Mozambique tilapia.

Fortunately the fish had not been released into the main ponds, so after explaining the pest characteristics of this particular tilapia it was agreed that it was better to destroy them rather then have them contaminate the swamps. In the interim it was suggested to do some trial culture of the local shrimp instead. The lesson learnt from this was the need for Fisheries and SPC to proactively assist in fish stocking programmes at the village level to ensure that, mistakes are not unwittingly made which may jeopardise future fish farming efforts.

From the road's end we were able to view extensive mountainous terrain where remote hill tribes lived. Clem reported that Fisheries had recently learnt that for a number of years the hill tribes had been experimenting with fish farming and that it was becoming a common practice amongst some tribes. The details were sketchy but it is thought the fish is a mullet species that is being restocked from juvenile phase. It was a member of the hill tribes passing through Nampauk village who sowed the idea of fish farming in the village.

Tridacna crocea *in the Fisheries giant clam hatchery*

Marine ornamentals

Although some small-scale hatchery rearing of giant clams is occurring, most of the ornamental trade is based on the wild fishery. Concern over the impact on the *Tridacna crocea* stocks has led the government to declare a ban on the harvest of this species. Along with giant clams, cultured coral and live rock are exported. Some exports figures for the ornamental trade are shown in table below.

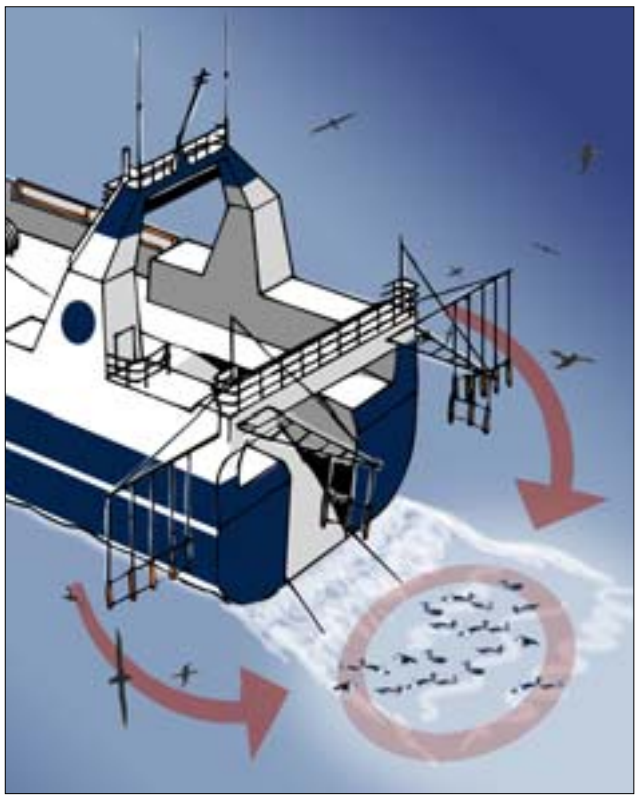
	2000 Qty	2001 Qty
Cultured coral	275 pieces	6,737 pieces
Live rock	13,710 pieces	19,195 kg
Giant Clam		10,008 pieces
T. crocea	113,940 pieces	
T. maxima	4,825 pieces	
T. squamosa	1,402 pieces	

CONSERVATION THROUGH COOPERATION — THE SEABIRD BYCATCH ISSUE IN NEW ZEALAND

by Alec Woods,
New Zealand
School of Fisheries

Over the last year, an alliance of fishing industry groups, government agencies, environmental organisations and other interested parties under the name of Southern Seabird Solutions, has been the guiding force behind a quiet revolution to reduce seabird bycatch in the trawl and longline fisheries. While companies such as Solander Fisheries, Sanford and Sealord have been active for years in seeking to reduce incidental seabird capture, these and other stakeholders now realise that not only does New Zealand need to develop its own mitigation measures, it also needs to share these models with the international fishing community.

New Zealand and its offshore islands can rightly lay claim to being the albatross and petrel capital of the world. The waters and offshore islands support more species of these global travellers than anywhere else in the world, yet here lies the problem. Although these birds breed in New Zealand waters, they spend much of their lives in other parts of the world. Albatrosses and petrels have learned to follow fishing vessels for food, unaware of the risks of becoming caught on baited hooks or entangled in fishing gear. They may accidentally be caught by any vessel, anywhere, that does not use seabird-safe fishing practices.



Recently, "bird baffers" were installed on hoki trawlers in order to reduce seabird interaction in this fishery

For this reason, Southern Seabird Solutions believes that cooperative, international programmes to reduce the number of seabirds caught during the course of fishing is the most effective way of conserving these species. Believing that best practice must start at home, New Zealand fishing companies have been encouraging their fishermen to develop mitigation methods. As John Bennett, longliner skipper with Sanford Ltd comments, "There is no single solution to seabird mitigation, as each species, in different areas, behaves differently at various times of the day and year. It's important to recognise and understand this." Bennett believes a vessel must have and use a range of mitigation techniques and that should be developed and fine-tuned daily. The best mitigation device, he believes, is a "can do" attitude.

The best person to convince a fisherman to change his ways is another fisherman. Not only does Southern Seabird Solutions champion fishers who are leaders and innovators in mitigation techniques, it is currently implementing a range of projects that it believes will make a difference. Two "sister ship" programmes are in the planning stage. New Zealand crew will be exchanged with crew from South Africa and Chile so that practices to reduce seabird capture are shared with nations fishing within the foraging range of New Zealand seabird species. The Regional Fishers Forum is being promoted as a

means of encouraging "fisher to fisher" dialogue, along the lines of the International Fishers Forum, (www.fishersforum.org). The multi-stakeholder alliance model, which has been such a success in New Zealand, is being exported to other interested countries and shows promise as a tool to meet further seafood industry challenges.

In both Australia and New Zealand, Seabird/Fisheries Advisory Officers are working alongside skippers and crew to promote awareness and seek new ways of avoiding seabird capture. A capsule-setting device, invented by New Zealand fisher, Dave Kellian, and which can set baited hooks 10 metres under water, is currently being trialled in Australia. A video about Southern Ocean seabirds and the threats they face from accidental capture in the course of fishing, is being produced in both English and Spanish. Although the video will feature interviews with New Zealand skippers, and highlight the methods they use, it will also emphasise that New Zealand does not have all the solutions. Hopefully it will encourage fishers in southern American and African waters, where New Zealand albatrosses and petrels spend so much of their time, to seek effective ways to reduce seabird bycatch in their own fisheries.

Fishing industry trainers met recently in Wellington to develop effective strategies for training vessel crew as well as new recruits to the industry. They have been training vessel crew, briefing them on the Codes of Practice for specific fisheries, and encouraging them to find their own solutions to the seabird bycatch problem. An integrated line-weighting trial, funded by the International Association of Antarctic Tour Operators, was successfully run last year. The trial is a model for the sort of "win-win" partnership that will hopefully go towards reducing seabird bycatch. Recently, "bird bafflers" were installed on hoki trawlers in order to reduce seabird interaction in this fishery. These strategies represent a general overview of the measures being taken to find a solution to the seabird bycatch problem.

Southern Seabird Solutions' experience has highlighted the need for fishers worldwide to take responsibility for developing a range of mitigation measures that are effective. The New Zealand experience shows that responsible fishing is the key. By providing a vessel that is professionally managed and operated, the unintentional capture of seabirds is a problem that can be resolved.

New ways of avoiding seabird capture are being trialled in both Australia and New Zealand

SPC/NELSON COURSE FRESHENED UP

by Michel Blanc,
Fisheries Education and Training Adviser
SPC, Noumea
New Caledonia

The SPC/Nelson Polytechnic Pacific Island Fisheries Officers Training Course was initiated in 1979 in response to a request from island governments for additional training opportunities for Pacific Islands fisheries extension workers. The course was designed to provide selected Pacific Islanders with extensive practical training in a variety of fisheries skills and knowledge. Between 1979 and 2002, 23 successful training courses were carried out and 275 Pacific Islanders from 18 countries and territories of the region were trained at the New Zealand School of Fisheries in Nelson.

The training was initially intended to provide the practical fisheries skills necessary to operate a small fish-receiving station or remote extension centre, especially on outer islands. In its more than 20-year history, the course has gone through a number of relatively minor changes driven primarily by directions received from the annual Heads of Fisheries Meeting (formerly the Regional Technical Meeting on Fisheries, RTMF).

2002 course review and its findings

Fisheries in the Pacific have undergone a number of major changes over the last two decades with the development of subsistence, artisanal and industrial sectors. Although "fine tuning" of the course has occurred during this period, a comprehensive review of the training programme was considered essential. This review took place during the second half of 2002. An external consultant was contracted by SPC to visit several countries and territories and canvass the opinions of senior fisheries personnel and past course participants. The consultant's report was finalised in December 2002 and presented with SPC's response at the recent Heads of Fisheries Meeting. Both documents are available on the SPC website at:

http://www.spc.int/coastfish/Sections/training/FTS_pages/workplan_and_reports.htm

The 2003 Heads of Fisheries Meeting endorsed the findings of the review and SPC's response, and made the following observations:

> The value of the regional six-month SPC Fisheries Officers Course as an intensive programme of training in practical topical issues for addressing the needs of Pacific Islands fisheries officers was acknowledged.
>
> The theoretical component of the course should continue to be delivered at an overseas institution. In addition, regional heads of fisheries suggested that, given the uncertainty of funding and the need to maintain momentum, the New Zealand School of Fisheries should implement recommended changes to the syllabus and deliver the course for a further cycle.
>
> The practical fishing component should continue to be run in New Caledonia and topics offered should be broadened in scope to make full use of SPC fisheries programmes and other institutions available in New Caledonia.
>
> SPC and the New Zealand School of Fisheries should explore mechanisms for the formal accreditation of the course and its linking with higher level diploma and degree courses from the University of the South Pacific and other institutions.

The New Zealand School of Fisheries is located in Nelson, New Zealand. The picture shows the facilities of Nelson harbour

The course should be realigned more towards sustainable fisheries management and industry development, while maintaining key elements of existing practical training.

While the course would remain a broad-ranging introduction to fisheries, its entry requirements should be raised to include one or two years of relevant fisheries experience.

After being put on hold in 2003 to allow for the course review and its endorsement by Heads of Fisheries, the new training programme will be offered by SPC and the New Zealand School of Fisheries early in 2004. Certain aspects of the course (notably its syllabus) will be quite different from the training programme that had been run until 2002. Some of the important changes are summarised below.

Funding

This course has traditionally been supported by the government of New Zealand, the Commonwealth Secretariat, the Commonwealth Foundation, the Secretariat of the Pacific Community and, more recently, by the government of New Caledonia. Despite the range of donors contributing to the course budget, securing the funding for this major training programme has always been a concern. In 1997, following a recommendation by the Regional Technical Meeting on Fisheries, a course fee of USD 2380 to be paid by the nominating country was introduced.

The changes made to the course (introduction of new modules, duration increased by one week) mean an increase in the overall course budget. Compounding this, the recent decision by the Commonwealth Foundation to stop sponsoring the course will make the financial management of the proposed new training programme very difficult. As a consequence, the course fee to be paid by participating countries and territories has been increased to USD 3000 per trainee.

Course objective

The new objective of the course is to provide broad-ranging training to Pacific Islands fisheries officers to enable them to assist fishing communities and fishing enterprises to develop sustainable and profitable fishing operations.

Target group and selection criteria

The course is now specifically targeting Pacific Islands government fisheries officers. It is felt that trainees with a previous exposure to national fisheries issues will benefit better from the training than totally new recruits. The 2002 course review, endorsed by the August 2003 Heads of Fisheries meeting, has recommended a slight elevation of entry requirements to include a one to two year fisheries experience. As the course is conducted entirely in English, including written and oral assessments, it is essential that the participants have a very good command of English to fully benefit from the course. It is also important that nominated candidates be between 20 and 35 years of age. The accommodation provided during both the Nelson and New Caledonia components is suitable for female participants (single rooms with separate bathrooms for men and women).

Course outline

Introduction and orientation: Familiarisation with the trainee's new environment (7 hours)

Extension and communication: Role of fisheries extension officers and skills to assist with the planning and delivery of extension services (35 hours)

Navigation and chartwork: To a standard required for taking a small boat on coastal and short inter-island passages (35 hours)

Practical netting and seamanship: Rope types, common knots (with nylon monofilament and rope), 3-strand rope splicing, other essential seamanship skills, net repair (35 hours)

Marine electronics: Familiarisation with modern electronic equipment used at sea (radar, echo sounder, GPS, VMS), NZ Restricted Radio Operator's Certificate (24.5 hours)

Safety and survival at sea: Short course to expose the participants to all aspects of safety and survival at sea including firefighting (35 hours)

Outboard repair and maintenance: Introduction to the operation of small outboard engines, troubleshooting, maintenance and repairs (35 hours)

Seafood safety and quality management: The basics of fish spoilage, seafood quality, preservation methods (chilling, freezing, salting, smoking and drying). Introduction to HACCP hazard management principles and requirements, product development and process control. Structured factory visits (42 hours)

Vessel construction and safety management: Types of fishing vessels and construction

methods in the Pacific region. Safety management systems and safe operational plans. Structured port visits (21 hours)

Business management: The economics of operating a small fishing venture. Simple record keeping and analysis. Financial services available to commercial fishing operations (21 hours)

Report writing: Instruction on how to structure and prepare reports. A country project report and an end-of-course report will be written. Private study using reference materials from the school's library is possible (40 hours)

Computers: Introduction to computers, word processing, spreadsheets and databases (56 hours)

Fisheries science (**NEW**): Introduction to oceanography, marine ecosystems and their threats, marine biology (main groups of marine organisms) (56 hours)

Aquaculture (**NEW**): Introduction to aquaculture farming techniques, farm infrastructures, water quality and common diseases (35 hours)

Pacific fisheries (**NEW**): Overview of Pacific fisheries and their importance (21 hours)

Fisheries management (**NEW**): Objectives and different types of fisheries management, fisheries regulations and their enforcement, importance of data collection and analysis, fisheries management in the Pacific (42 hours)

Observers (**NEW**): Workshop on the role and importance of observer and port sampling programmes in the Pacific (35 hours)

Learning reviews: End-of-week sessions to consolidate learning outcomes (18 hours)

Practical netting and seamanship, including rope splicing, are one of the components of the Nelson Course curriculum

Field component: Two-week exposure to SPC fisheries programmes and projects followed by four weeks of practical fishing experience (longlining, bottom fishing, trolling, catch processing and marketing) (210 hours)

Dates and venue

The 18-week core course will be held at the New Zealand School of Fisheries, Nelson Marlborough Institute of Technology, from Monday 26 January to Friday 28 May 2004. This will be followed by a 6-week field component in Noumea and Koumac, New Caledonia, from Monday 31 May to Friday 9 July 2004.

Original text: English

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