



# Fisheries

## Newsletter

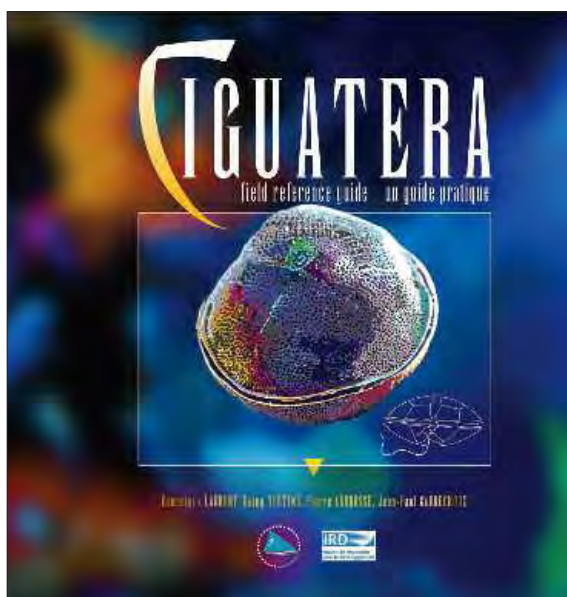
Number 115 (October – December 2005)

## Editorial

Welcome to the latest issue of the SPC Fisheries Newsletter for 2005. One of the highlights of the last quarter has been the publication of the long-awaited book on ciguatera fish poisoning, "Ciguatera, a Field Reference Guide".

Acknowledging the importance of this issue to Pacific Island communities, the Secretariat of the Pacific Community and the Institute of Research for Development (IRD) decided to jointly produce a field guide reviewing the current knowledge on the matter. It is hoped that this joint effort between the two organisations will enable fisheries managers in the region to better understand the causes of ciguatera fish poisoning and manage the problem, learning to live with the risk while reducing it to the absolute minimum.

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The book is divided into two chapters that  
1) address the theoretical aspects of ciguatera  
and its consequences, highlighting the use of  
traditional remedies in the South Pacific, and  
2) explain how to assess and reduce the risk of  
ciguatera poisoning by introducing monitoring  
measures amongst other things.



SECRETARIAT OF THE PACIFIC COMMUNITY

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## ■ FISHERIES DEVELOPMENT SECTION

### Technical assistance provided to the National Fisheries College in Kavieng, PNG

Fisheries Development Officer, William Sokimi, continued his work with the National Fisheries College (NFC) and the Asian Development Bank (ADB) loan-funded Community Fisheries Management and Development Project (CFMDP). At NFC, William worked on implementing a Certificate in Fishing Operations 3 (CFO 3) course, and assisted with several other programmes scheduled to be implemented with the CFO 3 course. These included two European Union Integrated Fishing Group Training (EU-IFGT) courses and an EU-Masterfisherman's course. Baiting assignments, using "bouke-ami" and "basnig" type methods, were also undertaken as part of the NFC fishing methods enhancement exercise for community development. Work with the CFMDP involved rigging and deploying five shallow-water fish aggregating devices (FADs).

#### *Certificate in Fishing Operations (CFO) 3 course*

William's work at NFC mainly focussed on implementing the CFO 3 course to ensure it was appropriately conducted and that assessments and standards were maintained at the level required for national development. The CFO 3 course trains qualified skippers for the fishing industry, keeping them abreast of industrial development manning requirements as approved by the PNG Department of Transport Maritime section in compliance with the International Maritime Organization (IMO) Standards of Training, Certification and Watchkeeping (STCW) 1978 convention. The course is the college's most advanced stage of the vessel operators programme, and focuses on equip-

ping students with the skills required to command a 40-m fishing vessel in PNG waters.

Because this was the first CFO 3 course to be implemented, only seven students were enrolled in order to enable the four teaching staff to improve delivery of the course modules, and to better organise the overall structure for future courses. An oral examination carried out at the end of the course by an independent consultant examiner, Mr Simon Reid, revealed that students did not have the required skills to be skippers of 40-m vessels. Six of the students were issued attendance certificates and were advised to repeat the CFO 3 course the following year to obtain the Certificate of Competency level required. (The seventh student was expelled from the course.)

A moderation exercise for all CFO courses was carried out during the last phases of the CFO 3 course by Mr Grant Carnie of the Australian Fisheries Academy. Mr Carnie identified several deficiencies in the three CFO courses. These mainly concerned the elimination of slight inconsistencies in course preparation, authentication of sea-time, selection of appropriately qualified candidates, record keeping, delivery strategies and incompatible assessment methods.

#### *European Union (EU) – Integrated Fishing Group Training (IFGT) courses*

The CFO section at NFC was tasked with running the IFGT courses requested by the EU – Rural Coastal Fisheries Development Project (RCFDP). These courses were run around the same time as the CFO 3 course.

One IFGT course was programmed for delivery in Port Moresby while another was conducted in Kavieng.

The IFGT courses assisted recipients in acquiring the necessary fishing skills to set up a viable and sustainable fishing operation immediately after receiving their fishing assets from the RCFDP project. This loan scheme was meant to help loan recipients while they familiarised themselves with handling their new vessels and acquired new fishing skills. The college's Small Fishing Operations (SFO) course was tailored to meet the EU requirements whereby loan recipients carried out actual fishing trips as part of their familiarisation training and had an extra week fishing so that at the end of the course they had the capital to continue with their fishing business.

The IFGT courses emphasised:

- 1) safe boat operations using safe operations plans;
- 2) safety and gears checklists;
- 3) on-board hygiene and proper handling of catch;
- 4) basic post harvest knowledge;
- 5) operations, maintenance and trouble shooting propulsion systems for outboard engines or small diesel engines;
- 6) keeping log records of catches and fishing areas; and
- 7) basic small fishing business management principles.

William monitored the delivery of this course by the NFC tutors, plus assisted with fishing trials of new lift nets described below.

### *EU-Masterfisherman course*

The groups of fishermen who were the initial loan recipients of the EU-RCFDP were selected as prime candidates for the first EU-Masterfisherman course, since they had improved their fishing operations and developed their own fishing experiences using the vessels and fishing gears issued under the loan scheme. The EU-RCFDP management team considered it to be a strategic move to train this pool of fishermen to a "Masterfisherman" level, because the fishermen would then be able to assist and oversee the performance of all new and recurrent EU loan recipients. These masterfishermen would provide assistance and oversight in sustainable and viable fishing operations with concentrated effort on productivity through the enhancement of fishing skills. The course also trained fishermen in carrying out leadership roles so that they could coordinate the efforts of other EU-RCFDP fishermen in the development of rural commercial fishing operations. With these trained leaders in place it is hoped that safe, sustainable, consistent and profitable fishing operations can be further developed in the rural commercial fisheries sectors. Again, William's role was to monitor the delivery of this course and provide assistance when needed.

### *Inshore (shallow-water) FAD rigging and deployment*

The inshore FAD project was a follow up to CFMDP strategies for promoting sustainable fishing practises in rural communities, where pressure on reef fish stocks can be relieved by encouraging villagers to fish for pelagic fish species near inshore FADs. This work was carried out over three weeks and involved the assistance of Mr Peter Watt, Community Management Adviser for the CFMDP; Mr Samol

Kanawi, NFC's Masterfisherman; Mr Kaius Mai, NFC's Fisheries Technician; and Mr Malakai Komai, NFC's Fisheries Technical Assistant.

The concept behind the construction of these FADs was to make it as simple and affordable as possible so that coastal communities could maintain and rig FADs of their own. The FADs were constructed from locally grown bamboo stems cut to four-metre lengths and bound with tarred 6 mm Kurolon rope. Each FAD consisted of four bamboo stems. Tires — which are durable and can sustain rough weather conditions — were used to bind the raft (Fig. 1) and as strongpoints for connecting the mooring section. Three of the raft's mooring connectors were wheelbarrow tires, and two were larger car tires. Bamboos of sufficient age were chosen for the rafts, and were slowly cured over an open fire to make them stronger and to rid them of insects.

Although the FAD designs were meant to be as inexpensive as possible, the FAD deployment team decided to include chain and other accessories such as swivels and shackles in the

CFMDP FAD moorings. The coastal communities where the FADs were deployed were advised that they could do without these accessories if they could not afford them, or if the accessories were not available, but that the accessories extended the lifespan of the FADs in the water.

A sea bottom survey was conducted at each FAD site to determine the depth and slope of the bottom. In all FAD sites, villagers were shown how to use a simple sounding line and a hand-held GPS to carry out the surveys. A 200 m x 80 kg test monofilament line was marked every 10 m and wound onto a hand-reel with three, 60-g oval lead sinkers attached to the loose end of the line.

The five FAD deployment sites were Lavongai and Tioputuk in the New Hanover group of Islands; Nanovaul and Ngoto (Kunevulit) in the Tigak group; and Panachais on the West coast of New Ireland. The FAD at Lavongai was moored in 120 m depth, at Tioputuk in 122 m, at Nanovaul in 22 m, at Ngoto (Kunevulit) in 85 m, and at Panachais in 121 m.



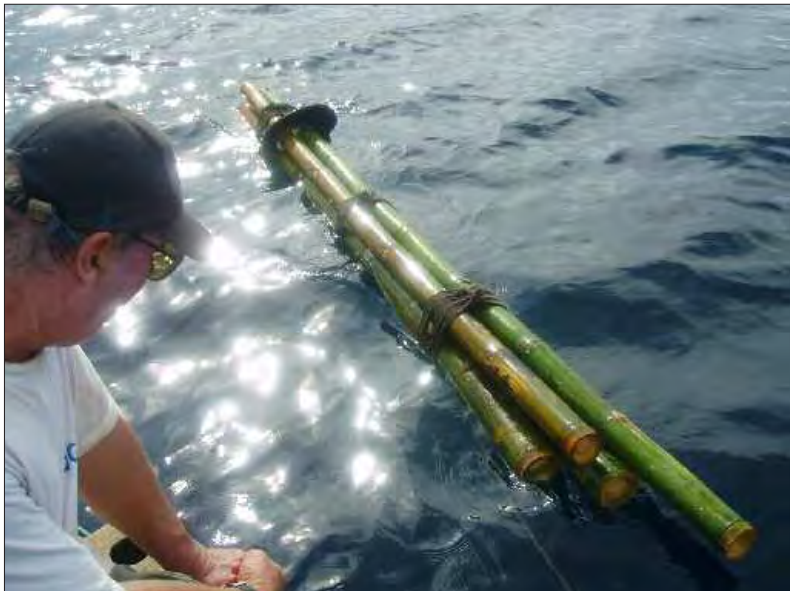
**Figure 1: Using bamboo and a tire to rig a FAD raft**





Polypropylene rope was used to moor the FADs at Lavongai, Kunevulit (Ngoto) and Panachais, while at Tioputuk and Nanovaul 3 mm monofilament mainline was used. Engine blocks, caterpillar tracks and heavy scrap engine parts weighing between 80 and 120 kg were used for the FAD anchors (Fig. 2).

Two weeks after the FADs were deployed at Lavongai and Tioputuk, reports started coming in that baitfish were aggregating around the FADs and that pelagic fish (e.g. skipjack tuna, frigate mackerel, yellowfin tuna, bigeye scads, sailfish, marlin, wahoo and mahi mahi) were already being caught in the vicinity. Later, villagers from Panachais met with William and the college Masterfisherman to request assistance with fishing methods that are effective around FADs since baitfish and pelagic fish species were already aggregating around the FAD deployed off their village.



The FAD at Ngoto (Kunevulit) was visited by William, the college CFO tutors and the course participants, a month after deployment. It was reported that a large school of fish was circling the general area of the FAD, and that baitfish were also seen in the area. Unfortunately, most of the rope that bound the FAD had been removed and the bamboos were held together mainly with the wheelbarrow tire (Figs. 3a and b). The Ngoto (Kunevulit) FAD had been vandalised for the Kurolon tarred rope that bound the bamboos. This was one of two FADs deployed for the peo-



**Figure 2 (top): Engine blocks connected together with 8 mm galvanised chain to form FAD anchors**

**Figures 3 a (middle) and b (bottom): Ngoto FAD before (neatly bound) and after vandalism**

ple of the Tigak Island group who are the traditional fishing ground owners of the area. The FAD deployed off the main Nanovaul village was completely removed by one of the villagers who had been a participant at the FAD awareness programme carried out in the village before the FAD was deployed.

FAD vandalism is one of the main problems with inshore FAD programmes. Even though community awareness programmes were carried out in New Ireland to educate the community about the benefits of installing a FAD in their fishing area, the FADs were still vandalised. Perhaps a better strategy is to encourage communities to purchase their own gear and then request assistance with constructing and deploying their FADs. The use of natural materials or inexpensive gear may reduce the probability of vandalism but this lessens the chances of keeping the FAD moored long enough to aggregate fish. Mooring rope and binding gear with sufficient strength is an essential component of FAD construction, but it also attracts thieves.

### **"Bouke-ami" and "basnig" type bait fishing trials**

Two baiting methods were trialled during the project. These were based on the bouke-ami (stick-held) lift net and the basnig lift net techniques. The trials were carried out during the EU-IFGT and the EU-Masterfisherman courses. The nets were constructed at the college (Fig. 4)

The bait netting trials focussed on providing local fishermen with an alternative fishing method that can be used (at a subsistence-commercial level) as an alternate income generating activity as well as providing additional food for the household. The lift net methods produce live bait as well as whole dead bait and can be a potential subsistence-commercial product for value-adding. The sizes of target species can be selected, depending on the mesh size used and these methods can be worked off small vessels. The target species are potential long-line bait as well as good food fish, including: sardines (such as *Sardinella lemuru*), scads (e.g. *Selar crumenophthalmus*, *Selar boops*, and *Alepes mate*), garfish and hairback herring (*Nematalosa come*). Smaller baitfish

includes several species of anchovies, sprats, and other herrings and sardines.

The baiting methods were adopted from Japan and the Philippines and while the basnig system has not been conducted in the Western and Central Pacific Ocean region, bouke-ami bait fishing was common in the pole-and-line industry, although this was mainly carried out on larger vessels that were 18 m or more in length.

Three bouke-ami night operations were carried out with NFC staff and participants from the IFGT and the Masterfisherman courses. The first operation trained the crew on how to carry out the operation, while the second and third night operations involved practical exercises to achieve catch results. This involved the use of lights (Fig. 5) to attract baitfish, and setting the nets to achieve optimum results regardless of whether the sea current was running or nearly slack. The bouke-ami net was attached to a bamboo pole that was moved away from the boat by two other bamboo poles, one from the bow and the other from the stern of the vessel (Fig. 6). Ropes were used to haul the loose end of the net when baitfish become attracted.

During the first night trial, four bouke-ami sets were made, and each time, the major school of baitfish escaped capture except for a few, although an abundance of baitfish aggregated around the lights after a short time. It took only 1.5 hours to aggregate sufficient baitfish for the operation. Lights were set at around 1800 hours, just before dusk, and by 1930 hours, large schools of baitfish were aggregated around the lights. During the second and third trials participants had perfected their newly acquired skills and the



**Figure 4: Constructing the bouke-ami net at the college**





baiting exercises were carried out successfully. Three sets were carried out on each occasion, and on each set, the potential for catching 200 kg plus of bait was evident. Only around 50 kg (Fig. 7) were taken ashore on each occasion to be identified and distributed to participants and staffs, while the rest of the bait was released alive into the sea.

Only one baiting operation was carried out using the basnig net. This was done after the bouke-ami exercises and involved three sets. The single night trial was sufficient to convince participants that the technique also has potential for catching baitfish on a large scale. Although the operation requires two boats (Fig. 8) or an outrigger canoe style boat, the operation is similar to bouke-ami. The second boat replaces the bamboo for attaching the net, with bamboo poles used to keep the two boats apart at a set distance (Fig. 8). The light attraction and luring procedure is the same as for bouke-ami and all the same precautions must be taken during the baiting operation, including consideration of current strength.



Bait species identified after the bouke-ami and basnig hauls included sardinella (*Sardinella lemuru*, *Sardinella melanura*, *Amblygaster sirm*), anchovy (*Thryssa mystax*, *Stolephorus waitei*, *Encrasicholina punctifer*, *Encrasicholina devisi*), cardinal (*Apogon fragilis*), scad (*Selar crumenophthalmus*), silversides (*Hypoatherina barnesi*) and sprats (*Spratelloides lewisi*).



**Figure 5: Underwater lights used for attracting baitfish**

**Figure 6: Setting the bouke-ami net using bamboo poles to move it away from the boat**



**Figure 7: Sardinella caught during the bouke-ami baiting exercises**



**Figure 8: Connecting the two boats with bamboo poles to use the basnig lift net**

### Input to a corporate planning exercise in the Solomon Islands

In October, the Solomon Islands Department of Fisheries and Marine Resources (DFMR) invited stakeholders in all areas of the local and provincial fisheries sectors, related government departments and regional organisations to a workshop to review a draft corporate plan developed for the department. The process was part of an institutional strengthening project being implemented by the New Zealand Government through NZAID. A consultant facilitated the two-day workshop, and SPC Coastal Fisheries Programme Manager, Lindsay Chapman, attended the workshop.

The draft corporate plan was developed through a consultative process and workshop with fisheries staff, and compiled by the NZAID-funded consultant in conjunction with fisheries staff. This workshop reviewed the draft corporate plan, which allowed stakeholder input. The draft corporate plan identified six priority areas: rural livelihoods, value of the Solomon Islands fishery, Solomon Island

Government revenues, resource management, fishery monitoring, and organisational capacity. Fisheries staff made presentations on each of the priority areas, identifying key outcomes under each.

After the presentations, participants were split into four focus groups to discuss a series of topics. The four groups included DFMR staff, Provinces' officials, the fishing sector, NGOs and regional organisations. Lindsay participated in the latter group. Two topics focused on the key outcomes and whether they adequately covered the issues and directions for DFMR. Another topic area involved participants in listing the top three issues that most needed to

be addressed by DFMR. Most groups reported that updating the Act, implementing management plans and capacity building for DFMR were the top three areas to be addressed urgently.

Over the two-day period, other presentations were made, some looked specifically at the provinces and rural fishing activities, while others focused on marketing and value-adding. Overall, the views expressed by the different groups were similar, and the process was excellent, especially if all of the input is taken on board and reflected in the final version of the DFMR corporate plan.





## DEVFISH update

### Coordination meeting

The Development of Tuna Fisheries in the Pacific ACP Countries Project (DEVFISH) held its first planning meeting in Honiara (3–5 October). Present at the meeting were the Solomon Islands EU representative, Paul Baker; the Forum Fisheries Agency's (FFA) Manager of the Economics and Marketing Division, Len Rodwell; FFA's Tuna Industry Adviser, Masao Nakada; Lindsay Chapman from SPC; and the DEVFISH team Mike Batty (team leader), Jonathan Manieva and Teriba Tabe (Fig. 9).

The meeting established DEVFISH's work plan for the first year of operation. Activities will include conducting tuna fishery case studies, looking at domestic development in different countries (or in different tuna fisheries), including post-harvest activities; a review and refinement of existing models developed at FFA on tuna fishery or vessel economics; the documenting of successes and failures in different strategies used to promote domestic tuna fishery development; country visits to collect tuna fishery information; the setting up or

establishment of tuna fishing associations; and a range of other activities.

### SPC's work activities in the last quarter

Six Pacific ACP countries were visited by Jonathan and Mike: Solomon Islands, Nauru, Tonga, Samoa, Cook Islands and Niue. The purpose of the trips was four-fold:

- Collect up-to-date information on the domestic tuna fishing industries of these countries;
- Review the economic and policy environment in which they operate in each country;
- Review the status of fishing associations and mechanisms for consultation between government and the tuna industry; and
- Identify constraints and possible areas for assistance under the project.

Country visits, in addition to reviewing reports and gathering other domestic tuna fishery information, were crucial for

identifying the current situation in the country and the required training needs, and also the status of fishing associations.

Supporting national processes for private sector participation in tuna management and development plans is an important part of the DEVFISH project. The process involves the establishment and strengthening of tuna fishing associations. The need for effective associations to represent fishing interests has been acknowledged in all countries visited. In countries with an established association, the fishing industry is involved in securing fiscal concessions or assistance from government for their respective fisheries. This is the main area Jonathan is working on.

### Summary of tuna fishing associations

In Solomon Islands and Nauru there is no formal private sector tuna representative interest group, although processes are underway to establish associations.

In Solomon Islands, the interest is driven by two main domestic commercial operators. Status and assistance to the Solomon Islands Fishing Industry Association is very much in the same status as with Nauru.

The Nauru Tuna Fishermen's Association was primarily initiated by local fishermen to convey their concerns to government, and to address specific issues affecting their fishery. An elected executive committee is pursuing initial processes of establishing the association. Jonathan has provided a sample constitution, which is being reviewed by the executive committee. Upon acceptance of a final constitution, further assistance to register the association will be provided. The Nauru Fisheries and Marine Resources Authority acknowl-



**Figure 9: DEVFISH team, Teriba Tabe (left), Mike Batty (centre) and Jonathan Manieva (right)**



edges the process undertaken, as it appropriately meets the requirement of its new tuna management plan for stakeholder representation.

In Tonga, the Tonga Export Fishing Association (TEFA) has been long established and is operational and active in its functions. TEFA represents the interests of tuna longline fishermen, as well as exporters of deep bottom fish and aquarium species. TEFA has been successful in negotiating concessions, notably duty free fuel for the industry, and provides several representatives on the national Tuna Management Committee (established under Tonga's Tuna Management Plan). This committee also includes representatives from the snapper fishery, the Game Fishing Association, and a range of government departments, and is chaired by the Secretary for Fisheries. It meets about once a year; and because of this infrequency, a sub-committee, comprising representatives of tuna fishing interests and government, will coordinate requests to the DEVFISH project.

The Samoa Fish Exporters' Association (SFEA) is formally established, and is most active in commercial tuna fishing interests. It represents commercial tuna boat owners and exporters, and was instrumental in securing the recent relief on loan interest. SFEA is represented on the Commercial Fisheries Management Advisory Council (CF-MAC), a consultative committee chaired by the Minister of Fisheries, which provided substantial input into the new Tuna Management and Development Plan 2005–2009. Associations representing artisanal fishermen on the two islands of Savaii and Upolu seem to be less active, and there are plans to re-vitalize a new association to represent alia fishermen.

The Cook Islands Tuna Industry Association was formed in late 2005, and has secured government support for establishing a revolving fund to provide longline bait to the tuna industry. The association also intends to provide input into the ongoing development of a National Tuna Management Plan – a process that should be completed in

2006. There are also organisations representing small-scale fishermen and sportsfishing interests on Rarotonga.

In Niue, the Niue Fish Processing (NFP) joint venture is the only commercial tuna exporter, and the company is directly represented on the Tuna Management Advisory Committee (chaired by the Minister of Agriculture, Fisheries and Forestry). Niue Island Fishermen's Association (NIFA) represents dinghy fishermen on the same committee, while the Vaka Association represents canoe fishermen. Both associations are formally established and have been vocal on management issues. NIFA was recently instrumental in securing a supply of duty free fuel for small-scale fishermen.

A synopsis of the report from the last countries visited and detailed updates of the project can be viewed at:



<http://www.ffa.int/>



## Set Your Longline Deep brochure

The French version of the Set Your Longline Deep brochure was produced and distributed in the fourth quarter. In addition, WWF who funded the printing and distribution of this brochure in both English and French (Fig. 10) has also had the brochure translated into Spanish for distribution in Costa Rica, and other countries in Central and South America.



**Figure 10: Brochure in English and French**

## ■ TRAINING SECTION

### **"Start Your Fishing Business" training in the Solomon Islands and Vanuatu – an update**

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

With funding support from the Commonwealth Fund for Technical Co-operation (CFTC), SPC conducted a training needs analysis (TNA) in Vanuatu and the Solomon Islands in August 2004. The TNA identified a need in both countries for training fishing communities in small fishing business planning and

management. It also reported on the commitment of local institutions and government to sustain training in this area once initial funding support from aid donors terminated. The TNA concluded that a combined training of trainers (TOT) course would be the best option for establishing a network of competent SYFB trainers in both countries.

The initial phase of the project took place in June 2005 at Santo, Vanuatu, where a TOT course was run by SBDC Master Trainers (13–29 June). Eleven future trainers from Vanuatu (Department of Cooperatives, Fisheries Division, Vanuatu Maritime College and the Vanuatu Women Development Scheme –VANWOD– Micro-finance) as well as four participants from the Solomon Islands (Fisheries Division and the Small Enterprise and Business Centre) completed the course and received their certificate of attendance. In order to become accredited by ILO as SYFB trainers, each apprentice-trainer was required to deliver one SYFB course to their target audience, under the supervision of Master Trainers (phase 2 of the project). Once accredited, the trainers are available to run additional SYFB courses on their own (phase 3).

As part of the TOT course in June 2005, participants from both countries produced an action plan for the subsequent phases of the project. From mid-August to October 2005, the 11 participants to the initial TOT course successfully ran their trial courses in Honiara (Solomon Islands), Efate, Malakula and Santo (Vanuatu). This made possible their accreditation as ILO/SYFB trainers by their supervisors, the Master Trainers

from SBDC. In 2006, the third phase of the project will consist of a series of SYFB courses in most provinces of Vanuatu and the Solomon Islands. Participants will include fishermen and prospective operators of small fishing businesses.

Relevant institutions in both countries are fully supportive of the present initiative and had agreed to support an ongoing SYFB training programme past SPC/CFTC's financial and logistical assistance, which ended in October 2005. While future SYFB training in both countries requires a financial commitment from local institutions, it is envisaged that SPC and SBDC will continue to monitor the delivery of subsequent SYFB training, acting as facilitators and quality controllers in the process.

SPC, the Commonwealth Secretariat, and their counterpart institutions in PNG are now keen to further export the SYFB training concept to other Pacific Island countries. A similar gradual training methodology will be used and, for cost-effectiveness, a sub-regional approach will be taken. Provided funding is available early in 2006, a Training Needs Analysis will be undertaken around April in several countries, prior to the training of potential SYFDB trainers before the end of 2006.

SPC and the Commonwealth Secretariat acknowledge and thank the contribution of NFA and the PNG SBDC in the development of networks of SYFB trainers in the Pacific region. Both organizations are also grateful to the individuals and the local institutions that are supporting and making possible the delivery of SYFB training in Vanuatu and the Solomon Islands.





## Seafood company managers upgrade skills

In October 2005, 14 participants from 11 Pacific Island countries traveled to Nelson, New Zealand to begin the fourth regional course for managers of medium-to-large size fisheries enterprises. Since these short courses began in 1997, over 100 seafood company managers, fishing skippers and marine engineers have benefited from the available expertise in the fishing port of Nelson. With funding from the New Zealand Government, the course is jointly run by the SPC Fisheries Training Section and the New Zealand School of Fisheries, with a major contribution from the School of Business at the Nelson Marlborough Institute of Technology.

The course commenced with a trip to Motueka where the group was greeted with a traditional Maori welcome at Te Awhina *marae*. Following this warm welcome, participants continued to the processing plant at Talley's Fisheries, where an in-depth tour was given of the site's operations. Because it was the first day of the scallop season, "the openers" (staff whose job it is to pry open scallop shells) were a big attraction, but there was also the coated product line to view, hoki and shark were being filleted and inshore species were being packed for chilled transport to both domestic and export markets. After visiting an ice cream manufacturing plant, 14 rather chilly managers headed back to Nelson where the day concluded with a social hour and welcoming BBQ.

The pattern for the remainder of the course was similar to that of previous courses. In the morning sessions, the Business School developed a theme of enhancing management skills and developing strategies designed to improve the commercial viability

of seafood businesses. In the afternoon sessions, the School of Fisheries invited local industry leaders and experts, representing a range of topics and themes, to share their experiences with the participants.

Highlights for those attending the course included the chance to learn more about New Zealand's Quota Management System and the importance of the value of "downstream processing", or adding value and utilizing byproducts. As in previous courses, Tim Masters at MacCure Seafoods guided the group around his factory and explained the processes as an illustration to the presentation on HACCP given earlier by Cushla Hogarth of Seafood Solutions Ltd. This plant represents an excellent example because it is simple in processing terms yet produces a range of well presented "ready to eat" products using strict quality standards backed up with comprehensive staff training.

Beverly Levi, a participant from Samoa, was intrigued to see the numbers of women in New Zealand that were employed at sea. It is not usual to see women at sea on New Zealand factory vessels where they will often hold senior roles, either as factory managers, shift supervisors or QCs. Beverly got a taste of a sea-going career on the Saturday when the group embarked on the *Marie Antoinette* for half a day's scalloping in Tasman Bay. The group came returned with enough scallops to feed the entire gathering at the excellent function put on in honour of the group by the local Pacific Island community.

Ian Lister and his team from the School of Business covered a range of topics during the course, including strategic planning, human resource issues,

staff performance management, accounting for non-accountants, budget planning and project management. Topics were discussed with special reference to the participants' unique situations. In the second week of the course, more speakers from industry shared their experiences. Mike Wells and Tad Krogulec talked about post-harvest handling of long-line caught tuna, Darren Guard (president of the Port Nelson Fishermen's Association) talked about fuel prices and ways to reduce vessel running costs, and Fred Te Miha described the workings of the fisheries allocation process and how that was impacting on Maori-owned fishing businesses. Louisa Sifakula from the Pacific Island Trade and Investment Commission explained how the commission could assist companies in finding and developing new markets for their products. On the final day, Charles Hufflet of Solander Fisheries (who had just returned from a southern bluefin tuna meeting in Taipei), gave the group a few lessons on how not to run a fishing business. He also pointed out some of the perils of joint ventures and the need to have top rate negotiators on your side when determining how catches should be allocated among nations.

It is a tradition that when a visit from a group of Pacific Islanders coincides with a sporting event organized by the Students' Association, the group enters whatever it is (and usually wins!). This time was no exception. The Fisheries Enterprise Managers cleaned up the opposition and took away the title of Champion Tug of War team to celebrate the 200th Anniversary of the Battle of Trafalgar. We won't go into detail about who won the actual battle, other than to say that a chap with one eye

and a funny hat presented our group with their medals!

By Friday, 21 October, some of the participants began to depart, having first made their presentation to the rest of the group. For some of those who remained, there was one last invitation to accept. Fred Te Miha invited the group to the opening of the *whare kai* at Whakatu *marae* early on Saturday morning. So, at an early (and rather chilly) hour, a

group representing Fiji and PNG gathered at the *marae* and were welcomed on by Dr John Mitchell, Ngati Tama elder and ex-Waitangi Fisheries Commissioner. The group was asked to present a musical performance and obliged, ably led by Sunia Logo. Following this, the group was summoned into the new dining room and treated to a feast of traditional food. Afterwards, it was time to leave, but not before meeting and talking to Maori Queen, Te

Atairangikaahu. This event was a fitting way to end a course that had seen people representing different cultures come together to discuss challenges in common, to share new ideas, and to make new friendships. The consensus seemed to be: "Let's do it again soon".

(Contribution from Alec Woods, SPC course coordinator, Nelson Marlborough Institute of Technology)



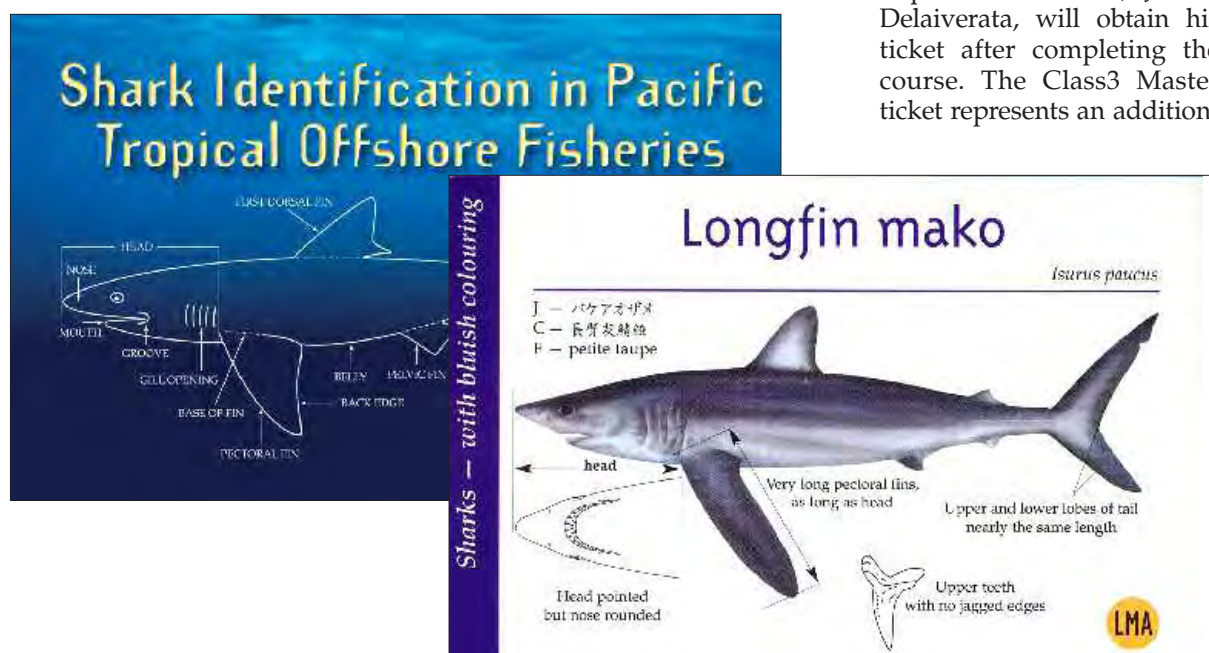
## Fisheries Training Section – In Brief

- The shark identification cards are now available in French. Initially produced in English, this pocket-size, water-proof booklet results from a joint effort between SPC's Oceanic Fisheries Programme (Fisheries Monitoring Section) and SPC's Coastal Fisheries Programme (Fisheries Training Section). It is hoped that using the i.d. cards will improve catch data and statistics on sharks that interact with longline and purse-seine fisheries in the western and central Pacific. With a better under-

standing of shark stocks, regional fisheries managers can ensure that sharks remain fished in a sustainable manner. The most likely users of the cards will be fisheries observers, fishing masters, and crew on board longline and purse-seine vessels operating in the western and central Pacific. Fisheries training institutions and fishing communities are other potential users as these identification cards complement previously published training and awareness-raising materials on the bycatch

issue (turtle ID cards and releasing guidelines, pamphlets, poster, manual on protected marine species). For further information, contact Fisheries Training Section staff at: [michelbl@spc.int](mailto:michelbl@spc.int)

- The Fisheries Training Section has organised and co-funded the training attachment of a first mate from the National Fisheries Development Limited (Solomon Islands) to a Class 3 Master course at the PNG Maritime College in Madang. The 42-week course started on 30 January 2006. It is hoped that trainee, Junior Delaiverata, will obtain his ticket after completing the course. The Class 3 Master ticket represents an addition-





al step towards Junior's ultimate goal of becoming the first Solomon Island skipper of a tuna purse-seiner. Junior is well known to section staff as he was part of the first SPC Traineeship Programme held at the Australian Fisheries Academy in 2000. We wish him well during this course!

- The production of sea safety awareness-raising materials in Pacific Island languages is progressing well. After Kiribati, Niue, Tokelau and Papua New Guinea in 2003–2004, the Fisheries Division in Apia requested last year the printing of SPC safety posters in the Samoan language. Production of this Samoan version took place in November and by the end of the year, 250 copies of the four posters had been shipped to Apia. Samoa Fisheries staff will use the posters to raise sea safety awareness amongst fishing communities in Upolu and Savaii. Countries not yet covered under this ongoing project may contact the Fisheries Training Section if they want the sea safety materials translated in their vernacular language.
- The second edition of the new SPC/Nelson Fisheries Officers Training Course started on Monday, 30 January at the New Zealand School of Fisheries. This year's course was attended by 10 participants from Kiribati, Nauru, Papua New Guinea, Samoa, Tonga, Fiji and Vanuatu. The trainees initially studied at Nelson (for 17 weeks) then traveled to New Caledonia for a one-week exposure to SPC's fisheries programmes, before flying to Santo, Vanuatu, for four weeks of practical fishing experience and sea safety training. For the first time since 1996 (in Abaiang, Kiribati), the course's practical fishing component was not held in New Caledonia; nevertheless, the quality of staff and training facilities at the Vanuatu Maritime College, as well as the richness of local fishing grounds made Santo a great venue for this event. Using the three VMC training vessels *Emm Nao*, *Etelis* and *Evolan*, the SPC trainees practiced horizontal and vertical tuna longlining, deep-bottom fishing, trolling, and bait fishing while fishing operations will be eased by a soon-to-be deployed FAD. As part of the new course, trainees will also be required to process catches to export standards and marketing trials will take place. Those readers with a good memory and who are concerned trainees, will recall that the then Vanuatu Fisheries Training Centre previously hosted the SPC/Nelson course's practical fishing module in 1992 and 1993. Let's hope that the 2006 catches will be as memorable as those back then!
- The second issue of the section's information bulletin on sea safety was published in October 2005. This time, the bulletin featured safety management systems (SMS) and safe operational plans (SOP) as a new way of looking at vessel and crew safety while the technology feature in this bulletin focuses on the safety "grab bag", a simple but necessary piece of safety gear that is easy to store and could well save lives. Please contact section staff if you have not received your sea safety bulletin.



**Left: Training vessel *Em Nao* will be used to demonstrate small-scale fishing operations**

**Right: Well known FV *Etelis* will once again play a key training role on the SPC/Nelson course**

## ■ AQUACULTURE SECTION

### Aiyura hatchery review

In November 2005, SPC's Aquaculture Officer, Satya Nandlal, attended a workshop to review the hatchery operations of the Highland Aquaculture Development Centre (HAQDEC) at Aiyura, Kainantu, Papua New Guinea (PNG). Satya was invited by Dr Paul Smith, team leader for the ACIAR-funded project, "Inland pond aquaculture in PNG: Improving fingerling supply and fish nutrition for smallholder farmers". The Aiyura facility is the flagship of freshwater aquaculture in PNG and is a critical infrastructure to ensure the success of aquaculture in this country.

#### Workshop background

The inland pond aquaculture project in PNG will run from 2005–2009 and is considered a key project in the Asia-Pacific region. The project's goal is to increase fingerling production in order to meet the growing demand of small-scale farmers in PNG. This will be done by conducting research on improvements in fish feeds, and conducting training programmes for fish farmers and hatchery operators.

One of the first project activities was to conduct a review of the HAQDEC hatchery in the Eastern Highland Province and to make recommendations for improving operations. The facility is the main freshwater hatchery in PNG that produces tilapia and common carp fingerlings. The hatchery operation is funded by the provincial government of the Eastern Highlands Province.

The workshop review was carried out from 7–11 November 2005, and was attended by four overseas experts, 25 leading hatchery operators, farmers, PNG National Fisheries Authority staff, NGO personnel, and provincial officers from five PNG provinces.

#### Review structure

The review, under the chairmanship of Dr Paul Smith from the University of Western Sydney was held at the Coffee

Research Institute, located 1 km from HAQDEC. The review was organised along four main topics: broodstock, spawning, growth to fingerling stages, and packaging and distribution of fingerlings. Discussions were based on a report by Dr Smith, reports from experts sharing their relevant experiences, and country reports on experiments by HAQDEC staff. After the presentations, panel sessions addressed the four main topics.



**Top: GIFT fish from Yonki Lake barbequed at roadside on Goroka-Lae Highway**

**Bottom: Aiyura workshop participants**



The following text provides a brief summary of the discussions and recommendations from the workshop, based on the four above-mentioned topics.

### Broodstock

- There are concerns about the broodstock used at HAQDEC. The quality of tilapia broodstock at HAQDEC is constrained because only a limited number of breeders are used as base populations (i.e. a limited gene pool). The original GIFT fish introduced from the Philippines suffered mass mortality in the first three to four months of rearing. Only two females and one male were available and used for breeding. These were lost after producing the first generation, and it is not clear whether these were original stocks or F1. Some of the progeny from these stocks escaped into Yonki Lake. This tilapia, sold at roadside stalls, has very good body features. Apparently, all tilapia in PNG come from F1 generation.
- A first step in identifying stock quality is to test the performance of stocks at HAQDEC with other available stocks in the country. Tilapia have already been collected from Lae (ERAP), Madang and Asaro. According to staff, these locations (also Yonki) were recipients of original fingerlings of F1 generation. These stocks will be bred using standard procedures and comparative growth studies will be carried out.
- New introductions of tilapia (e.g. GIFT fish) are recommended if it is ascertained that present stocks are not performing to acceptable levels. Prior to arrival of the new stock, all other tilapia stocks at HAQDEC should be destroyed or culled/sold to avoid introgression, or mixing, with new stocks. (The PNG National Fisheries Authority will review reports on original tilapia introductions and prepare a proposal for the importation of new stocks).
- There is a need to inventory tilapia and carp stocks that are maintained at the Aiyura facility, and to determine the number that are required to meet the demands for fingerlings in PNG.
- At present, the role of HAQDEC is not clearly defined. The PNG National Fisheries Authority's vision of HAQDEC is as a supplier of fingerlings; but in the future, as other hatcheries are established, it should be a source of broodstock.
- It seems obvious that the role of the Aiyura facility would be to perform continuous, long-term maintenance of founder stocks (new introductions) and genetic improvement programmes. Farmers and commercial hatchery operators have limited capacity and resources and so are not able to carry out this type of research. There is a need to prioritize research requirements and develop strategies for research, database management, evaluating new breeding stocks, documenting genetic progress, producing and distributing fingerlings to distribution centres and broodstock to multiplier stations (hatcheries). The Aiyura facility should also act as a centre for evaluation and certification of hatcheries (multiplier stations), quarantine, training, pricing, financing and marketing.
- The quality of common carp stocks should be assessed, and if unacceptable, new stocks should be introduced.
- There is a need to train HAQDEC staff in broodstock management.
- PNG (HAQDEC through NFA) should apply to the WorldFish Center to join the International Network of Genetics in Aquaculture (INGA).
- The supplementary feed used for the maintenance of fish stocks needs to be improved



**New feed making machine: pelletizer set up at Goroka**

to ensure that present and future fish introductions are maintained properly.

- Apart from supplying fingerlings, the role of distribution centres should be to supply fish feeds, because farmers do not have access to quality feed.
- Presently, wild fish are found in the main reservoir. The reservoir should be drained and cleaned and its inlet and outlet pipes screened and regularly maintained.
- Most of the ponds at the Aiyura facility are silted and have not been maintained properly due to a lack of resources. There is a need for the ponds to be de-silted and properly prepared. They should also be properly managed to ensure that broodstock are healthy.

### *Spawning*

- The hapa method of tilapia breeding should be carried out at HAQDEC in order to produce future broodstock fish. All breeding activities should be carried out early in the morning when water temperatures are low.
- Kakaban (refuge for eggs) is used for common carp spawning. Carp can spawn using basic spawning procedures (i.e. without the application of hormones).
- Technology for collecting carp pituitary glands for hormone induction is known to HAQDEC staff and was also demonstrated to all workshop participants.
- It is recommended that large size fish (> 2.5 kg female, and > 2 kg male) be used for

**Demonstration of carp pituitary extraction by Kine (HAQDEC Manager) and Dr Paul Smith**

spawning. After spawning, spent broodstock should be kept separate from fish that have not spawned.

- There is no supply of trout eggs, and trout cannot be spawned at HAQDEC due to the high water temperatures.
- For all breeding programmes, it is essential to plan ahead to ensure resources and facilities are available when required.
- There is a need to improve the records of all fish (inventory) at the farm.
- The water quality of all fish ponds should be monitored regularly.

### *Growth to fingerling stage*

The priorities identified were: availability of feeds, simple technology for fingerling grading, and mortality reduction during fish transfer from ponds to holding tanks.

- For rearing fry to fingerlings, a nursery phase is very important as it provides a conducive environment for fast growth. Small nursery ponds are easy to manage

and should be prepared and managed based on standard protocols.

### *Packaging and distribution of fingerlings*

The priorities identified were: availability of plastic bags, rubber bands, aerators and other essential equipment for transport. This equipment is not available for many seed suppliers.

- The types of transport containers are unlimited. The basic factors for all fingerling and fish transport are: healthy fish in clean water, cool water temperatures during packing and transport, aerators (or hand splashing), fingerlings purged 24 hours before packing.
- While transporting, the mode of transport, time, size and species of fish should be considered. As a basic guide, 60 g of fish for every 1 L of water.
- During transport, instructions should be given to the people transporting the fish and fingerlings (i.e. boxes should be labelled), and instructions should be given to farmers about pond stocking. Requirements for trans-





port in plastic bags should be understood and applied correctly. Feedback should be obtained from farmers.

- The Goroka fish distribution centre is now in operation to cater for farmers who cannot access fingerlings from Aiyura. Town water is used but must be stored for a few days to remove chlorine.

#### Other activities

SPC's Aquaculture Officer also took the opportunity to visit Yonki Lake to discuss the project proposal, "Improved diet and stocking density for GIFT tilapia, *Oreochromis niloticus*, in cages culture in Yonki Reservoir", with relevant staff. Accompanied by Pita Minimulu (food security aquaculturist, for the PNG National Department

of Agriculture and Livestock-NDAL), several fish farms were visited and discussions with farmers were held about improving the ponds for semi-commercial production. Meetings were held with NDAL staff and the ACIAR representative, Dr Geoff Allan, on feed formulation and distribution of fingerlings from the Goroka distribution centre.



### SPC involvement in FAO and NACA meetings in Ramsar, Iran

SPC's Aquaculture Adviser, Ben Ponia, participated in a series of FAO and NACA meetings in Ramsar, Iran. The host for these events was the Iranian Fisheries Organisation, Ministry of Jihad-e-Agriculture.

The FAO expert workshop "Synthesis of Future Aquaculture Developments" was attended by about 50 aquaculture researchers and information, training and policy officers from 16 countries in Asia and Southeast Asia, and from Iran and Eastern Europe, as well as the Pacific Islands. The objective of the workshop was to identify emerging trends and priorities in the aquaculture sector for the Asia-Pacific region. These priorities will be synthesized into a global status and trends overview and a prospective review to inform the decisions of the third meeting of the Sub Committee on Aquaculture of the Committee on Fisheries, which meets in September 2006 in New Delhi.

Five major trends for the future development of aquaculture were identified.

**Iranian fisheries development and research officers contributed actively in both meetings. Speaking is Mr Hosseini, Aquaculture Deputy of the Iranian Fisheries Organisation, to his right is Dr Muhammad Pourkazemi, Director of the International Sturgeon Research Institute and Asia's representative to CITES.**

- 1) Restricted aquaculture expansion will increase the shift towards intensification:
    - There are contrasting issues of intensification versus low technology extensive culture;
    - System/production efficiency will increase.
  - 2) There will be continued diversification of species and the need for their responsible use:
    - Indigenous species and issues of biodiversity and conservation will be affected;
    - More new species will be introduced.
  - 3) There will be continued diversification of systems:
    - There will be growing interest to adapt and integrate aquaculture; and
    - Look for new ways to use environments, create new systems.
  - 4) Markets, trade and consumption will have a growing influence:
    - Value markets, quotas, new markets and formation of associations are factors;
    - Food safety and quality will improve;
    - There will be efforts to encourage more fish consumption.
  - 5) Regulation and better governance will be enhanced:
    - This will affect the regulatory framework in the context of enforcement, registration, codes-of-conduct and information management.
- These trends will serve to increase demand for better management of aquaculture leading to:
- Sustainable water and land use,



- Improvements in genetics and stock,
- Better hatchery management/seed certification,
- Improved feeds,
- More technology,
- An emphasis on health management, and
- Improved research, training and extension links.

The Eighth Technical Advisory Committee Meeting of NACA involved many of the participants from the preceding FAO workshop, who are mostly members of the Advisory Committee of NACA. The meeting's purpose was to lay down the technical basis for the next Work Program for Aquaculture Development in the Asia-Pacific covering the period 2006–2010. A review of the achievements over the past five years pointed to the need for re-focusing the programme from its current theme of aquaculture for rural development to “empowering and getting the farmer to stay in business and being justifiably rewarded for doing so”. This was largely prompted by the encouraging results of a number of field projects, which reported that when farmers are organised into clubs or clusters, they interact better with other stakeholders in the market chain, and thus adopt better management practices. This in turn provides higher yields and returns, and a better quality product, with less incidences of on-farm diseases and disruption to the environment.



**Top: A trout farm high in the hills near Ramsar. Iran's trout farmers produced 24,000 tonnes last year.**

**Middle: Sturgeons under culture at the International Sturgeon Research Institute**

**Bottom: Officers of (left to right) NACA, the Secretariat of the Pacific Community and FAO's Inland Waters and Aquaculture Services (FIRI) review a working group's conclusions.**

Several study tours were organised by the Iranian hosts. These included a visit to a trout farm and to the International Sturgeon Research Institute on the Caspian Sea. Sturgeon fish, which produce the highly priced caviar, are an endangered species, and the Iranian institute

is at the forefront of efforts to manage this fishery and develop aquaculture techniques.



Sturgeon fish  
(Source: [www.aquarticles.com](http://www.aquarticles.com))



## Mud crab study tour to the Philippines

### Introduction

The mud crab is one of the most common edible and widely sought commodities in Asia and the Indo-Pacific regions. It is now recognized as an important species for culture in brackish water ponds and other suitable impoundments.

There are four main species of mud crab: *Scylla serrata*, *S. olivacea*, *S. tranquebarica* and *S. paramamosain*. This crab is known by several names in Pacific Island countries and territories: for example, "qari" in Fiji, "crabe" in New Caledonia, and "u'paki" in Cook Islands. The major mud crab producing countries are the Philippines, Indonesia, Singapore, Malaysia, Thailand, Vietnam and India. A total of 4608 mt of mud crab were produced in the Philippines in 2001. Mud crab is considered to be a high value, low volume commodity.

There is substantial potential for the culture of mud crab as an important source of income for poor rural coastal dwellers in Pacific Island countries and territories. However, a lack of appropriate technology and capacity has constrained the culture and research of this species. The lack of information about culture technology and a lack of awareness about the potential for mud crab culture may explain why few Pacific Islands have taken up mud crab farming. In 2005, aquaculture representatives from several SPC member countries requested information on mud crab aquaculture and how to set up small-scale operations. In response, SPC's Aquaculture Section organised and conducted a study tour to the Southeast Asian Fisheries Development Center (SEAFDEC) Aquaculture

Department in Iloilo, Philippines from 3–11 December 2005.

The main purpose of the trip was to observe commercial mud crab farm operations and visit SEAFDEC, and NGO and government facilities carrying out research, technology verification, training, and information dissemination for mud crab farming. Six participants from the Cook Islands, Fiji, Federated States of Micronesia and New Caledonia were part of the team including SPC's Aquaculture Officer.

### Mud crab culture in the Philippines

SEAFDEC has been conducting research in mud crab farming for many years, and more recently through a European Commission funded project. This project ended in November 2005 after four years of research work that was done in collaboration with the University of Wales Bangor, Ghent University in Belgium, and the Can Tho University in Vietnam. The project aims were to support conservation and protection of fisheries resources and biodiversity through the development of mud crab farming in coastal waters, and mud crab enhance-

ment integrated with mangrove conservation and rehabilitation. Studies were carried out to improve the reliability and economic viability of mud crab hatchery and nursery systems, and to quantify growth, migration and mortality of populations of *Scylla* species.

The itinerary included visits to two large commercial farms: Capiz farm (61 ha), Tacuyan farm (87 ha), other smaller farms, EU-funded mud crab projects, and NGO farms.

Mud crabs are cultured in ponds and pens of various sizes. The basic requirements for pond culture are:

- Sufficient supply of brackish water or marine water;
- Water depth of 80–100 cm;
- Sandy clay/clay loam substrate;
- Proper water quality: salinity 10–34 ppt, temperature 25–34° C, dissolved oxygen > 3 ppm, and a pH range of 8.0–8.5.

For pen culture, the basic requirements are similar to those for pond culture, except that the water depth at high tide should be 30–100 cm, the site should be free from large waves

### Visit to SEAFDEC mud crab hatchery





**Typical mud crab pond**

and floods, and the area secure from vandals and poachers.

The stocking size of juveniles into ponds and pens is usually 5 g and the grow-out cycle is four to six months (120–150 days), by which time, the average weight reaches 250–500 g and in some cases 800 g. The stocking rate is 0.5–1 crablets per square meter of surface area. Seed stock is usually collected from the wild and a small quantity is being produced and supplied by the SEAFDEC crab hatchery. In the wild, crablets are available throughout the year and cost 5–20 Philippine pesos each (~USD 0.09–0.38), depending on species, size and access to the source. There are two private hatcheries on Mindanao Island.

A set of procedures is followed for pond and pen preparation and installation, following which crablets are stocked at strategic areas. Stocking is usually done in the morning or late afternoon, and with crabs that are active, healthy and with complete body parts, and of a uniform size. A nursery, located in the ponds, is recommended for small-size crablets (i.e. those that can pass through bamboo slats or

net fencing) procured from the wild or a hatchery. Direct stocking to grow-out ponds and pens is the usual practice.

Cannibalism occurs throughout the culture cycle. The mud crab survival rate is 50–80% and in some instances this could be lower due to a lack of appropriate feed, proper water quality and problems such as stress. Mud crab feed mainly consists of “trash” fish (small, undersize fish, squid, and leftover fish from the markets) and, in some

localities, crab pellets. In terms of production costs, trash fish constitute 36.5% of the cost in ponds and 30.6% in pens, with a food conversion ratio (FCR) of usually 5:1 (i.e. 5 kg of trash fish produces 1 kg of mud crab).

Some or all of the mud crabs are harvested, depending on the availability of equipment to handle the crabs, available labour, and markets. In some cases, female crabs with maturing eggs are separated from males with large pincers for specific customers. Crabs are tied individually and are bunched together either by the kilogram or by the dozen. For long distance travel, crabs are kept inside hard cartons, wooden or Styrofoam boxes, and bamboo or palm baskets.

Mud crabs are sold live and processed. There are several selection procedures for the marketing of crabs that are usually sold at 250–800 pesos per kg (USD 4.60–14.80/kg). There is a large local market in the Philippines and at present, it seems there is an unsaturated export market, especially to Taiwan, Hong Kong and China. Commercial farmers prefer to export through an agent because prices are higher and



**Crabs ready for the market**



because agents usually arrange for trash fish for feed.

Based on the results of completed trials by SEAFDEC, pond and pen investments range between approximately USD 2200 for a half hectare pond and USD 1000 for a 0.4 hectare mangrove area, respectively. There can be two mud crab "crops" per year. An average body weight of 216 g and a survival rate of 67% are achieved in ponds within 150 days of culture, and 275 g and a survival rate of 86% in pens within 160 days of culture. To recoup the investment in a 0.5 ha pond, the pond should produce at least 1366 kg per year for two years and for a 0.4 ha pen infrastructure, it should produce at least 980 kg on one year.

Major problems faced by farmers and the industry in the Philippines are a lack of reliable and adequate supplies of crablets and juveniles, a lack of a continuous supply of trash fish for feed, and limited availability of commercial feed.

Some of the main concerns and issues in the Philippines with regards to mud crab farming are:

1. There is a need for the development of a stable local and export market for live and processed mud crab product.
2. The marketing of mud crab is still irregular due, in part, to an unpredictable supply from farms. Markets are volatile and opportunity comes only to those who take well-calculated risks.
3. Production of crabs in ponds and pens is at an early stage of development. At present, production costs give a reasonable profit margin, thus there is a need for production to be more efficient by reducing costs and producing quality crabs.

#### Comments from participants after the study tour

- a. Maciu Lagibalavu, Ministry of Fisheries (Fiji). Stated that mud crab is an important commodity for Fiji, and that SEAFDEC should offer in-country training in mud crab culture. He said it would be better to build a hatchery in Fiji, rather than importing seedlings from SEAFDEC, which is trying to meet the needs of local Filipino farmers.
- b. James Herman, private sector (Cook Islands). Said he would like SEAFDEC to establish a presence in the Cook Islands. He reported that the population of Cook Islands is 16,000 and that over 80,000 tourists visit there annually; thus, he said, there is a need for industries that can support local production rather than depending on imports.
- c. Reedson Abraham, Department of Fisheries (Federated States of Micronesia–FSM). He stated that he appreciated the support given by SPC to attend the study tour. He said he was satisfied with all the activities, and reported that FSM was building a crab hatchery and was looking to employ a hatchery technician for two years. He said he would like SPC and SEAFDEC to identify experts, offer trainings and the sharing of information, and run additional mud crab workshops.
- d. Dominique Pham, IFREMER and Bernard FAO, South Province (New Caledonia). Both people were very interested in the trip, and said that they will test some of the information they learned in the workshop with SPC.
- e. Satya Nandlal, SPC Aquaculture Section, said that SPC would like participants to carry out activities thorough consultation with their respective departments/employers. He said that SPC will access any further information required by participants and will seek collaboration with SEAFDEC on mud crab technology. He also said that participants need to note that there are many other areas apart from mud crab farming to learn from SEAFDEC.

4. There must be a stable seed supply
5. Crablets remain as the most expensive input of production, closely followed by feed. Supply of trash fish is still unreliable, and formulated feeds for mud crab are still being trialled.
6. Prospective growers need support from government and NGOs in terms of policy, financial, technical and marketing.
7. There is an investment opportunity in the mud crab industry; however, information dissemination and accelerated technology transfer are necessary to support interest and investment in the mud crab industry and ancillary activities.
8. Small and medium business enterprises should be developed as important components of the industry, such as grower, feed supplier, seed supplier, processor, marketer, technologists and other aspects.
9. Government agencies and all other stakeholders have the capability to regulate the responsible conduct of this business (see #8 above). Hatchery technologies are being refined and the low supply of crablets from the wild may be addressed by conserving mangrove habitats by way of prohibiting the catch of gravid female mud crabs and allowing them to spawn naturally in the wild.



## SPC regional pearl meeting

The plush setting of the Tokatoka Resort in Nadi was the venue for the first regional pearl meeting, which ran from 31 November to 2 December 2005. Considering the economic significance of this industry and the widespread interest of Pacific Island countries in developing their cultured pearl industry, a regional forum to discuss technical issues was long overdue. Critical challenges to the sector that need addressing were identified, and included

- Seed supply: increasing hatchery capacity;
- Farming: utilising technological advances, such as triploid oysters;
- Pearl quality: improving technician standards;
- Sales: strengthen marketing.

### Meeting background

Cultured pearls are among the most alluring products from the Pacific. Although they are no longer a novelty item, the Pacific Islands remain determined to develop local pearl industries, despite the existing challenges. This resolve has been evident through past and current efforts.

The meeting objectives were to enable a technical round-table forum to benchmark the status of pearl production in the Pacific, share information of common interest, and explore areas for technical collaboration.

Meeting participants included representatives from government, private sector and academia. The meeting Chair was Mr Maciu Lagibalavu, Director of Aquaculture, Fiji Ministry of Fisheries.

### Status of pearl farming in the Pacific Islands

The major commercial producers of pearls in the Pacific are

French Polynesia and the Cook Islands. Fiji Islands, Marshall Islands, Federated States of Micronesia, Tonga, Papua New Guinea, Solomon Islands and Kiribati are all in varying stages of commercialisation (country reports and special topic presentations will be reproduced in a forthcoming issue of the SPC *Pearl Oyster Information Bulletin*). In recent years, the average yearly export value from the Pacific has been around USD 100 million, and French Polynesia is the dominant producer. This value is down from a peak of around USD 170 million in 2000, which apparently was caused by an oversupply of pearls and ones of poor quality.

While countries mainly target the cultivation of *Pinctada margaritifera* for its black pearl, there is an opportunity to diversify the range of pearls coming from the Pacific. For example, both the Solomon Islands and Papua New Guinea have naturally occurring stocks of *Pinctada maxima*, which produces a luminescent white pearl branded as the "South Seas Pearl". The winged oyster, *Pteria penguin*, is found in Fiji and Tonga, and can be cultivated for a half pearl with purple undertones similar to that of abalone pearls.

Among the emerging pearl producers in the region, Fiji has made great progress. There is an active pearl unit within the government and commercial production has begun in the private sector. This is attracting the attention of international investors. In

### Pearl farm mapping at Manihiki Atoll in the Cook Islands

Micronesia, the results of hatchery and farm trials are being adapted for small-scale opportunities suited to rural communities, as explained by Mr Masahiro Ito from the College of Micronesia. The low cost and low technology pearl hatchery in Kiribati continues to reproduce an unusually high success rate in pearl spat settlement.

### Constraints and opportunities

In countries where natural stocks of oysters are low, the lack of seed supply is a constraint to the expansion of pearl farming. Given that the investment portfolio for a pearl enterprise is at least on the order of 10–15 years, it is critical to secure a consistent source of oysters. Fortunately, the technology for breeding pearl oysters is fairly well developed and there are a number of operational hatcheries to learn from. However, establishing a hatchery requires the technology to be customised according to local conditions and (government facilities in particular) often, the level of dedicated effort required to operate efficiently is underestimated.

Furthermore, the Pacific should be supportive of research in order to ensure that it does not lose out on technological advances that may offer significant benefits. For example, sterile oysters induced





through triploidization divert their energy from reproduction into growth. This, according to Associate Professor Paul Southgate, from James Cook University in Australia, could significantly reduce the time (and cost) to harvest pearls, ultimately increasing profit. Establishing a genetic improvement programme could select oysters that generate specific coloured pearls or very large sized pearls.

Environmental management becomes crucial as farming levels intensify. This is a lesson that was learned the hard way in the Cook Islands, which is still recovering from a severe oyster disease at Manihiki atoll in 2000 due, in part, to overstocking. Management measures outlined by Mr Kori Raumea from the Cook Islands Ministry of Marine Resources involve:

- 1) regular environmental monitoring, such as water quality testing using automated probes deployed on a remote buoy,
- 2) a digital mapping system to allocate farm leases and analyse oyster density, and
- 3) new legislation and an Atoll Lagoon Management Plan to regulate best farming practices.

The pearl grafting operation ("pearl seeding") is the perhaps the greatest aspect directly affecting pearl quality, and contributes to a significant portion

of production costs. Dr Maria Haws from the University of Hawai'i provided some straightforward arguments that clearly show why a poorly skilled seeding technician drastically reduces revenue to unprofitable levels. According to her analyses, if an "excellent performing" technician and a "poor performing" seeding technical were provided a thousand oysters, the excellent technician will generate USD 19,000 dollars revenue compared to just USD 8600 dollars from the poor technician (Table 1). Even subverting to a lower fee for a poor performing technician will still lead to unprofitable levels of revenue.

Clearly, if the Pacific wishes to improve profitability in the pearl sector, then investing in programmes to raise the standard of pearl seeding technicians will be of significant help.

Pearls are jewellery items and maintaining a marketing campaign is essential to enticing buyers. No segment of the industry understands this better than the private sector. Pearl farmers Mr Temu Okotai from the Cook Islands and Mr Justin Hunter from Fiji shared their experiences of marketing in the business world. (In addition, Mr Hunter outlined the integration of their Savusavu farm with the aspirations of the local *qoliqoli*). Mr Okotai raised the concept of a Pacific brand for marketing pearls, and challenged the region to work together for mutual benefit, rather than to

compete. The recent stabilisation of pearl prices brings some optimism to the marketing environment although the adage that "high quality pearls will always sell" remains true.

Dr Quentin Fong from the University of Alaska provided economic sensitivity analyses based on a North Pacific farm model showing that variation in marketing prices is a factor having the greatest impact on profitability and cost. A one percent increase (or decrease) causes a five percent increase (or decrease) of net profits. This reiterates the earlier presentations by Temu and Justin on the importance of marketing.

### Meeting recommendations

The following draft recommendations were made by meeting delegates to synthesis the current challenges in the pearl sector and to provide suggested strategies to address them, emphasising regional collaboration.

### Policy, networking and information

1. The lack of clear policies in the pearl sector must be addressed.
  - a. Existing policies should be reviewed to amend or create clear policies where needed;
  - b. All stakeholders must be involved in this process.
2. The lack of regulations and legislation — particularly in the area of water rights, leas-

**Table 1. Performance measure and profitability for varying level of technician skills (seeding 1000 pearl oysters and charging a fee of USD 3 dollars per oyster).**

Parameter	Technician 1 "Excellent"	Technician 2 "Average"	Technician 3 "Poor"
<i>Results at harvest</i>			
Poor quality, unsaleable pearls (%)	20%	30%	40%
<i>Revenue at harvest</i>			
Revenue from pearls	<b>USD 19,000</b>	<b>USD 13,300</b>	<b>USD 8600</b>
Seeding costs as % of revenues	37%	53%	81%

- es and tenure for private sector individuals — must be addressed.
- a. Clear regulations and legislation should be implemented.
3. Policies should incorporate the obligations of a grafting permit required by a seeding technician.
    - a. Because the majority of seeding technicians are foreigners, such a permit may need to be incorporated into foreign investment policies.
  4. A regional association should be established as a commission for the pearl sector.
    - a. Its formation could be endorsed through the Pacific Islands Forum Secretariat (PIFS) Heads of Government meeting;
    - b. It should include the main producing countries (e.g. French Polynesia). Assistance could be provided through regional organisations;
    - c. The Pacific Regional Maritime Association (PACMA) may serve as a prototype – SPC serves as the secretariat;
    - d. Regional meetings in the pearl sector are urgently needed.
  5. The lack of information and resources to share information must be addressed.
    - a. The Secretariat of the Pacific Community (SPC) and other regional bodies should be encouraged to address this shortfall;
    - b. Newsletters, bulletins, websites, etc. should be used;
    - c. A database may be required;
    - d. If necessary, a regional coordinator post should be created and recruited;
    - e. A network for collaboration should be established.
- Marketing**
6. SPC should be tasked with gathering and disseminating marketing information in a timely manner to all of its member countries.
    - a. Information sources such as national marketing reports and international newsletters could be used;
    - b. The SPC *Pearl Oyster Bulletin*, SPC's Aquaculture Section portal website, electronic flash message distribution service, etc. could be used as information clearing house mechanisms.
  7. Countries should be encouraged to develop a national marketing strategy.
  8. A regional marketing strategy should be developed.
    - a. The regional marketing strategy should take note of the opportunities and constraints for inter-regional "branding" of pearls.
  9. A regional association should be formed comprising of national representation for the purpose of marketing (including intelligence, standards and etc).
    - a. PIFS and SPC should be tasked with the formation and administration of this association;
    - b. The functions of this grouping may be carried out through the regional association suggested for policy directives in recommendation #4.
  10. The region should adopt the Gemological Institute of America (GIA) standards as a minimum requirement.
  11. The goal of research and development should be oriented towards increased profitability. This equates to improved pearl quality and retention, more efficient culture methods and stock improvement.
    - a. Some of the exiting opportunities for research include genetic selection, triploidy and seeding techniques;
  12. Enhance the capacity for pearl disease management.
    - a. SPC should collaborate with other key regional agencies such as the South Pacific Applied Geoscience Commission (SOPAC) and the South Pacific Regional Environment Programme (SPREP) in developing guidelines for best farming practices.
  13. There should be efficient communication between the various stakeholders involved in the research and development process.
    - a. SPC could be the vehicle to establish communication and utilize mechanisms such as the SPC *Pearl Oyster Special Interest Group Bulletin* and aquaculture portal website to achieve this.
  14. Special emphasis should be placed on the monitoring and evaluation of seeding technicians.
    - a. Critical control points such as that employed by the United States HACCAP standards may be employed as a checklist and minimum standards for technicians and farmers to adhere by;
    - b. Where comparisons may be useful, countries within the region should be encouraged to share data on the seeding success/failure rates of their technicians;
    - c. A standard reporting sheet could be developed that countries may adopt towards a common database. There needs to be confidence built within countries and industry on how sensitive seeding information will be handled;



- d. A regional or national “grafting inspector” may be required within the profession.

### Infrastructure

15. The critical and urgent area that needs to be addressed for infrastructure lie in developing hatcheries and spat collection to ensure consistent supply of spat for farming.

### Training

16. Training in oyster biology, hatchery culture is a key priority need for the region that must be addressed.
- JCU and the University of Hawaii at a Hilo (UHH) are training institutions within the region. In the past, JCU has run courses in this area that were funded by the Australian Centre for International Agricultural Research (ACIAR);
  - ACIAR is a potential funding agency within the region;
  - An oyster biology, hatchery training programme may include the following:

- two courses per year over a three-year period;
- courses to be six weeks long, covering: pearl farm longline deployment; micro algae culture; spawning induction; hatchery culture; larval, nursery culture and grow-out;
- once the course has been fine-tuned and established, it should be phased into the region by involving the University of the South Pacific (USP) as a regional training centre. This could occur in year three or thereabouts.

17. Training efforts should be undertaken to increase the number of qualified successful local seeding technicians within the region, particularly in countries with large commercial production.
- A source of abundant pearl oysters must be found, however, in order for training to take place. This may necessitate a regional training centre where resources can be shared (e.g. a hatchery);
  - It is preferable that training be undertaken in-country;

- c. A travelling trainer may be the most effective way of providing training in seeding techniques to remote and distant areas of the region. A “Master Grafting Technician” may be required within the seeding technician profession.

18. A regional workshop on pearl grading should take place to upgrade farmers’ knowledge about pearl quality and marketing aspects.
- The SPC should be tasked with organizing and seeking funding for such a workshop;
  - It may be more effective for a travelling trainer/grader to visit countries.

19. Certification provided by training programmes could be used as a requirement for those seeking a permit under a national permitting system (for e.g. French Polynesia).
- This could ensure a minimum level of technical competence within the industry;
  - Regional standards could be incorporated into national certification programmes.



**Top: A low cost pearl hatchery in Kiribati**

**Right: Pearl farm being prepared in Micronesia**



## Regional seaweed meeting benchmarks status of production and explores opportunities for collaboration

*Kappaphycus* seaweed<sup>1</sup> is one of the priority aquaculture commodities for the Pacific identified in the SPC Aquaculture Action Plan<sup>2</sup>. In 2005, the Australian Centre for International Agricultural Research (ACIAR) and SPC jointly implemented a project to identify and evaluate the constraints and opportunities for *Kappaphycus* seaweed in selected Pacific Island countries, including consideration of options for a multi-country (bilateral and/or sub-regional) cooperation in marketing and processing.

SPC's Aquaculture Adviser, Ben Ponia, and ACIAR consultant, Dennis McHugh (Australian Defence Academy, retired), conducted national workshops in Kiribati (31 May 2005), Solomon Islands (7 June 2005) and Fiji (13 June 2005) to assess country reports and opportunities for regional linkages. In October 2005, Ben and Dennis organised the Nadi sub-regional meeting to collate the findings of the consultancy and to obtain feedback from key country stakeholders for incorporation into a final report.

### Meeting arrangements

Participants of the three-day meeting included government and private sector representatives from Fiji, Kiribati, Marshall Islands, Solomon Islands and Vanuatu. Organisations, including the University of South Pacific's Institute of Marine Resources, also participated. Dr Iain Neish from SeaPlant, Indonesia, was a key technical adviser who provided useful information on the situation in Asia and gave an update on emerging technology that would be appropriate for the Pacific. The

meeting was chaired by Alifina Vuti the (acting) Chief Executive Officer, Fiji Ministry of Fisheries and Forestry.

### World supply and demand situation

*Kappaphycus alvarezii* seaweed (also known as "cottonii") produces carrageenan, a starchy substance used as a thickening and stabilising agent in a variety of applications, most commonly in food and pharmaceutical products.

At present, there is a strong demand for seaweed and low supplies of raw product, so prices are high. The total world production is approximately 220,000 mt (dry) with the bulk provided by the Philippines and Indonesia. China is an emerging market where carrageenan is used for petfood. Markets in Korea and India are also growing. This has helped drive the spot prices from export buyers up to as much as USD 950 dollars per tonne (January 2005) and to hover between USD 600 and 800 per tonne. Previous boom bust cycles have seen prices drop to lows of USD 300 per tonne. Iain Neish believes that a stable price of USD 400 per tonne will probably help ensure a balance between supply and demand and bring sustainability to the industry.

Industry predictions are that the demand for carrageenan will

grow at an annual rate of around 4–6%. Opportunities for expansion are mostly in meat, poultry and dairy products. Carrageenan is making inroads as a replacement for animal products such as gelatin, which is out of favour with consumers unsettled by recent outbreaks of mad cow disease.

### Seaweed processing

Seaweed is characterised as a high volume and low value product. Freight often involves lengthy and expensive domestic and international routes which reduces profitability through the whole supply chain. In Kiribati, for example, the seaweed grown at Fanning Island is shipped to Tarawa where it is baled and stockpiled before international freightage across the Pacific to the Philippines for processing.

If the region were able to carry some form of processing of the bulky raw product, then this might cut freight costs. However, this is not thought to be feasible because of the low and inconsistent supply coming from the



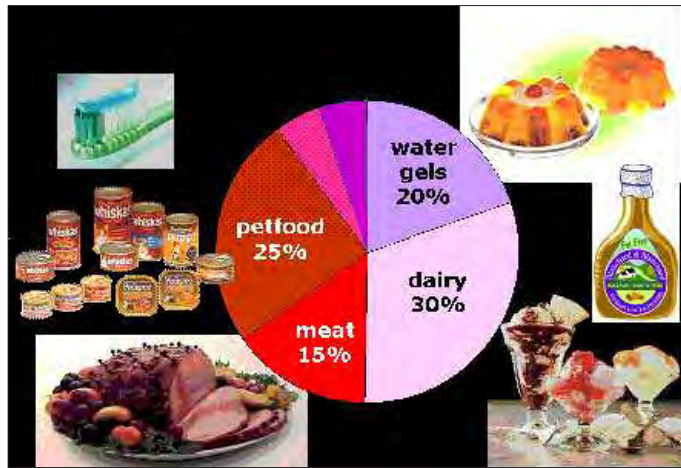
**Carrageenan extracts  
from *Kappaphycus* seaweed**

<sup>1</sup>. See SPC's aquaculture profiles online ([http://www.spc.int/aquaculture/site/commodities/PDF/Seaweed\\_page.pdf](http://www.spc.int/aquaculture/site/commodities/PDF/Seaweed_page.pdf)) for a description of *Kappaphycus* seaweed farming

<sup>2</sup>. Online reference: <http://www.spc.int/aquaculture/site/publications/documents/spc-aquaplan.pdf>







**Commercial use of *Kappaphycus* seaweed  
in the food industry**  
(courtesy of SeaPlant.net)

Pacific. Also, processing involves large quantities of fresh water, a scarce resource in some atoll environments. There is also a treatment of hot chemical alkali, which, along with the non-carageenan discharge, might pose an effluent problem.

Emerging technology being trialled in Indonesia, however, uses basic extractive technology with liquids and solids being physically separated thereby reducing chemical or freshwater inputs. The basic concept, as explained by Iain, is similar to a cider press. The liquid and solid byproduct has household and commercial potential as plant fertiliser. The scale of economy is more suited for the small volumes coming from the Pacific (i.e. about 1500 tonnes per annum). The product is a semi-

refined chip, which is about a quarter of the volume of the raw product and, therefore, incurs less export freight cost.

#### Status of production in the Pacific

For the past few decades, seaweed has mainly been commercially farmed in Kiribati and Fiji, joined recently by the Solomon Islands. Presently, total production from the region is relatively low, on the order 1000 tonnes per annum. Elsewhere, research and development trials have been conducted. Notably, Vanuatu and the Marshall Islands, where both countries experienced problems with fish grazing and finding appropriate sites. The Papua New Guinea government has expressed interest in seaweed farming as an alternative to

copra and sea cucumber harvesting, although no actual trials have taken place.

Almost all seaweed from Kiribati comes from Fanning Atoll in the Line Island Group. The seaweed is purchased and processed by the Danish company CP Kelco at its factory in Cebu, Phillipines. A peak of 1440 tonnes was produced in 2000 (Table 1), but subsequently, there was a lull, declining to 490 tonnes by 2003. This was attributed to the stopover of tourist liners from Hawaii and farmers seeking opportunities in the tourism trade. Some of these ex-farmers have now reportedly returned to seaweed farming because of the guaranteed income compared with selling tourism curios and because of a shortage of raw materials such as sea shells, which have been overharvested. This trend is reflected in the slight increase in production in recent years. According to Mr Kevin Rouatu, the CEO of the Atoll Seaweed Company, the company plans to expand farming to other islands through the introduction of a new strain of seaweed. The morphology of this seaweed is suited to high wave action on the ocean crest side and is therefore less susceptible to ice-ice disease, which has caused the demise of farming in the past. The Gilbert Islands is the main area to be targeted.

Farming in Fiji Islands peaked with 520 t in 2000 (Table 2) under

**Table 1. Seaweed production (dry) from Kiribati**

Year	2000	2001	2002	2003	2004	2005 (Apr)
Tonnage	1440	1160	530	490	640	200

**Table 2. Seaweed production (dry) from Fiji**

Year	1998	1999	2000	2001	2002	2003	2004	2005 (May)
Tonnage	20	300	520	280	80	20	50	30

**Table 3. Dry seaweed production (tonnes) from Solomon Islands**

Year	2002	2003	2004	2005 (Mar)
Tonnage	4	50	260	230

a programme heavily subsidized by the government. The industry experienced problems in freight and marketing arrangements and competition from alternative cash crops, which caused a decline. The government intends to rejuvenate the industry by concentrating its efforts on the atoll islands of the Ono-I-Lau group where there are suitable sites and few opportunities for alternative cash livelihoods. The fisheries department has a temporary contract with local marketing and promotion agencies, and is sourcing overseas buyers with a view to set a beach price (money paid to the farmer) at FJD 70 cents a kilogram compared to previous price of FJD 50 cents.

The Solomon Islands has had the most spectacular growth, increasing exponentially from 4 tonnes in 2002 to 260 tonnes in 2004 (Table 3). Seaweed is exported to Degussa Ltd in France. During the Solomon Islands' ethnic crisis, seaweed farming at Rarumana Island was rejuvenated to generate basic household cash income. Technical and funding support was provided by the fisheries department, the European Union Rural Fisheries Enterprise Project and SPC. Farming spread quickly

in Rarumana and seaweed was also introduced to nearby Wagina Island, which now exports around 30 tonnes per month. Many Wagina Islanders who used to rely on diving for the (presently) overfished sea cucumber trade, have now found a renewable source of cash in seaweed farming. Assistance to the Solomon Islands is being provided through the European Union funded Seaweed Commercialisation Project, which began in late 2005. The project will concentrate on the existing farm sites as well as expand to a few key sites such as North Malaita, Ontong Java and the Reef Islands.

A monograph of national country reports and comprehensive regional analysis of the seaweed industry is being compiled by Dr Dennis McHugh.

Recommendations were made by participants to the meeting with a focus on regional collaboration that will boost production in the Pacific. It is thought that increased production from the Pacific will lead to better opportunities in processing and greater bargaining power for freight and marketing arrangements.



**New strain of *Kappaphycus* seaweed introduced in Kiribati**

## Meeting recommendations

### Communication

1. A good communication network is an essential first step to enabling countries to collaborate on any aspect of the seaweed industry, especially at this time in regard to farming and improving production.
  - Staff of farming organisations in all countries to utilise email, fax and phone to maintain consultation and cooperation on any aspect of farming

### Farming

2. Countries within the Pacific can learn from each other about the mechanisms that motivate farmers to produce (e.g. cash payments or a bonus system).
  - All countries involved; connect with SE Asia (Indonesia is a logical and geographical connection to the Pacific through PNG)
3. Initially, concentrate farming on a small number of sites, rather than spreading efforts more thinly over a large number of sites. This has been a successful strategy in the Solomon Islands.
4. There is a need to encourage collaboration on the sharing of cultivars (subject to quarantine protocol and for research on new *Kappaphycus* strains).
  - Fisheries Departments undertake research; regional agencies to assist with technical supervision and quarantine
5. It is essential that there be some regional collaboration on quarantine procedures.
  - SPC, USP to continue efforts; invasive issue explored further (with the Secretariat of the Pacific Regional Environment Programme (SPREP), the University of Hawaii)



6. Develop a better understanding of buyer specifications (e.g. 30% water content) and eliminate "trading games".
  - Learn from SEAPlantNet
7. Communication between farmers and from farmer to buyer can significantly boost production within countries. Possibility of learning from SEAPlantNet in Indonesia, PFnet model in Solomon Islands for communication with remote communities.
  - Countries to study communication methods with remote communities in Indonesia and Solomon Islands
8. Explore lessons learned and trends for development of farming and marketing in major producing countries.
  - SEAPlantNet to share the lessons from Indonesia and the Philippines
9. Applied research. Some topics are of global importance and efforts could be collaborative at an international level. Priority topics include:
  - ice-ice outbreaks,
  - epiphytes,
  - grazers,
  - processing technology,
  - alternative seaweed products,
  - local applications (e.g. fertilisers, animal nutrition).
  - Use USP extension centres; involve ACIAR as a donor and technical agency; producing countries to be involved in refining and implementation.
10. Identify the opportunities and constraints for equal gender participation in seaweed farming (traditional and innovative).
  - Possibly supervised by USP
- in delivering technical assistance (e.g. training materials, training workshops) to farmers. Encourage the type of agency collaboration (e.g. between SPC and USP) already in place.
  - All countries involved
12. Encourage country placements within the Pacific community to support emerging countries to learn from more advanced countries.
  - SPC and governments of producing countries to facilitate
13. There is a need to maintain a program of "training-the-trainer" type courses.
  - USP, SPC, Fiji to explore a training module in 2006; all producing countries to assist in identifying a "model" farmer who can also be a teaching resource
14. Regional efforts could be coordinated through a regional posting (organise training, share country experiences, technology).
  - Position could be located within SPC but would be working closely with USP
- the viability of seaweed farming as micro, small and medium business enterprises and to be a catalyst for production.
  - Countries to identify
16. Countries should make a concerted effort to find and empower their entrepreneurs in the seaweed farming industry.
  - Producing countries to find entrepreneurs
17. Encourage countries to raise the profile of seaweed farming in regional forums as a viable alternative livelihood for coastal peoples — build on comparative advantages (c.f. tuna). Regional organisations should also maintain communication with non-producing countries who may wish to farm seaweed in the future.
  - SPC through regional forums, communications
18. Regional organisations and countries should work together to lobby donors (EU, the World Bank, Asian Development Bank) to support where necessary the development of seaweed farming.
  - SPC to coordinate
15. Identify a few successful seaweed farmers to showcase

### *Promotion of farming*



**Seaweed plot in the Solomon Islands**

### *Training*

11. Countries in the region should combine their efforts

**Processing**

19. Explore the benefits of in-country processing versus exporting raw product with transparent value-added chains in place.
- Focus on the current three producing countries (Kiribati, Solomon Islands, Fiji); Kiribati to share its processing consultancy report; SEAPlantNet to advise on progress of small scale processing project.

**Marketing**

20. There is an opportunity for regional collaboration in marketing; countries could share marketing intelligence, prices paid, exporting strategies.
- All involved, SPC take a lead, learn from SEAPlantNet
21. Consider establishing a third party testing facility in the region to act as an honest broker between buyers and sellers in verifying export quality.
- USP a potential host for the facility

22. Consider the need to develop regional product standards and certification schemes (linked to third party testing) to conform with global standards. Pacific Islands should target a high quality product and consistent quantity in order to secure a stable market demand. The Pacific region needs to build a positive image. Consider developing a single Pacific-wide brand (contribute to broader discussion on other products such as ornamentals).
- SPC to work with the Pacific Islands Forum Secretariat (PIFS); marine ornamentals standards; other aquaculture standards

**General**

23. Countries should develop national development plans for the seaweed industry and share this plan with other producing countries as a means to communicate their future intentions and targets (production levels etc).
- Countries to develop plans, SPC to help disseminate information

24. Continue efforts to hold regional forums on a regular basis.
- SPC to help organise and seek funding; consider an internet based forum etc
25. Use the above recommendations as a framework for a regional inter-governmental agreement that countries will cooperate in boosting seaweed production within the region. Submit this framework to the SPC Heads of Fisheries meeting for endorsement.
- SPC to work through the current ACIAR consultancy and with all workshop participants to formulate final framework



## National Freshwater Aquaculture Awareness Workshop (Santo) and National Aquaculture Sector Planning Workshop (Port Vila) held in Vanuatu

There has been substantial progress with aquaculture in Vanuatu recently, both in the government and the private sector. The fisheries department has been quite active in promoting small-scale, rural freshwater aquaculture — particularly tilapia and shrimp — and a large privately-funded penaeid prawn farm has just begun the first commercial harvest, after several years of setting up the operation. Other types of aquaculture are in the pipeline. To assist Vanuatu, SPC's Aquaculture Officer was the lead trainer in a workshop that provided key agencies and

potential farmers with technical grounding. After this, SPC's Aquaculture Adviser helped organise and run a consultative workshop, the objective of which was to develop a national plan, which will help guide the aquaculture sector over the next five years.

### First aquaculture awareness workshop, Sanma Rural Women's Training Centre, Santo, Vanuatu

The purpose of the workshop was to provide information on theoretical and practical aspects

of freshwater prawn and tilapia farming to farmers and government officers. The workshop was funded jointly by the UN Food and Agriculture Organization (FAO) and the Vanuatu Fisheries Department. SPC's Aquaculture Section carried out this training at the request of the government.

In 2003, FAO in collaboration with SPC (at the request of the Vanuatu Government) conducted a feasibility study on, "The potential of farming tilapia *Oreochromis niloticus* and freshwater prawn *Macrobrachium*



*rosenbergi* in Vanuatu". The study was carried out on Efate and Santo Islands and both tilapia and freshwater prawns were recommended for farming.

Since mid-2004 the following activities have been carried out by the Fisheries Department:

- A semi-commercial tilapia farm has been established at Erapo on Efate Island. A total 500 kg of tilapia was produced in June 2005, the first tilapia production in Vanuatu. The tilapia was sold in the local market in Port Vila. Several tilapia farms have since been established in other islands.
- On Santo Island, ponds were constructed by Fisheries Department to test the potential of farming local freshwater prawn *Macrobrachium lar*. This project was funded by Australian Centre for International Agriculture Research (ACIAR) with technical assistance provided of SPC aquaculture section. (All the prawns were harvested, weighed and graded by the participants as part of the practical exercise).
- A pilot tilapia farm was also established in Santo and stocked with fingerlings in mid 2005. (The fingerlings at the farm were used for demonstrating sampling, seining feeding and etc as part of practical exercise during the workshop).
- Since January 2005, an FAO Aquaculture Technical Assistant (of Chinese nationality) joined the Fisheries department under an FAO Regional Programme for Food Security.
- Three fisheries officers attended training on tilapia and prawn farming including hatchery operations in Fiji in 2003–2004.

According to Mr Jimmy Robert (Principal Biologist), a considerable number of requests for technical assistance to set up small-scale tilapia and prawn farms from communities and individuals have been received by the fisheries department. In addition, fisheries extension officers and officers from other line agencies (Animal Health, Quarantine and the Environment Department) based in outer islands were also assisting in aquaculture activities. These officers had not attended any aquaculture training and as such, this workshop was organised to train these officers as well as farmers based on Santo Island. Farmers from other islands were not able to attend the workshop due to lack of funds to cover for travel and accommodation.

### The workshop

Twenty participants attended the workshop: 10 prawn/tilapia farmers from Santo; one FAO volunteer, fisheries officers from Santo, Malampa, Penama Island, and Efate, one Livestock Officer, one Environment Officer and one Quarantine Officer — all government officers from Santo. The workshop was conducted by

SPC's Aquaculture Officer with assistance of aquaculturists from the Fisheries Department. The four-day training provided information on:

- basic biology of tilapia and prawns,
- tilapia hatchery operation,
- site selection for tilapia and prawn farms,
- methods of pond construction, and
- tilapia and prawn grow-out aspects (pond preparation, stocking, feeding, sampling, pond management, harvesting, marketing and record keeping).

Practical exercises were carried on site selection, manual pond construction, feed preparation, sampling, prawn harvesting and farm budgets.

Presentations were made in English and Bislama. Demonstrations were carried out in the classroom and at the Sarete Fish farm, about 40 km from the training site. Participants worked in groups to work through exercises, for example, steps involved in pond construction by hands (manually). This exercise was followed by practical pond construction at Sarete farm. All the



Participants testing soil quality for pond construction.

participants actively participated in the classroom and as well as field activities. There was a lot of interaction among the participants and also between participants and the trainers. Notes on all topics were provided in English and some parts were translated into Bislama.

At the end of the workshop, a dinner function was organized whereby participants were given certificates of attendance. Many of the participants would have preferred the workshop duration to be longer. Participants had enhanced their knowledge in the site selection, pond construction and pond managements including harvesting. As the farmers planned to construct ponds, it is envisaged that the acquired knowledge and experiences would enhance the capacity of participants especially the government officers, in order to provide better understanding on tilapia and prawn farming in Vanuatu.

SPC's Aquaculture Officer and Aquaculture Adviser visited potential farm sites and advised on pond selection and other criteria before returning to Vila.

#### National Aquaculture Planning Workshop, 21–23 November 2005, Port Vila, Vanuatu

The resource materials and presentations used in the Vanuatu national planning workshop were similar to those used in previous SPC workshops held in Fiji (2004) and Nauru (2005). The anticipated output is a government national planning document that will transparently outline government's priorities and

intentions and enable collaboration amongst stakeholders within the sector. The plan has a five-year planning timetable.

Robert Jimmy was the main government counterpart for the workshop. Mr Wycliff Bakeo (former Director of Fisheries) was engaged as an SPC consultant to help facilitate the workshop. Robert will follow up on the drafting of the plan. Participants were mostly government agencies including Department of Fisheries, Department of Economics and Planning, Chamber of Commerce, Environment, Ministry of Agriculture and the private sector. The Director of Quarantine and Acting Director General for Ministry Agriculture were key participants because there is a strong interest in Vanuatu in aquaculture quarantine and veterinary issues.

The first step of the consultation was the prioritization of commodities. This process was carried out by assessing and scoring the range of commodities that can feasibly be cultured in

Vanuatu. Eight key commodities were scored as a high priority.

Step two of the workshop was to draft a five-year log frame of objectives, activities and indicators, which will enable Vanuatu to attain its national goals and support the sustainable development of its aquaculture commodities. Further consultation with stakeholders will be carried out to refine the plan contents and finalize the document. The plan is to be submitted to Cabinet for endorsement.



**Top: Demonstration: female tilapia carrying eggs in her mouth.**

**Bottom: Prawns harvested and graded for sale.**



### ■ FAO AWARD FOR MODEL AQUACULTURIST FROM VANUATU

On 17 October 2005, Her Royal Highness Princess Maha Chakri Sirindhorn presented an FAO award to Felix Nguyen for outstanding achievements in aquaculture. The celebration was held during the World Food Day observance at the FAO Regional Office for Asia and the Pacific in Bangkok, Thailand. The text of the award citation is presented below.

#### Model aquaculturist from Vanuatu

Felix Nguyen hails from Vanuatu, a group of islands in the South Pacific Ocean. Many people on this island nation are of mixed origins, but Felix is unique because his father is Vietnamese and his mother is Ni-Vanuatu, the local and dominant ethnic group. Mr Nguyen's father had travelled to the South Pacific islands to

work as a coffee and cocoa planter.

"When I was growing up, my father told me almost every night that he came to Vanuatu because of hunger, not for the pleasure. He came to work, to bring money back to his first family in Vietnam," says Mr Nguyen.

Mr Nguyen says he doesn't want other people to be hungry. Since 1986, he has been working with the Vanuatu government on fishing projects with rural farmers. He wants to focus on the aquaculture industry to help poor communities on the islands. Mr Nguyen has helped to start fishing projects in inland communities, and is working on the first-ever aquaculture fish farm in Vanuatu alongside FAO officials.

"We have in the sea, depleted stocks of fish and shellfish, so the main thing is to move towards aquaculture," says Felix. "Our population is growing very fast, and we have a shortage of fish in the markets. We have so many rivers back in Vanuatu, and no work done on freshwater, so through the help of the Secretariat of the Pacific Community in New Caledonia, and training from Fiji, I decided to go back and start fish farms."

Mr Nguyen says the purpose of his work is simple: to provide food security for rural communities living on remote islands of Vanuatu.

(Source: Vanuatu News Port Vila Press Online, [www.news.vu](http://www.news.vu), 18 October 2005)



### ■ MAJOR TUNA CONFERENCE CONCLUDES IN POHNPEI

In December 2005, in Pohnpei, Federated States of Micronesia, more than 280 people involved in the global and regional tuna industry put in place the first components of a long term process to control fishing effort and catch and regulate regional tuna harvests in the WCPO. The meeting was chaired by Mr Glenn Hurry from Australia.

The meeting focused on controlling further expansion of the catch of bigeye and yellowfin tuna, both of which species received worrying stock status assessments as recently as August. The discussion was robust as the topic vital to the health and well-being of many Pacific Island economies was debated between the historical and extensive fishing interests of the world's largest tuna fleets and the fishery development

aspirations of the small developing countries and territories of the Pacific and the Philippines and Indonesia in whose waters the majority of the regional tuna harvest is taken.

Mr Hurry, commenting at the conclusion of the meeting, said that he was pleased with the outcomes and believed that the meeting laid the foundations for what will become one of the world's major fisheries commissions. He said that participants shared the view that continued expansion of the regional tuna catch cannot be sustained. He said: "The 2004 tuna catch, just over 2 million tonnes, was the highest on record. Scientists have stated that yellowfin and bigeye tuna stocks cannot sustain this level of fishing and there is a need for a reduction in both effort and catch". He went

on to say that "this is a new Commission, however with so much at stake it must quickly begin to work. It will take some time to develop tools to ensure that conservation and management arrangements are adhered to, but these measures must be adhered to if we are to sustain the livelihood of the Pacific. This Commission has the best opportunity of all the world's regional fisheries management organizations to successfully manage its fish stocks, it must not fail."

The Commission took its first steps along this path, with the adoption of resolutions aimed at constraining further increases in catch and effort for North Pacific and South Pacific albacore, bigeye and yellowfin tuna, support to reduce the catch of seabirds and turtles that are taken incidentally during fishing opera-

tions, and measures to reduce fishing capacity, particularly among fleets that have expanded rapidly in the last five years.

Tools to assist with the enforcement of these decisions include the world's largest satellite-based system for monitoring the operations of fishing vessels and programs for placing observers on fishing vessels operating on the high seas to complement those programs that members of the Commission support in their national waters.

The Commission also agreed to explore options for temporary closures in western and central Pacific tuna fisheries along similar lines as has been implemented in the Eastern Tropical Pacific under the auspices of the Inter-American Tuna Commission. Members also agreed to develop management plans for the use of fish aggregating devices in an effort to reduce the catch of juvenile bigeye and yellowfin tunas.

Representatives of the major fishing interests whose tuna

fleets operate in the WCPO and those countries that support significant stocks of tuna have been working since 1994 to build an institutional framework to support the conservation and management of WCPO tuna stocks. The result, the Western and Central Pacific Fisheries Commission, was formally established in 2005 with a secretariat based in Pohnpei.

(Source: Western and Central Pacific Fisheries Commission press release; [www.wcpfc.org](http://www.wcpfc.org))



## ■ NOAA PREDICTS WEAK LA NIÑA

Weak La Niña conditions are predicted in the tropical Pacific just in time for spring, but NOAA scientists stress it is too early to know how this could affect springtime and summertime weather patterns in the United States. La Niña is the periodic cooling of ocean waters in the east-central equatorial Pacific, which impacts the typical alignment of weather patterns.

On 12 January 2006, scientists at the NOAA Climate Prediction Center released the latest El Niño Southern Oscillation Diagnostic Discussion, which highlights the early stages of a weak La Niña episode developing in the tropical Pacific and, for now, are expected to remain in place for three to six months. Yet the full impact of this weak event is yet unknown. Jim Laver, director of the NOAA Climate Prediction Center, the lead government agency on El Niño/La Niña monitoring and forecasting, said "The strength of La Niña's impacts depends on the strength of the La Niña event."

Wayne Higgins, NOAA's principal climate specialist at the NOAA Climate Prediction Center said, "One thing, however, is for

certain. La Niña was not the cause of the early January rains in the west and wildfires in the south." He added, "While La Niña can produce similar patterns, there is no indication that these jet stream winds are related to the developing weak La Niña."

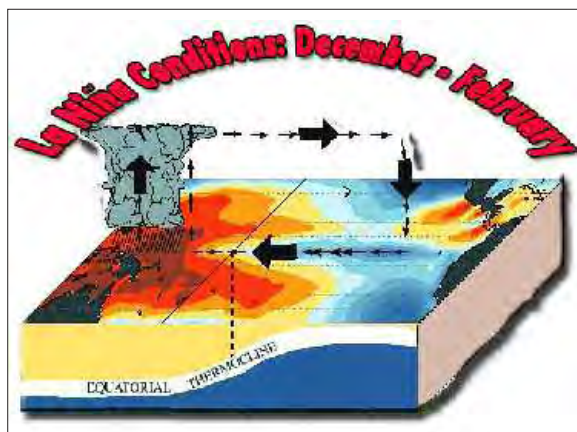
La Niña events recur approximately every three to five years. The last La Niña occurred in 2000–2001 and was a weak event.

NOAA will continue monitoring this event and report on any potential impacts as the event progresses. The next ENSO Diagnostic Discussion has been

posted on the NOAA Climate Prediction Center website on February 9.

The El Niño/Southern Oscillation Diagnostic Discussion is a team effort consisting of NOAA's Climate Prediction Center, Climate Diagnostics Center, National Climatic Data Center, Geophysical Fluid Dynamics Laboratory, Atlantic Oceanographic and Meteorological Laboratory, and the International Research Institute for Climate Prediction.

NOAA, an agency of the US Department of Commerce, is dedicated to enhancing economic security and national safety through the prediction



**Figure 1: La Niña conditions during December through February**

and research of weather and climate-related events and providing environmental stewardship of the nation's coastal and marine resources.

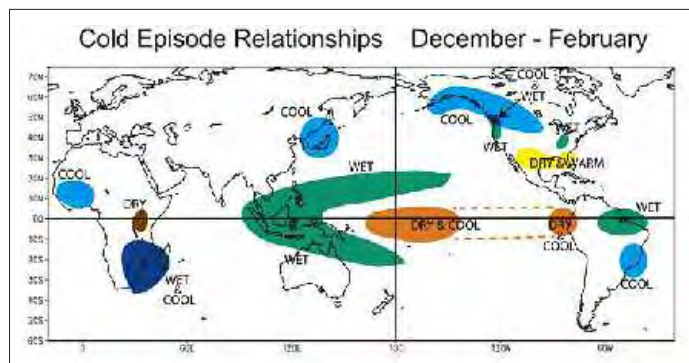
Through the emerging Global Earth Observation System of Systems (GEOSS), NOAA is working with its federal partners and nearly 60 countries to

develop a global monitoring network that is as integrated as the planet it observes.

(Source: NOAA; 12 January 2006)



<http://www.noaanews.noaa.gov/stories2006/s2559.htm>



**Figure 2: La Niña global impacts during December through February**





# SURVEY OF FISHING ACTIVITIES IN TOKELAU

## Introduction

Tokelau (Fig. 1) consists of three low-lying atolls — Nukunonu, Fakaofu and Atafu — located between 8° and 10° S latitude, and 171° and 173° W longitude. The mid-2003 population estimates for Tokelau was 1500 people.

Although Tokelau's land area is only 12 km<sup>2</sup>, its exclusive economic zone (EEZ) is around 290,000 km<sup>2</sup>, bordering five other Pacific Island nations (the Republic of Kiribati to the north, the Cook Islands to the east, American Samoa and Samoa to the south, and Wallis and Futuna to the southwest). Around 15 per cent of Tokelau's EEZ borders international waters to the northeast and west.

Subsistence fishing is an important component of everyday life in Tokelau, and the development of fisheries is the main opportunity for economic development. Set in this context, a joint Secretariat of the Pacific Community (SPC) and Pacific Islands Forum Fisheries Agency (PIFFA) mission was undertaken from 28 August to 10 September 2003. The main aim of this mission was to gather information for drafting a national tuna fishery development and management plan, with SPC focusing on the development aspects and PIFFA focusing on management issues. The secondary aim of the mission, and the focus of this article, was the collection of sex disaggregated data, through household survey questionnaires, on Tokelauan fishing activities.

*Lindsay Chapman<sup>1</sup>,  
Kim Des Rochers<sup>2</sup>, and  
Mose Pelasio<sup>3</sup>*

## Household survey form and methodology

The questionnaire used for the household surveys was developed as part of the fish aggregating device (FAD) research project conducted in Niue and the Cook Islands from 2001 to 2004, and reported in *Fisheries Newsletter* #113. The survey form consisted of five main question areas. General fishing activities by household members (father, mother, sons, daughters, aunts, uncles, etc.) were recorded with a percentage of fishing time attributed to each of the 10 fishing methods listed. The number of canoes and boats per household

was also recorded, with details about of each craft and motor noted. Specific information about canoe and boat use outside the reef was recorded, along with fishing methods used and the percentage of fishing time attributed to each method. Estimated catch from both canoes and boats fishing outside the reef, as well as any processing that was undertaken (e.g. gilling and gutting, filleting, smoking, salting and drying, etc.) was entered onto the form. The survey form also included questions about people's knowledge of marine protected areas.

At each of the three atolls, the aim was to interview as many of the households as possible in the limited time available. Wherever possible, the head of the household was interviewed. Interviews were conducted in English, although local interpreters were used on each atoll when the interviewee was not comfortable answering in English. To assist in identifying houses, New Zealand Overseas Development Assis-

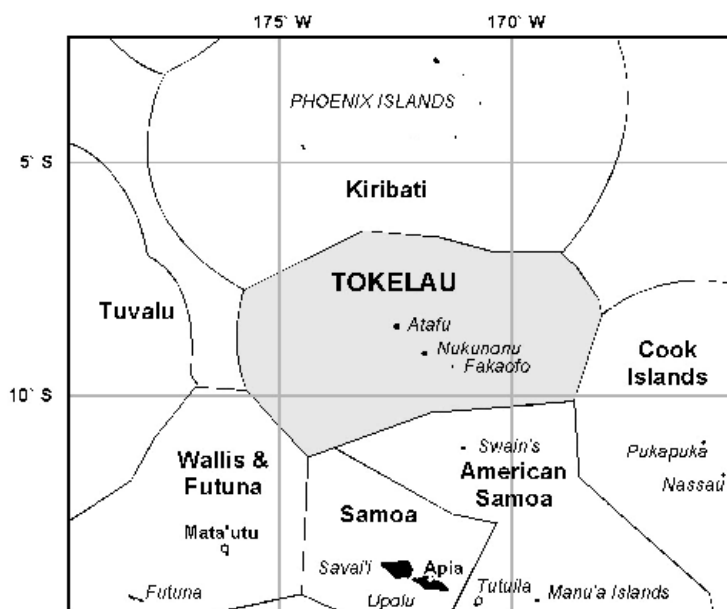


Figure 1: Tokelau, its EEZ and neighbouring countries

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<sup>2</sup> Kim Des Rochers, Consultant

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tance/Tokelau Public Works Department maps (2001) were used for each atoll.

### Survey results

Surveys were conducted opportunistically in the three to four days spent at each atoll, allowing interviewers to work around official meetings and arranged activities. The Tokelau 2001 census data provided baseline information on household numbers, although this only covered the number of actual houses on each atoll (Table 1). To get a better understanding of the actual number of households on each atoll at the time of the survey, prominent people such as village elders from each atoll were asked to provide an estimate of household numbers (Table 1). From this the percentage coverage was calculated for each atoll (Table 1), which ranged from 61.3 per cent on Atafu to 84.5 per cent on Nukunonu.

Two teams were used wherever possible to conduct the surveys. Each team consisted of two people, an interviewer and an interpreter. Surveys were conducted at people's houses, outside meeting places and in common areas where local people were gathered (Fig. 2). In several locations, community kitchens provided an excellent venue as groups of people



**Figure 2: Kim (right) interviewing the head of a household on Atafu with translation assistance from Ms Malia Daleb (left)**

gathered, and people could be taken aside one by one without affecting the cooking or food preparation activities.

Table 2 presents the overall results from the community survey in regard to the number of households involved in various fishing activities. It should be noted that all but one household, a retired widow, was involved in some form of fishing activity, which highlighted the dependence of Tokelauans on harvesting marine products as their main protein source.

Over 60 per cent of households used their canoes and boats with outboard motors to fish outside the reef.

The actual fishing activities conducted at each atoll are the same (Fig. 3), however, the percentage of time attributed to each activity changed by atoll. On Atafu, around half (48%) of all fishing effort was focused in the lagoon and reef area, with reef fishing and gillnetting accounting for around 22 and 16 per cent of fishing effort, respectively. In contrast, spearfishing, diving, reef gleaning and baitfishing combined only accounted for 10 per cent of total fishing time. When fishing outside the reef, Atafu fishermen mainly trolled (20%) and fished in mid-water (14%) for tunas and other pelagic species, or bottomfished (10%) to reduce fuel costs.

**Table 1: Estimate of survey coverage by atoll**

Atoll	Census (2001) data on house numbers	Local estimate of household numbers (September 2003)	Number of households surveyed	Percentage coverage based on 2003 estimates
Atafu	83	75	46	61.3
Fakaofu	80	70	58	82.9
Nukunonu	66	58	49	84.5
Total	229	203	153	75.4

**Table 2: Summary of data collected during the household surveys conducted in Tokelau**

Atoll	Number of h/holds surveyed	Number of people covered	People per h/hold	H/holds fishing	Percent of h/holds fishing	Number of canoes	Number of boats	Number h/holds fishing outside reef	Percent h/holds fishing outside reef
Atafu	46	299	6.5	46	100.00%	31	37	32	69.60%
Fakaofu	58	320	5.5	57	98.30%	3	86	47	82.50%
Nukunonu	49	280	5.7	49	100.00%	4	56	30	61.20%
Total	153	899	5.9	152	99.30%	38	179	109	71.70%

On Fakaofu, fishermen also spent around half (51%) of their fishing effort inside the reef, with gillnetting (15%), reef fishing (12%), spearfishing (8%) and diving (7%) being the main fishing methods used. Outside the reef, fishing effort on Fakaofu was the same as on Atafu, with trolling (18%) and mid-water fishing (13%) for tuna and other pelagics, and bottomfishing (13%) being the main methods used. Fishermen on Nukunonu spent more than half (57%) of their time fishing outside the reef, with bottomfishing being the main method used (21%), followed by trolling (18%) and mid-water fishing (11%) for tuna and other pelagics. Fishing inside the reef at Nukunonu accounted for 43 per cent of fishing effort, with gillnetting (12%), reef fishing (10%), reef gleaning (7%) and diving (6%) being the main methods used. Across the three atolls, trolling was the main method used, followed by bottomfishing, reef fishing and gillnetting.

To identify the main people involved in the different fishing activities, sex disaggregated data was collected, and the results are presented in Figures 4 (a) and (b) on page 37 and 38.

Fathers, sons and other males were the main household members involved in fishing activities at all three atolls, whether fishing inside or outside the reef. When

fishing outside the reef (trolling, mid-water fishing, flying fishing and bottomfishing), mothers, daughters and other females only made up a very small percentage of the effort at Atafu, and an even smaller percentage at Fakaofu. Women at Nukunonu were not involved in fishing outside the reef at all.

Mothers, daughters and other females were involved in some inshore fishing methods, although males still dominated. Females accounted for just over 50 per cent of the reef gleaning effort, and around 40 per cent of diving effort, with most of the diving effort directed at harvesting clams. Females were also involved in gillnetting and reef fishing, but again at low levels. Overall, there was slightly more female fishing effort on Fakaofu (16%) compared with Atafu (11%) and Nukunonu (9%).

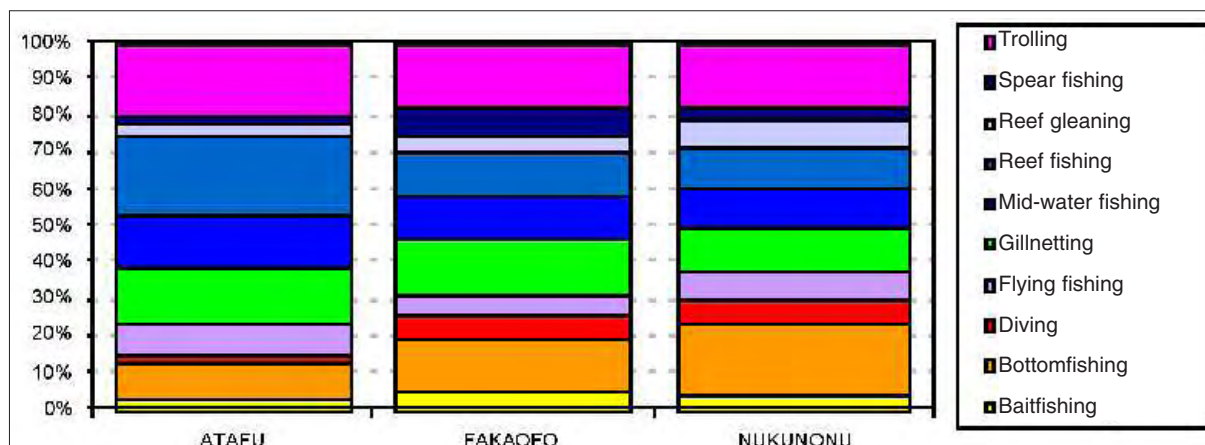
One interesting point that came out of the survey was the recent change in craft being used, from traditional outrigger canoes to outboard-powered aluminium dinghies. This is partly attributed to the lack of

suitable timber (large tree trunks) on Nukunonu and Fakaofu, however, there is also a convenience factor as these can be ordered from overseas and delivered by cargo boat (Fig. 5). Atafu still has a reasonable number of outrigger canoes, although many of these are falling into disrepair and will probably be replaced with aluminium dinghies in the future.

The authors hope that in years to come, a similar survey will be undertaken to document changes that will have occurred between this and the future survey. The authors would also like to thank all those who assisted with the data collection on the different atolls, especially Ms Fenuafala Faafoi, Ms Malia Daleb and Ms Hina Tuia.



**Figure 5: Four new aluminium dinghies being delivered to one of the atolls in Tokelau**



**Figure 3: Percentage of fishing effort by method and atoll surveyed**



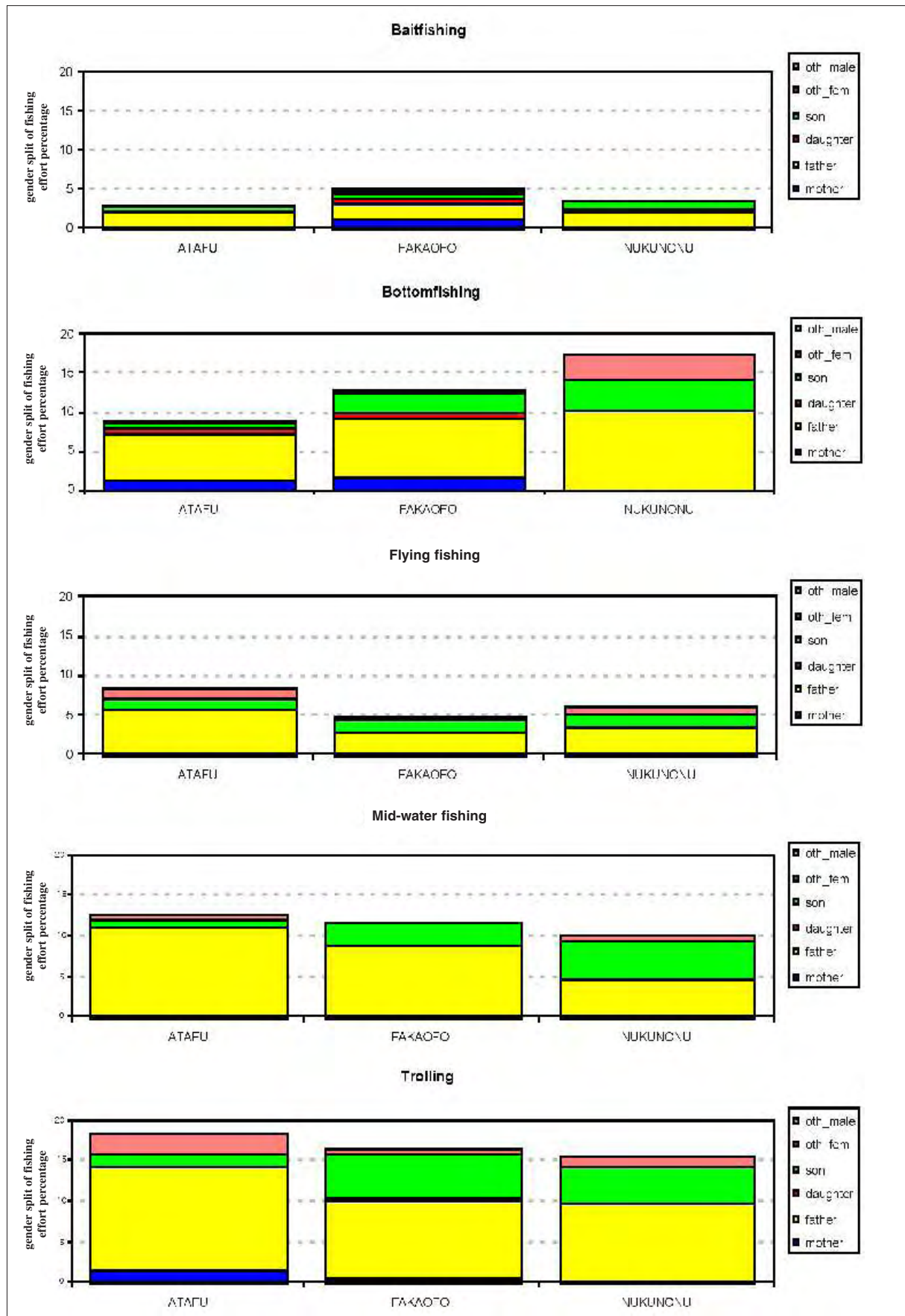


Figure 4 (a): Gender split of fishing effort by fishing method for the three atolls

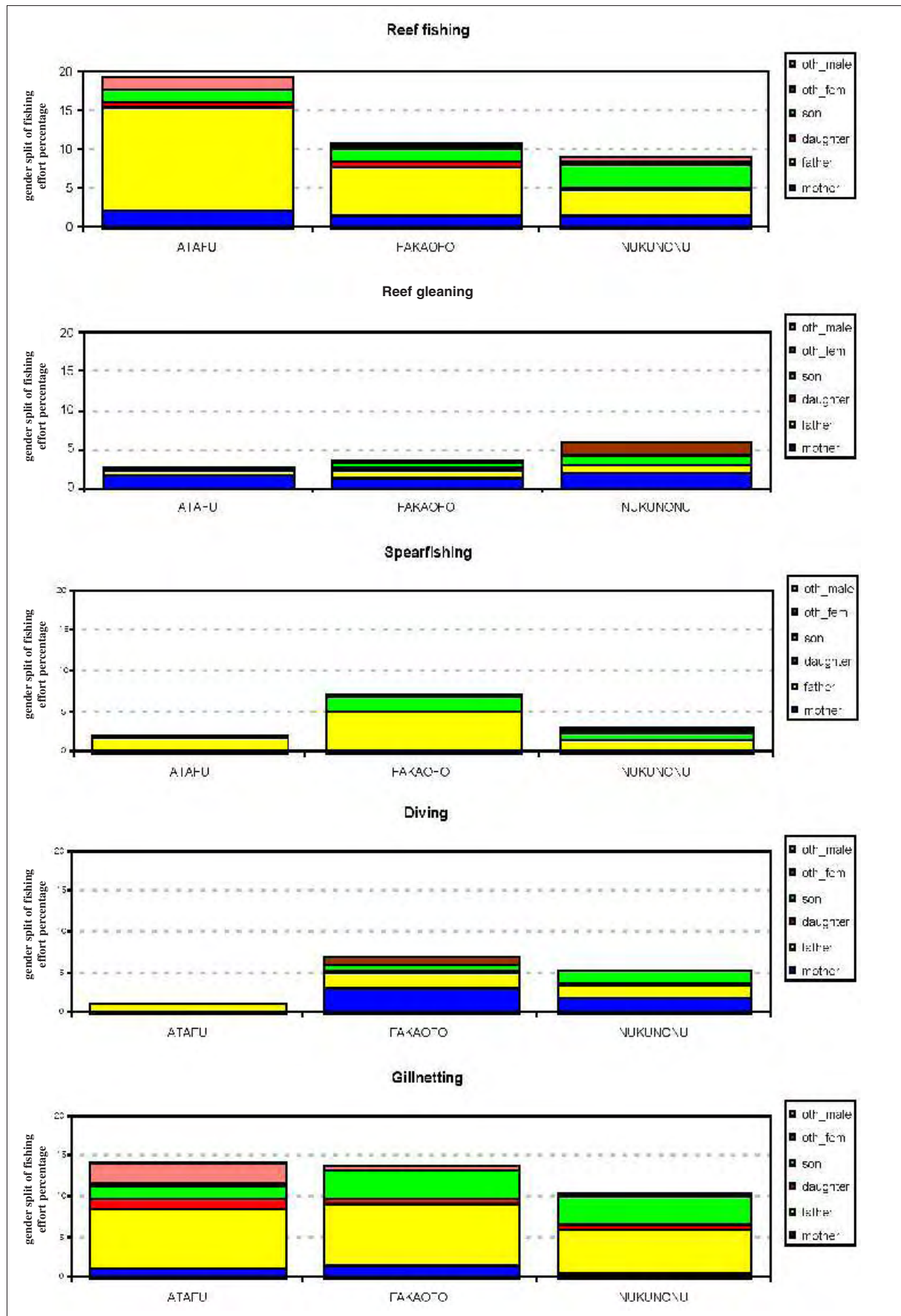


Figure 4 (b): Gender split of fishing effort by fishing method for the three atolls

# A QUIET ACHIEVER: AQUACULTURE IN THE PACIFIC

## Introduction

The Pacific has its own unique brand of aquaculture, one tailored to its needs and quietly assisting the economy and well-being of its people. It may come as a surprise to some people that aquaculture products are among the region's most valuable fisheries exports, ranging between USD 130 and 180 million each year. As well as its monetary value, the social capital of aquaculture in the Pacific is immense.

Aquaculture is the world's fastest-growing food production sector, currently accounting for one-third of all fish production; the remainder is provided by wild fisheries. By 2020, this trend is expected to be reversed, with 70 per cent of the world's fish needs produced through aquaculture.

Aquaculture includes anything to do with farming in fresh water or marine water (the term "mariculture" specifically refers to farming in seawater). A handful of key commodities — black pearls, prawns, seaweed and freshwater fish — demonstrate aquaculture's appropriateness and significance to the region.

## Current value and future wealth

By the late 1990s, cultured black pearls had become the flagship aquaculture product of eastern Polynesia and its most valuable export.

**Top: Justin Hunter in Savusavu, Fiji Islands, with some beautiful examples of valuable Pacific black pearls.**

**Bottom: Prawn farming in New Caledonia is conducted to high environmental standards.**

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In 1999, French Polynesian pearl exports topped USD 164 million and in 2000 exports from the Cook Islands amounted to USD 9 million. Subsequently, both countries experienced a slump. In French Polynesia, this was due to an oversupply of poor-

quality pearls, and in the Cook Islands it was from a pearl disease. French Polynesia is now consolidating after a campaign to control quality, while the Cooks are still struggling to recover from the disease.

Pearl farms are being established in many other countries, notably Fiji Islands, where Justin Hunter from J. Hunter Pearls Ltd., reports that "steady progress is being made".

## High quality and care for the environment

Prawn farming is a commercial success story in New Caledonia. Succulent white penaeid prawns





were introduced from Mexico several decades ago and now command a top market niche in Japan and France. They are the country's most valuable agricultural export commodity at USD 22 million, and with new farms under construction. Current production is expected to double to 4000 t by 2007.

The industry is renowned for its high environmental standards. Mangroves have not been cleared to make way for prawn ponds; instead, the mangrove forest has been retained to absorb nutrient outflows.

### Benefits for rural communities

*Kappaphycus* seaweed (trade name cottonii) produces a starchy gel called carrageenan that is used primarily in the food industry. Although easy to farm and requiring little capital input, the main drawback to seaweed farming is that the distant markets and limited transport links mean freight costs make it only marginally profitable for local middlemen.

Solomon Islands is experiencing exponential growth in production. Exports (to France) went

from 4 tonnes in 2002 to 240 t in 2004. Villages such as Vaghena used to rely on diving for sea cucumber, but with stocks overfished and a moratorium on harvesting coming into force, seaweed farming will provide up to 90 per cent of the people's cash income, essential not only for their basic daily needs but also school fees, church donations and other social obligations. With planned expansion to places such as North Malaita, Reef Islands and the low-lying atoll of Ontong Java, the country could eventually export up to 4000 t per year, according to Rory Stewart of the EU-funded seaweed project.

*Kappaphycus* seaweed is also being farmed in Kiribati and Fiji Islands.

### Securing local food sources

In Fiji, the GIFT strain of Nile tilapia (not to be confused with Mozambique tilapia, which is considered a pest) is a popular freshwater fish. At Driti Village, in the interior of Vanua Levua, a women's group raises tilapia for village consumption and modest commercial sales. This alleviates the burden on the men, who must earn wages from seasonal labour in the Labasa sugarcane fields. Elsewhere in Fiji, Laisani Baleinacagi from Navua in Viti Levu says he would like to showcase tilapia farming as a "positive way forward of utilising unused rice paddies".

There are 11,000 fish-pond farmers in Papua New Guinea. GIFT tilapia and carp are being farmed in the lowlands, while in the mountainous highlands it is rainbow trout. Barramundi farms are also being established.



**Top: The popular GIFT tilapia**  
**Bottom: Seaweed farming is an important local business for the people of Solomon Islands.**

### Where to now?

As with any emerging production sector, there are a host of challenges to be addressed. These include:

- Responsible environmental safeguards should be in place. For example, a robust biosecurity programme is required to support the proper introduction of new genetic material.
- Profitability is a key bottom line. Many past failures have been attributed to poor market research, and future efforts must be supported by proper economic and financial analysis.
- Expansion of fish and shrimp production will depend on developing cost-effective feeds, based to the greatest degree possible on local ingredients.

- Aquaculture may assist in replenishing commercially overfished stocks and providing alternative livelihoods for those affected by such overfishing. The sea cucumber is one such fishery, and pioneering experiments are being conducted in New Caledonia to artificially breed and restock juveniles.
- The Pacific should be mindful that it sits at the doorstep of Asia — a powerhouse and low-cost producer. A graphic example is China, which in just a few years has switched to culturing *Penaeus vannamei* prawns and flooded the world market with hundreds of thousands of tonnes, driving farm prices down to a low of USD 1.50 per kilogram.

- Where practical, efforts should be made to encourage the domestication of local species rather than introduce exotic species. Farming should also integrate traditional practices. In Vanuatu and Wallis and Futuna these concepts are being trialled, with the local freshwater shrimp *Macrobrachium lar* being cultured alongside dalo (taro) in swamp beds.

This article acknowledges Dr M.V. Gupta, a pioneering aquaculturist from India and a friend of the Pacific who was awarded the prestigious USD 250,000 World Food Prize for 2005 for his role in improving the food sources and livelihoods of the world's poor people through the development of small-pond aquaculture.



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# CATCHING EELS IN PACIFIC ISLAND COUNTRIES AND TERRITORIES

## Introduction

The eel is a fascinating creature and has long been studied in great detail. Reports indicate that since the time of the ancient Greeks, people have wondered where eels came from and where they spawned. Eels have been considered a gourmet delicacy for thousands of years in many parts of the world.

Eels are found in marine, brackish and fresh waters worldwide and reports suggest there are 15–19 species in total, with about 10 species in tropical waters and 5 in temperate waters (Fig. 1). Of these species, the Japanese eel (*Anguilla japonica*) is most important in East Asia (China, Japan and Taiwan), the European eel (*A. anguilla*) in Europe (mainly Italy and the Netherlands), *A. australis* and *A. reinhardtii* in Australia, and *A. bicolor*, *A. megastoma* and *A. marmorata* in PNG and other Pacific Island countries and territories (PICTs).

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Eels are consistently fished because of their accessibility and market demand. According to the United Nations Food and Agriculture Organization (FAO), there has been a global decline in the eel catch, from a peak of 18,600 t in 1994 to 12,700 tonnes in 2000 (Europe 5300 t; Asia 2400 t; Oceania 1600 t; North America 1100 t). A portion of these catch figures refer to glass eels and elvers. The International Council for Exploration of the Sea (ICES) declared the eel spawning stock to be over-exploited from safe biological limits (FAO 2002). Some of the reasons attributed to the decline in catches are river development and dam construction, overfishing and environmental degradation.

World aquaculture production of freshwater eels has increased over the past decade and about 233,000 t were harvested in 2000, with a value of USD 978 million (FAO 2002). The artificial propagation of eels has not yet been achieved commercially. For aquaculture, glass eels or elvers must be caught from the wild for stocking in culture facilities. The increasing worldwide demand for eels and the overexploitation of many eel fisheries present an opportunity for eel culture. Pacific Island countries offer a good environment in which to culture eels, as they grow rapidly in tropical climates, preferring a temperature range of 23–28° C, and a pH range of 7.0–8.0. In ideal conditions they grow to marketable size (150–200 g) in 10 to 20 months, although their growth rates can be extremely variable. For pond-based aquaculture, the best site is one with a constant water supply; other pond features are generally similar to those required for tilapia and prawns.

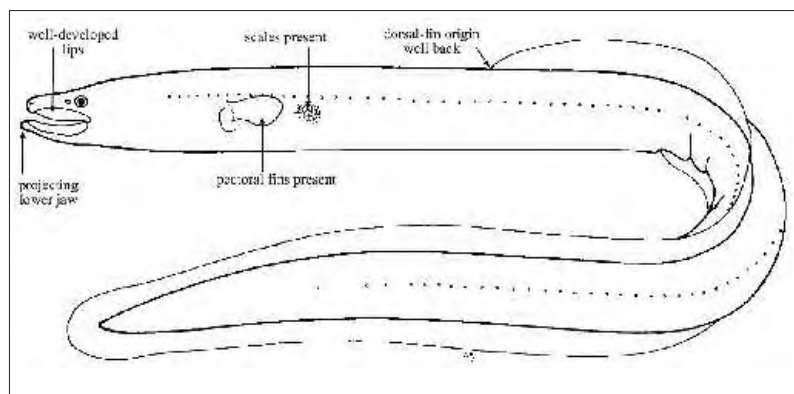
Eels are consumed in PICTs and particularly in Fiji, where it is an important source of protein for the rural indigenous population. In some localities, high demand has led to the collection of young eels from the wild for culture in tilapia ponds.

In Fiji, elvers and juvenile eels are caught from estuaries, mountain tributaries, swamps and ditches using various types of local gear. These eels are grown to marketable size in ponds designed for tilapia culture and sold live at FJD 10.00 per kg at Suva and Nausori markets. An artisanal capture fishery also exists in Fiji, with small volumes of wild adult eels captured from the wild and sold at some municipal markets.



**Figure 1: *Anguilla obscura***  
**(Photo by Pierre Laboute, ©**  
**IRD)**





**Figure 2: Eel morphology**

Eels are still largely under-utilised in PICTs, despite the present shortage of many more established marine food fish. One reason may be that the public remains unfamiliar with eels, and there may be little awareness of eels as a potential candidate for aquaculture. With sufficient clean water and available land for aquaculture, and given the dwindling international supply of eels, PICTs have the opportunity to develop an eel capture fishery and culture industry. Some agencies have expressed their desire to help develop this industry by funding research to gain knowledge of the availability of the species in the wild, due to the fact that eel culture is totally dependent on the availability of wild glass eels and elvers.

In PICTs, eels are caught with hand lines, spears, cane knives and push nets. This gear is designed to capture a wide range of fish and crustaceans and is not specific to capturing eels. In other parts of the world, specially designed traps, otter trawls, long lines, fyke nets, haul seines and other gear types are used to catch eels. In some localities in PICTs, the indigenous population has traditional knowledge of the best times to capture eels; in others, stories are told about eels. This article presents some basic information on eel catching methods and a brief description of eels. Future articles will

address eel capture, life history, the potential for aquaculture and other aspects. We urge readers to send any information or stories that they wish to share with us and others in the region.

### General description

The eel has an elongated snake-like body, is very slimy and is without scales. A pair of pectoral fins is positioned just behind the small head, and there is a small gill opening in front of each fin. The back and anal fins are very long and merge with the tail to form a

continuous soft-rayed fin fringe (see Fig. 2). The freshwater eel varies in colour from dark brown to greenish, black, yellowish white, and golden yellow on the belly. Eels are found in rivers, streams, creeks, swamps, lakes, pools, reservoirs, wells, fish ponds and along the coast. Eels feed on a variety of feeds such as fish, molluscs, crustaceans, and terrestrial and aquatic insects.

In Fiji, when the word “duna” or “bham” is used, it is certain that the fish referred to is the so-called common eel, *Anguilla*, which occurs in most of the islands. The taxonomic classification of eel is as follows:

Kingdom: Animalia  
Phylum: Chordata  
Class: Osteichthyes  
Order: Anguilliformes  
Family: Anguillidae  
Genus: *Anguilla*

The family contains a single genus *Anguilla*, with about 15–19 species. The eel species identified so far are given in Table 1, along with the areas of

**Table1. Some of the eel species found in the world.**

Species	Distribution
<i>Anguilla reinhardi</i>	Australia, Fiji, New Caledonia, PNG
<i>A. australis</i>	Australia, New Zealand, Fiji, PNG
<i>A. marmorata</i>	Fiji, Samoa, American Samoa, PNG, New Caledonia
<i>A. bicolor</i>	PNG, Philippines, Indian Ocean
<i>A. megastomata</i>	Fiji, PNG, Tonga, Samoa, Solomon Islands, Tahiti
<i>A. obscura</i>	Fiji, PNG, Tonga, Samoa, Tahiti.
<i>A. japonica</i>	Japan, China
<i>A. bengalensis</i>	Indian Ocean
<i>A. mauritiana</i>	Central Pacific
<i>A. borneensis</i>	Borneo
<i>A. mossambica</i>	Indian Ocean
<i>A. nebulosa</i>	Indian Ocean
<i>A. celebesensis</i>	Philippines
<i>A. pacifica</i>	East Pacific
<i>A. anguilla</i>	Europe, Iceland, North Africa
<i>A. rostrata</i>	North America, Greenland

Source: Lane (1978), Allen (1991)

the world where they normally occur (this is not a complete list of species or distribution).

The life history of the species that have been studied is similar. Eels migrate downstream to the sea upon reaching sexual maturity. Spawning occurs in centralized locations in the deep ocean. The small larvae (leptocephali) swim and are carried by ocean currents to coastal areas, where metamorphosis occurs and the young gradually assume the appearance of adults (elvers) and migrate upstream. Eels have very muscular bodies and are well adapted to reach remote streams high in the mountains, and even travel across damp land. Reports indicate that eels may take as long as 10–20 years to attain sexual maturity before making their migration back to the sea.

#### Fishing methods and gear

The catching of eels in Fiji and other Pacific Islands normally involves inexpensive and very simple gear, which include: baited hook and line, spears, push nets, hollow bamboo piece or PVC pipes, baited trap, and seine nets. Of these, the first three methods are the most commonly used. The choice of method may be governed by the types and costs of materials available in villages. The author is unaware of any regulations regarding the type of gear that can be used for catching eels, as



the catch is mainly for subsistence use. Generally, the gear types that are used target edible-sized eels and do not capture juveniles or disturb the habitat. In some localities, villagers wish to limit the number of eels, which would otherwise prey upon other species of fish in pools, ponds and rivers.

#### Baited line

A fishing line with baited hooks is used in a number of ways in rivers, creeks, streams, lakes, drainage canals and swamps and pools in Fiji and in some other PICTs.

The most common approach is to use a small baited line (10–20 kg test) attached to a two to three-meter wooden pole and cast into the stream, river or pool water. This method is usually practiced by women for catching eels in streams after flash floods or rainfall. The bait used usually consists of earthworms and fishes (such as mosquito fish, *Gambusia*). Another method uses a fishing line with baited hooks (no pole used), which is cast into rivers, streams and lakes. The bait usually consists of chicken gut (something smelly) or fish such as *Gambusia*. The line may be set in the evening and checked at hourly intervals, or set at night and hauled in the morning. This method allows catching of eels with minimum damage to the body; eels may be kept in moist baskets for sometime before being sold in markets, roadside stalls or cooked.

#### Eel spears

Several types of spears are used, although a thin iron rod fixed to a wooden pole (see Fig. 3) is the most common type in Fiji. In some designs, the spearhead (the end of the iron rod) is sharp and has a small spike in the front portion, permitting capture of the eel by spearing and

pulling it up. If the spearhead lacks spikes, the capture of the eel is by spearing and then gripping it or holding it down and hauling it up by hand.

The spears are usually used in shallow streams or creeks when visibility is sufficient to distinguish the eel moving or lying idle in the water; at most times the eel's head will be jutting out of an "eel hole", a dead wooden trunk or a bamboo pole. Eels are most commonly speared at night with the aid of a bright light.

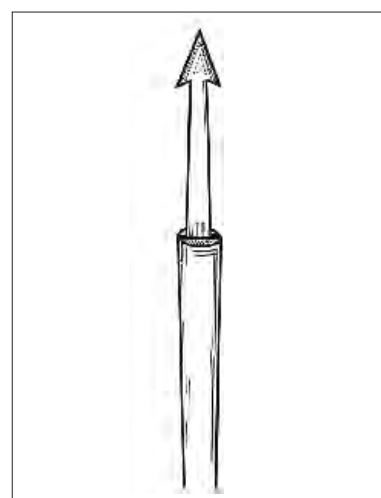


Figure 3: Eel spear

#### Push net

A push net or hand net is used in estuaries, streams and swamps for catching eels along with other local fishes and crustaceans, usually by fisherwomen. A net up to 0.5–1.5 m long and 0.5–1.5 m wide, and with a mesh size of 4–10 mm is manageable. The net is operated by pushing it in slow moving water over a smooth bottom in estuaries that are covered or partially covered with grass. The net may also be fixed into a deep portion of an estuary by pushing the ends of two poles into the ground and disturbing the water so that fish and eels move into the net. Eels hiding in crevices and holes are disturbed by pushing a hand inside them,

permitting the eel to move into the net; eels may also be caught by hand and pulled out and transferred into the basket.

#### *PVC pipe or bamboo method*

Various types of pipe or hollow pole are used: PVC pipe (dia 25–100 mm), polyethylene pipe, iron pipe, hollow bamboo, etc. PVC pipe (dia 75–100 mm and length 1–3 m) is usually preferred (see Fig. 4). One end of the pipe is closed with chicken wire mesh. A string or rope is tied to the other end to permit hauling on the pipe. Some pipes have a small hole in the central portion for placement of bait. The pipe is placed on the bottom of a river, swamp or estuary, with the mesh-covered end facing the current to allow water to flow through it. The eels usually move inside the pipe and "sleep" inside these tubes. The

pipes are usually set in the evenings and hauled the following day. This pipe method is also used for removing eels from prawn and tilapia ponds.

#### *Cane knife*

Villagers who do not have the above-mentioned gear use a cane knife to catch eels by chopping them at whichever place the knife strikes the animal. In some instances, the blunt side of the knife is used to strike the head of the eel. But some fear their eel may escape unless chopped in half. This method is usually used for catching eels in shallow streams or creeks at night with a bright light.

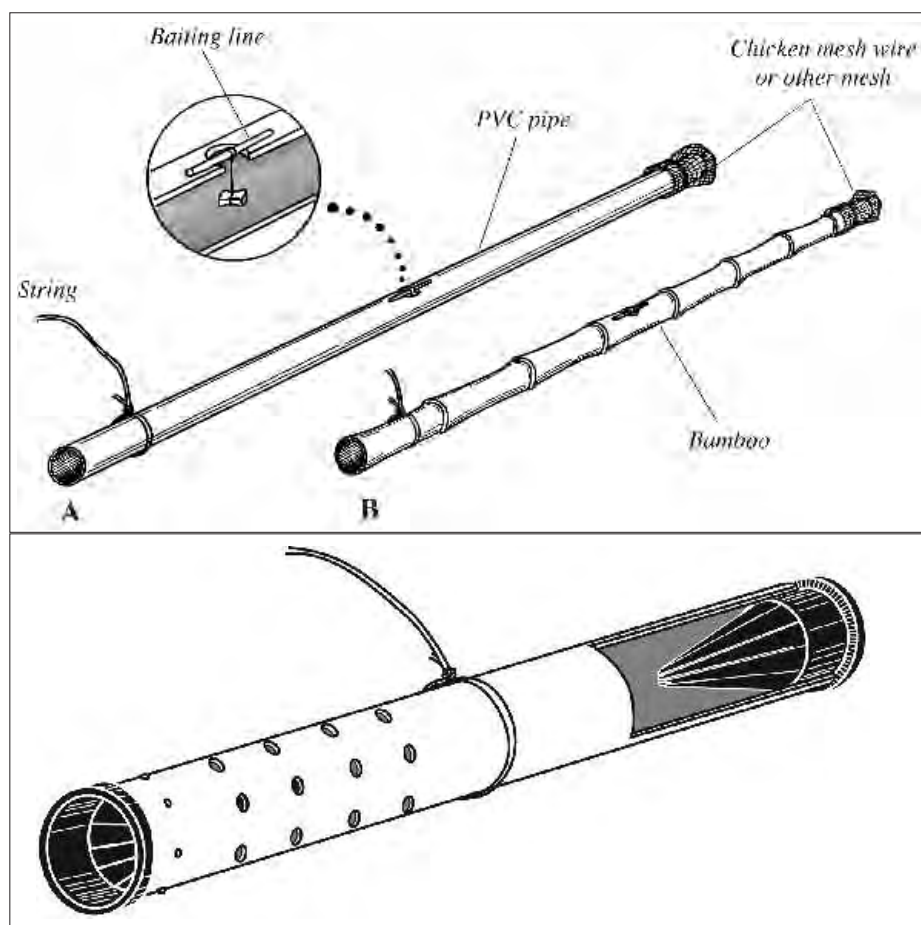
#### *Other methods*

Other methods of catching eels, such as baited traps, fyke nets

(see Fig. 5), longlines, shore seines and electric fish traps are not used in PICTs and are thus not mentioned here. Fishers are encouraged to use baited traps, however, many types of portable traps have been used including empty buckets or any trap-shaped structure.

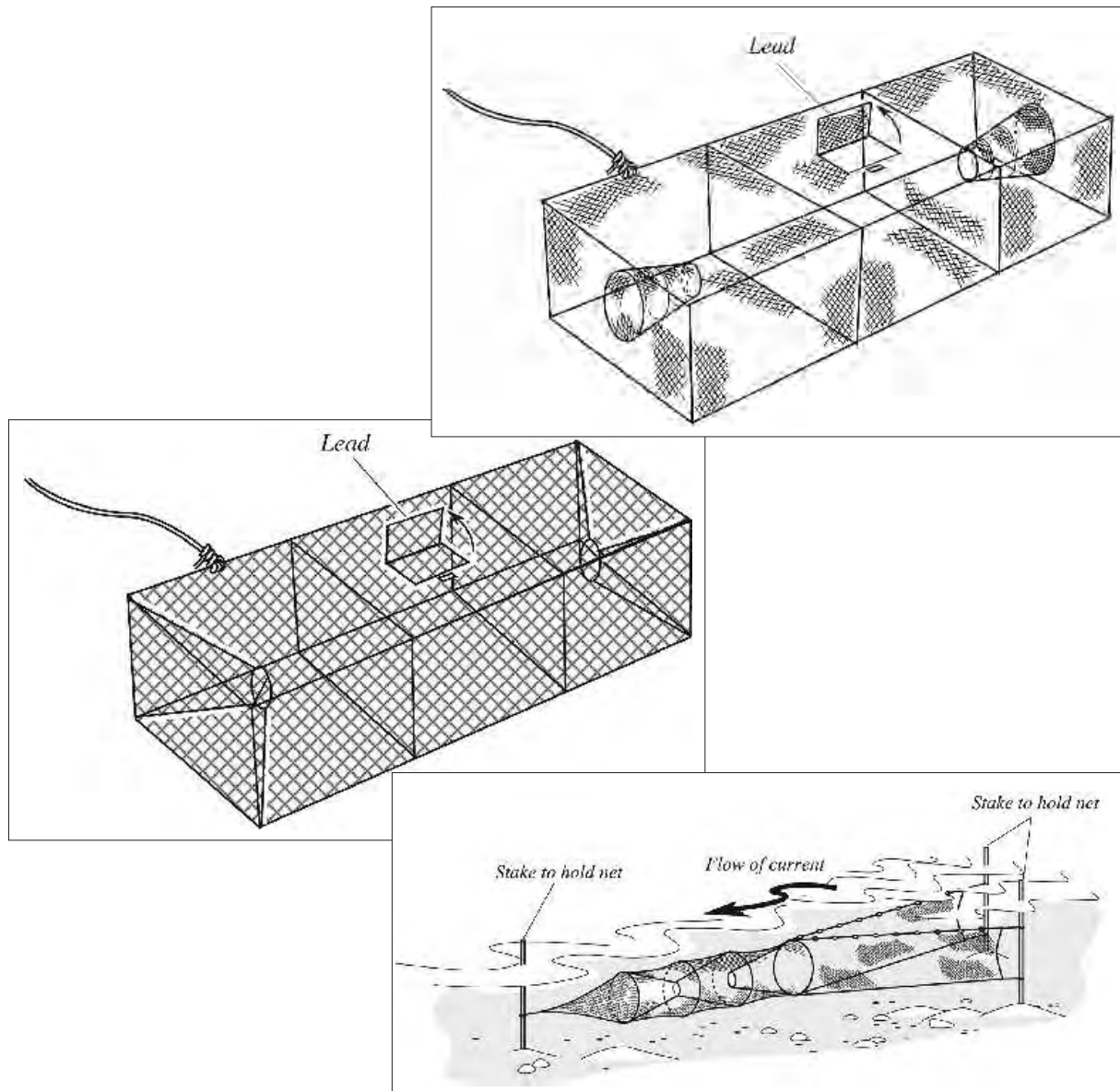
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**Figure 4: PVC pipe or bamboo method**





**Figure 5: Baited traps and fyke nets**



**Juvenile eel caught from a prawn grow-out trial pond at Futuna on 26/10/05**