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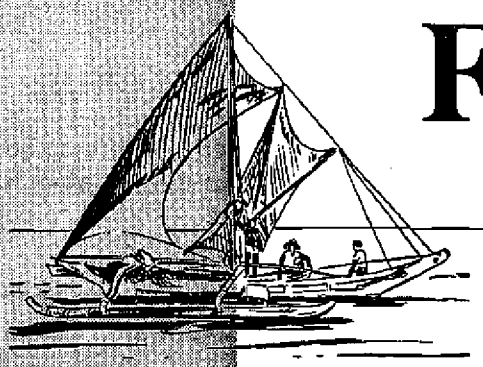


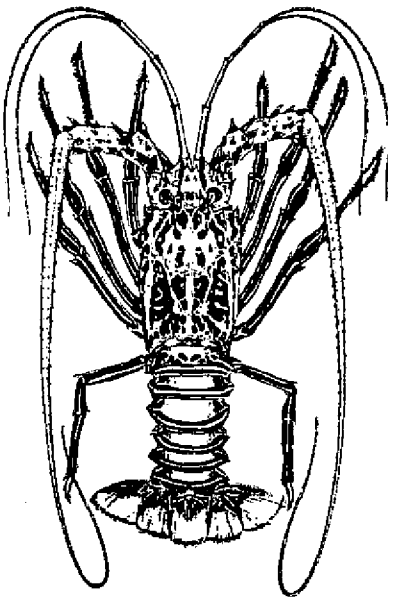
# FISHERIES

## *Newsletter*

NUMBER 67
OCTOBER — DECEMBER
1993

## IN THIS ISSUE





***Panulirus versicolor***

South Pacific Commission
Prepared by the Fisheries Information Officer
(Printed with financial assistance from the Government of France)

## TWENTY-FIFTH REGIONAL TECHNICAL MEETING ON FISHERIES (RTMF)

This meeting will review the Commission's fisheries activities for the last 18 months (our readers will recall that, due to financial constraints, the 1993 meeting was cancelled [see SPC *Fisheries Newsletter #66*]). The draft agenda for the meeting, subject to modification, is shown below.

### Draft agenda: 25th SPC Regional Technical Meeting on Fisheries

**14 March**
- Opening formalities
- Fisheries Programme Manager's report
- **Technical session 1**: Western Pacific tuna fishery overview
- **Technical session 2**: Update of assessments of yellowfin, skipjack and bigeye

**15 March**
- Oceanic Fisheries Programme overview
  - Statistics and monitoring
  - Biological research
  - Assessment and modelling
  - Reporting and liaison
  - Albacore Research Project
- **Technical session 3**: Outline of the South Pacific Regional Tuna Research Project
- **Technical session 4**: The status of Pacific Island inshore fisheries

**16 March**
- Coastal Fisheries Programme Overview
  - Capture Section
  - Post-Harvest Section
  - Training Section
- **Technical session 5**: Development of broadbill swordfish longlining in the Pacific region
- **Technical session 6**: Processing novel tuna products in the Pacific

**17 March**
- Coastal Fisheries Programme Overview (continued)
  - Resource Assessment Section
  - Information Section
- Report of the Sixth Pacific Islands Marine Resources Information System (PIMRIS) Steering Committee Meeting
- Statements by other organisations
- Review of regional institutional arrangements in the marine sector

**18 March**
- Quarantine protocols for marine species
- Timing of next meeting
- Other business
- Adoption of the report

## SIXTH PIMRIS STEERING COMMITTEE MEETING HELD IN SUVA

The Sixth Pacific Islands Marine Resources Information System (PIMRIS) was held in Suva, Fiji from 8 to 9 November 1993. This meeting usually takes place before the SPC Regional Technical Meeting on Fisheries (RTMF) but, due to financial constraints, the 1993 RTMF was cancelled and, subsequently, the PIMRIS meeting had to be rescheduled.

This year's meeting was attended by participants from American Samoa, the Marshall Islands, Papua New Guinea, Tonga and Vanuatu. The four participating agencies (FFA, SOPAC, SPC and USP) were also represented.

One of the major concerns to participants was the continuation of the PIMRIS Coordination Unit. Funding was running out at the end of 1993, but sav-

ings from the 1990/91 period have allowed the Unit to reallocate this money for continuation of its activities until the end of 1994.

Since the establishment of the PIMRIS network, various information activities have been undertaken by the participating regional agencies, two of the major initiatives being the development of the MOANA database (a second version of the PIMRIS database was released in March 1993), and the assistance given to national centres in the organisation of their information resources. Assistance has been given to 14 countries so far, including American Samoa, Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Northern Marianas, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa.

PIMRIS, which was developed to improve the dissemination of fisheries information to Pacific Island countries, has become internationally recognised and is now the official representative (as the South Pacific regional member) of the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC).

Another issue discussed during the meeting was CDS/ISIS interface (MOANA was developed using CDS/ISIS). The USP Library Systems Manager demonstrated a more 'user-friendly' search interface for CDS/ISIS. The participants recommended that the development work should be continued and that a CDS/ISIS Special Interest Group should be established within the region.

A report of the meeting (including recommendations) will be presented at the 25th Regional Technical Meeting on Fisheries, which will be held in Noumea, New Caledonia from 14 to 18 March 1994.

**Some participants at the 6th PIMRIS Steering Committee Meeting. Left to right: Calora Ysawa (Marshall Islands), Jean-Paul Gaudechoux (SPC), Deveni Temu (SPC), Henry Yule (Papua New Guinea)**

## INFORMATION SECTION

# The Pacific Islands Marine Resources Project (PIMAR)

The Pacific Islands Marine Resources Project (PIMAR) is a project funded by the United States Agency for International Development (USAID), and has a budget of some US$13.7 million (see SPC *Fisheries Newsletter #66*). Its main goal is to increase income-generating opportunities in Pacific island nations in ways which capitalise upon good conservation and management of natural resources.

Although PIMAR is regional in scope, six national components were determined: Fiji, Cook Islands, Kiribati, Papua New Guinea, Tonga, and Tuvalu. A country-specific project was planned to cater for each participant's needs. The possibility of 'exporting' these projects to other countries within the region was also considered.

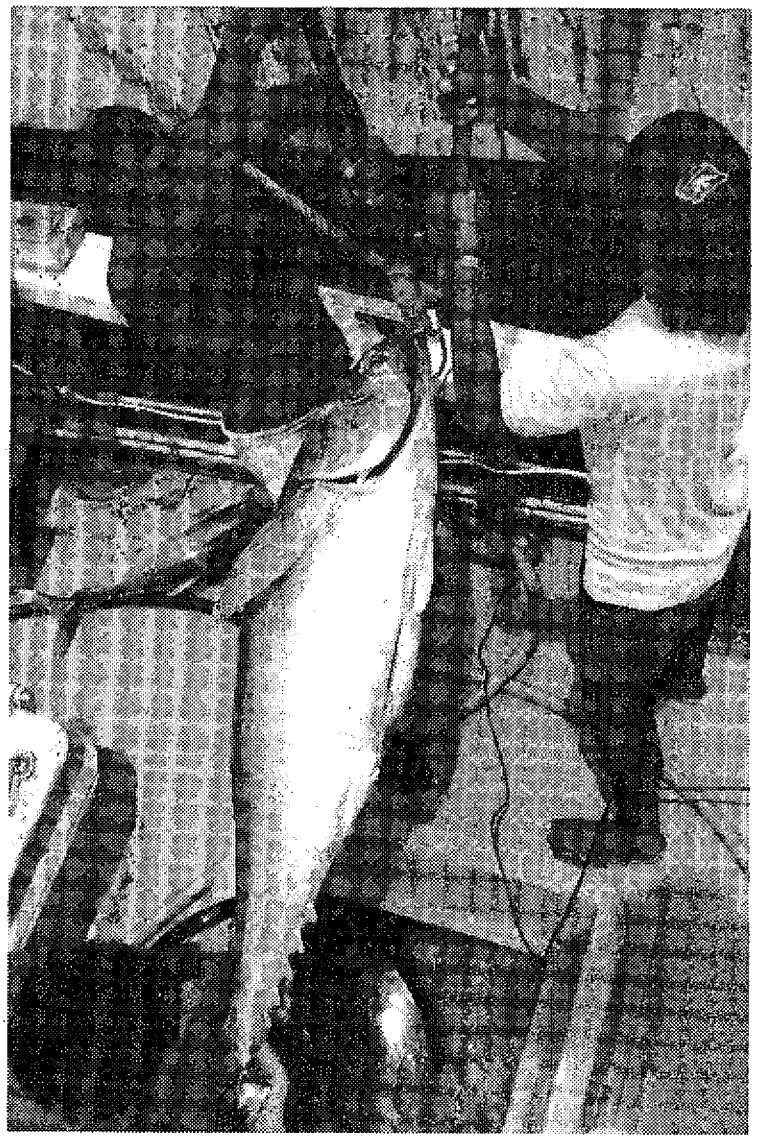
During the last quarter of 1993, the Fisheries Information Officer had the opportunity to travel in the region and visit three of the countries involved in this project: Papua New Guinea, Tuvalu and Kiribati. A short description of each country's project as well a progress report are presented below.

## Papua New Guinea

Papua New Guinea's Exclusive Economic Zone contains large stocks of tunas (industrial purse-seine harvests are about 100,000 mt, destined for foreign canneries). The goal of this PIMAR project is to increase tuna exports by encouraging the private sector to develop a local tuna fishing industry and to purchase appropriate fishing vessels (longliners). Efforts will have to be made to train crews in longline fishing techniques and in fish handling. This operation is aimed at breaking into the sashimi-grade tuna market, first in Australia and later in Japan.

In order to evaluate the project's feasibility, several phases have been identified. During the first phase, the South Pacific Commission was commissioned to provide an experienced longline fisherman to undertake FAD deployment, baitfish resource assessment and preliminary fishing activities. The Government of East New Britain supplied a fishing boat, the F.V. *Kuriap*, to carry out this test fishing project.

In mid-1993, following extensive vessel renovations, USAID allocated funds for SPC to equip the boat with a monofilament longline fishing system. Fishing trials have already begun and first results are encouraging.



**A yellowfin tuna is carefully unloaded from the F.V. Kuriap**

Fishing has mainly produced large yellowfin tuna (around 50 kg) and a few bigeye tuna, which are among the most sought-after after species on the sashimi market. At the present time, catches are marketed locally at the Kokopo fish market. Several other sites around Rabaul will have to be fished before any firm statement can be made about the project's viability. Experimental marketing is scheduled for early 1994 after installation of a sufficiently large ice-maker.

If the first phase is successful, the second will aim at encouraging the private sector, through the PNG Fishing Industry Association, to become involved in these types of activities, not only on-site, but also by holding workshops, publishing information sheets about the industry, and outlining investment schemes.

Based on evaluations of phase one and knowledge gained in phase two, it was anticipated that a third phase would establish and develop a sashimi-grade tuna fishing industry. It was planned that this would include training sessions on fishing techniques, creation of marketing networks in Papua New Guinea and abroad, and creation of an agency to be responsible for selling (special attention will be paid to product quality and management).

If all these objectives are attained, a promising sashimi-grade tuna export industry should have come into existence, allowing Papua New Guinea to make better use of its fisheries resources.

## Tuvalu

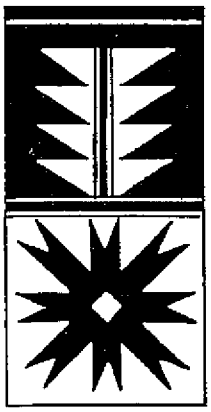
This project, budgeted at US$ 930,000, is aimed at assisting the development of small-scale offshore bottom-fish harvesting in Tuvalu, where deep slope and seamount fishing is a relatively new undertaking. Assessment of stock began in Tuvalu in 1976 with the arrival of a masterfisherman from the South Pacific Commission.

The principal objectives of this project are to assess Tuvalu's bottom-fish resources to determine the potential for exploitation, carry out fishing trials using new fishing techniques on seamounts and in the shallower waters of the exclusive economic zone (EEZ), define the technical characteristics of boats for local fishermen, and undertake experimental marketing in Hawaii and Japan.

Collection of data from the above-mentioned activities will permit the formulation of a bottom-fish management plan. The project began in October 1991, and since that time, resource assessment has been carried out using the *Manaui*. The seamounts in the northern section of the EEZ have been surveyed, and those in the southern zone should be surveyed soon. The data collected will be sent for analysis to the National Marine Fisheries Service (USA) in Hawaii. Fishing trials had also been scheduled, and a second boat, registered in Lautoka (Fiji) was chartered in late 1993, and will carry out 4-5 fishing trips in 1994. Catches will be exported from Fiji, which has a better infrastructure than Tuvalu, to Hawaii, the West Coast of the United States and Japan. By-catches will be sold directly in Suva.

Crew training is an important component of this project. About twenty local fishermen have been trained in fishery data collection techniques, fishing gear preparation, navigation, and fish handling. Five Tuvaluans participated in a five-week study trip to Tonga and Fiji. Two members of the Tuvalu Fishery Service were selected to take part in long-term training at the University of the South Pacific in Suva.

If this project is successful, a fleet targeting bottom fish may soon come into existence in Tuvalu. This will make it possible to transfer fishing effort, currently concentrated in very highly utilised zones, to little-used or unused areas.



## Kiribati

The purpose of this project (budget US$ 1,260,000) is to complete a large-scale survey of the Tarawa lagoon in order to formulate management strategies for its marine resources. On a wider, more regional scale, one of the project's goals is to develop strategies which could be used for other lagoon ecosystems.

The consultant selected, Biosystems Analysis Inc., has set up the project in conjunction with the University of the South Pacific Atoll Research Pro-

gramme. Most of the personnel are Kiribati nationals, except for some consultants who take part in the project as required.

Several objectives have been defined, which include:

**1. Assessment of shellfish stocks**

This assessment mainly concerns the shell *Anadara maculosa* (**te bun**). Data have already been collected, making it possible to identify the areas of abundance. It appears that this species has been over-exploited, especially in the shallow parts of the lagoon. A list of all invertebrates living in the lagoon has been made, thus giving a better picture of its biodiversity and of the predominant species. Tagging experiments, with the help of Superglue, were made on the **te bun** but, due to lack of information, the fisherfolk continued collecting this species, including those tagged. Assessment is in its final stages and should be completed at the end of 1993.

**2. Assessment of fish stocks**

Fish sampling took place in 1992 and 1993 to provide information about the state of Tarawa lagoon's fisheries resources. The data gathered came from two sources: landing data supplied by fishermen and direct sampling using gillnets or handlines. When compared with data from 1977, current data shows a noticeable decrease in the number of bonefish or **te ikari** (*Albula glossodonta)* as well as marked overfishing in Tarawa lagoon. The bonefish is certainly the most abundant species present in the lagoon. It is traditionally captured using traps, handlines, or gillnets. Local fishermen considered gillnets to be one of the principal causes of the decrease in bonefish and feel that their use should be banned during migration and spawning aggregation seasons.

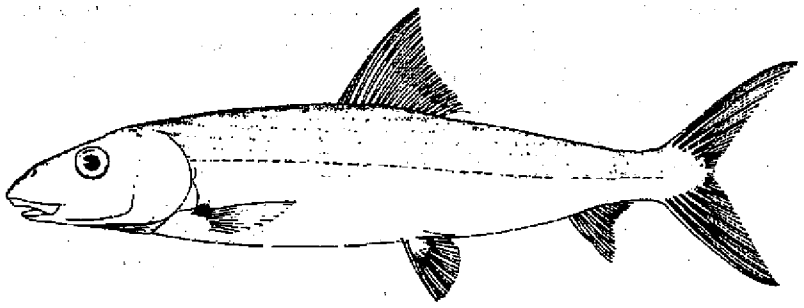
**3. Collection of data on water circulation and quality in Tarawa lagoon**

Study of water circulation in the lagoon is very important as it is responsible for the movement of organic particles and thus 'spins the web' of food in the lagoon. No eutrophication (a loss of oxygen due to, among other factors, large growths of algae) was noted. However, bacterial pollution due to faecal coliforms was recorded. A public information campaign is in progress to make the inhabitants aware of this problem.

An analysis of the different assessments will allow a marine resources management plan to be drawn up for Tarawa atoll.

Some other countries are involved in PIMAR. Brief mention can be made of the Cook Islands (budget: US$ 2.4 million) where a pearl culture development study is in progress on Penhryn atoll. In Tonga, development of a small-scale longline tuna fishery is the main goal (budget: US$ 2.3 million). This project will test different tuna fishing methods by using different types of boats to determine which is most effective. Baitfishing trials will show where and when baitfish are available, and training in fishing techniques for local fishermen is also scheduled. The scientific aspect has not been neglected, and collection of data on bottom fish and baitfish has been planned to assist in the preparation of a management plan for these resources. The sixth country in PIMAR is Fiji (budget: US$ 900,000), where the Lami jetty will be renovated. Study visits to the United States are planned for Fiji businessmen. This will allow them to establish business ties with the American private sector.

The PIMAR project, totalling US$ 13.7 million, is an ambitious project whose goal is to provide assistance to the private sectors of the countries involved, so that local businessmen can invest in small-scale integrated projects.



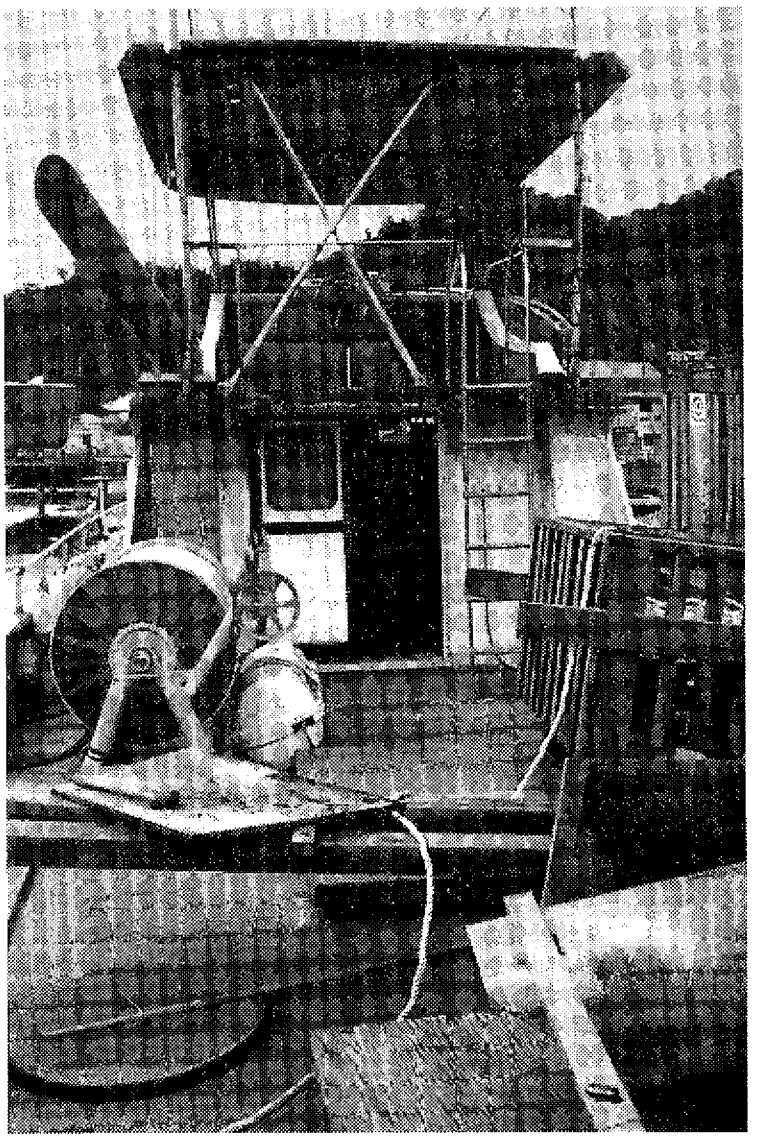
**The bonefish, *Albula glossodonta***

*Last minute update: Due to internal restructuring, the United States Agency for International Development has decided to close 21 of its offices around the world, include its Suva branch. We will keep Fisheries Newsletter readers informed of the effects that this decision may have on the PIMAR project.*

## CAPTURE SECTION

### Tuna longlining trials in American Samoa

In response to the regional growth in domestic sashimi tuna longlining operations, American Samoa's Department of Marine and Wildlife Resources decided to explore the potential for tuna and billfish longline fishing in its waters by undertaking a series of fishing trials. It was expected that these would produce catch CPUE and biological data which would assist in developing management plans for any emerging domestic longline fishery. To this end mono-filament longline gear and a hydraulic hauling drum was fitted to the Department's fisheries research vessel F.V. *Sausauimoana* and fishing trials commenced, targeting broadbill swordfish in the first instance. While promising results were obtained, problems with the vessel and bait supply hindered operations to an extent. With the loss of the vessel's skipper and before the trials were completed, the Department requested the assistance of the Section in providing the services of an experienced longline fisherman to complete the assignment and assess and advise on the local infrastructure required to support a domestic longline fishery.



**F.V. *Sausauimoana* showing the Lindgren Pitman longline reel mounted aft of the wheelhouse. The wooden crate on deck holds rope ready for a FAD deployment.**

Gerry Russo of Fiji, an experienced commercial longline fisherman, was subsequently assigned to this task. In Pago Pago he first made an assessment of the vessel and gear on hand and reviewed historical catch and effort data for tuna fishing in American Samoa's waters. This research included an examination of bathythermographic data for American Samoa's waters collated by SPC's Tuna and Billfish Assessment Programme.

These data, collected by expendable temperature/depth sensors (XBTs) deployed by ships at sea, under a programme jointly operated by the French scientific organisation ORSTOM and the Scripps Institute of Oceanography in California, can be used to gain an indication of thermocline depth for specific areas; useful information when configuring longline gear to target yellowfin, and more particularly, bigeye tunas, which are believed to prefer the temperature range 10–15° C.

In preparation for the trials extra fishing equipment and supplies were specified and ordered and bait supply orga-

nised, but the vessel was found to need extensive work before it could be taken to sea. Some of this work was completed by the consultant and other tasks were contracted locally. Fishing trials targeting tuna are expected to commence early in 1994.

## Solomon Islands rural fishery moves toward export marketing

Under the EU-funded Rural Fishing Enterprises Project, Solomon Islands' Ministry of Natural Resources has promoted small-scale commercial fishing operations at three rural centres, Yandina in the Russell Islands, Tataмba and Marau. Each site has a fisheries station which provides fishermen with ice, fuel and gear sales and other support. Annual production from the three centres has been about 90 t/year, most of which is sold in Honiara with some exports in the form of frozen fillets. The project's success in increasing rural catches, and the establishment of transport and marketing channels has led to brighter export prospects for high-value species, particularly deep-bottom snappers, to markets such as Hawaii.

To assist in this effort the Section was requested to provide the services of a Master-fisherman to train rural groups in deep-bottom handreeling and on-board handling to produce export-quality landings. SPC masterfisherman Paxton Wellington was assigned to this task in early December 1993. The training programme commenced at Yandina where Paxton helped outfit local vessels and demonstrated deep-bottom anchoring and fishing technique. Catches of deep-water species improved quickly and in the second week of operation 1.5 t was landed from seven small craft; 670 kg of this catch was successfully exported to Hawaii.

# TRAINING SECTION

## Regional course planning in progress

Recent discussions in regard to Fisheries Enterprise Management suggest some very worthwhile training opportunities may soon be on offer in the region. Alastair McIlgorm, Fisheries Economist with the Australian Maritime College, Tasmania, has developed two short-course programmes relating to managing fishing enterprises.

The **Fishing Enterprise Management Course** has an intended duration of 15 to 20 days, and is designed for participants with both educational and practical experience. The course aims to train junior management personnel from fishing enterprises or state fishing development organisations in developing countries in the practicalities of running fishing and seafood enterprises. Emphasis will be given to project development in an ecologically sustainable context and the participation of women in this sector.

The course will have seven core elements:

- Accounting and economic principles, such as costing and profitability analysis, for fishing enterprises,
- Appraisal of fishing projects and seafood business ventures,
- Management of fishing and seafood enterprises,
- Seafood technology principles and handling of seafood products,
- Markets and marketing of seafood products,
- Fishing business development and resource husbanding in an ecologically sustainable context,
- The role of women in business enterprises and project development.

It is intended that the course will be run on demand at AMC, but it is hoped that sufficient country interest will see the course run in the region.

Alastair has already been active in the region this year with the delivery of a **Fisheries Economics and Financial Appraisal Course** through the National Fisheries Corporation in Pohnpei, Federated States of Micronesia.

Both these courses should attract considerable interest in the region and AMC/SPC are keen to get feedback from fisheries personnel. Positive responses and requests for these courses

should enable joint AMC/SPC courses to be offered during 1994.

Another area which has attracted several country requests is **training in grading sashimi tuna for export.** Fresh tuna exportation is now operational throughout Micronesia, and in Fiji, New Caledonia, Tahiti and American Samoa. Papua New Guinea and Tonga are hoping to join this group, based on USAID-funded longlining projects currently under way in Rabaul and Vava'u.

Critical to the success of these export operations is the accurate grading of the tuna to meet the exacting needs of the importer. Grading according to flesh colour and oil content is essential and requires skills developed over time. Exporters must avoid sending tuna to markets where it will not meet the required grades – a potentially expensive error rarely offset by lower prices on the auction floor.

The skills of a top sashimi tuna grader are a valuable asset to all exporters; so much so that experienced graders are often brought in from traditional market centres. Skillful graders from within the Pacific region are few and far between.

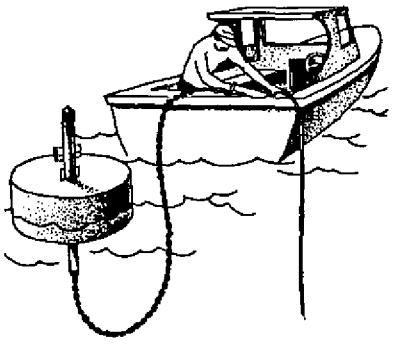
SPC is at an early stage of developing a training initiative to try to respond to this deficiency. Through an intensive training workshop lasting up to two weeks we expect to be able to train graders to a proficient level as a basis for on-the-job training.

This is potentially a valuable opportunity for any commercial tuna exporter. Expression of interest plus an indication of what commercial operators feel should be included in such training courses should be sent to the Regional Fisheries Training Programme at SPC.

Once comments have been received, SPC will formulate a workshop programme. It is hoped that if sufficient country and commercial sector interest is received, a workshop can be organised for the latter part of 1994.

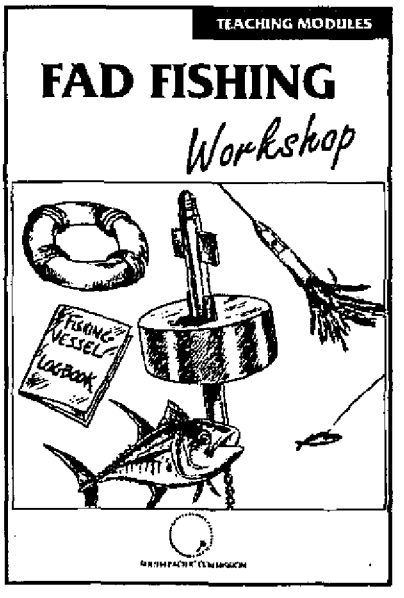
## Production of resource material for FAD workshops

The Fisheries Training Section has undertaken the production of resource materials to support a forthcoming series of workshops. These workshops will be jointly organised by the Capture and Training Sections and are intended to provide a logical follow-up to FAD deployments.



The intention of the SPC Coastal Fisheries Programme is to train Pacific Island fishermen from those countries having benefited from SPC's assistance in deploying FADs in their waters. The resource material under production is a 'tutor package' of eight modules covering areas such as safety at sea, fish handling and quality, small fishing business management, and of course the fishing techniques to use around FADs (trolling, vertical longlining, drop stone fishing, etc). The package will also include a number of overheads as well as suggestions for workshop outlines for 3-day, 5-day and 2-week courses. The choice of the workshop outline and the subjects to be covered will be left to the hosting country according to local training needs and workshop duration. Initially the workshops will be run by SPC staff with the assistance of a local tutor; the local tutor would then take over and run further workshops on his own.

The first workshops of this type will be hosted early in 1994 by the Tonga Ministry of Fisheries, following the deployment of two FADs around Nuku'alofa in October 1993.



## RESOURCE ASSESSMENT SECTION

### Fisheries resources survey of Beveridge Reef

During 1993, a New Zealand fishing company, Vakamanu Ltd, expressed an interest in fishing on and around Beveridge Reef, an oceanic partly emergent oval-shaped reef within the Niue exclusive economic zone (EEZ). Little documented information exists on the fisheries potential of Beveridge Reef and the Government of Niue asked SPC Fisheries Programme to assist the Department of Agriculture, Forestry and Fisheries (DAFF) in conducting a resources survey of the reef. The survey would be conducted during trial fishing on Beveridge Reef by the F.V. *Leann*, chartered by Vakamanu Ltd. The *Leann* is a US-registered 20 m albacore trolling vessel on which pelagic monofilament longline gear has been installed. It was intended that the survey would look at demersal and pelagic fish resources on Beveridge Reef, quantify the bêche-de-mer and giant clam resources and explore the potential for harvesting crayfish.

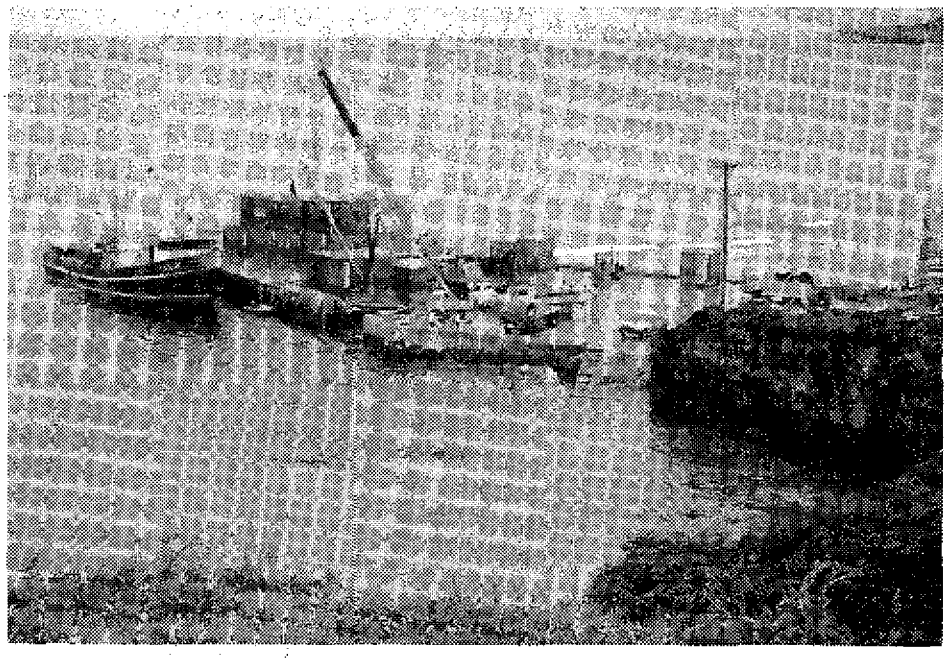
Inshore Fisheries Scientist Paul Dalzell visited Niue between 26 September and 8 October to participate in the survey. Funding for this visit was provided by the Forum Fisheries Agency. On his arrival at Alofi, the *Leann* was still conducting an exploratory fishing survey of Antiope Reef. On the morning of 30 September the *Leann* docked at Alofi and departed in the evening for Beveridge Reef with Paul Dalzell and three Niuean observers.

Unfortunately bad weather forced the *Leann* to return to Niue later that night. There was a strong likelihood of the bad weather with strong winds and rain remaining for a week or more making fishing at Beveridge Reef untenable. It was decided therefore that the *Leann* would leave Niue to fish for albacore in the southern convergence zone.

In the remaining time on Niue, Paul Dalzell searched through the DAFF files and documents for any information relating to fisheries resources at Beveridge Reef. Several fishermen on Niue, who had fished there during the 1980s, were contacted and interviewed.

Paul Dalzell also recorded observations on the development of coastal fishing on Niue since the initial IFRP survey in 1990. At that time, there were at most 5 serious fishermen on the island, i.e. men deriving their primary income from fishing.

By late 1993 there were about 20 fishermen in this category. This is due to the reduction in employment opportunities on Niue, particularly through the scaling down of the public sector workforce. Two retail fish shops in Alofi were getting ready to open at the time of this visit as a direct result of this increased fishing activity. As well as the increase in commercial fishing, subsistence fishing appears to be increasing as more people are importing aluminium dinghies and outboards. Another effect of this growth of fishing activity has been the drop in the average price of fish, from NZ$ 8.50 in 1990 to NZ$ 6.00 in 1993.



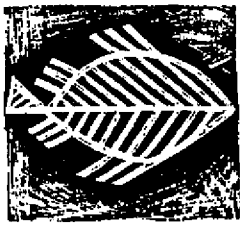
**The F.V. *Leann* at the wharf in Alofi**

*The following IFRP activities which occurred during the last six months were not reported in the last issue of the Newsletter as they were overshadowed by the ODA-PRAG review of the IFRP.*

## Attachment of PNG Fisheries Scientist and visitors to the IFRP

Over the past three years, the IFRP has assisted the Research and Surveys Branch of the PNG Department of Fisheries and Marine Resources (DFMR) in clearing a large backlog of unpublished technical reports. As a continuation of this work, DFMR Fisheries Biologist Augustine Mobiha completed a one-week attachment with the IFRP in August to finalise three technical reports on reef fish and estuarine molluscs. His visit to Noumea was fully funded by the DFMR.

Also in August, the IFRP hosted visits by two fisheries scientists from Australia and the UK. The first of these was Mr Glenn Sant from Traffic Oceania, based in Australia. Mr Sant was collecting information on the trade in commercial invertebrates in the region, including black and goldlip pearl oysters, trochus, green snail and bêche-de-mer, using the SPC library and documents made available by IFRP.



The second visitor was Dr Chris Mees from the Marine Resources Assessment Group, the commercial consulting firm attached to London University's Imperial College. Dr Mees is conducting a study on the management of multispecies tropical demersal bank and seamount fisheries on behalf of Britain's Overseas Development Administration. Dr Mees was interested in discussing this work with the IFRP scientists and Fisheries Programme staff, and in obtaining information on deep slope fisheries in the region.

## IFRP assists with reef fish conservation and biodiversity project

The IFRP was asked to assist the Coral Reef Fish Specialist Group (CRFSG) in documenting the distribution of surgeonfish (Acanthuridae) in the Pacific and elsewhere. The CRFSG is part of the Species Survival Commission, established under the auspices of the International Union for the Conservation of Nature. The CRFSG is presently conducting a worldwide survey of the status of coral reef fishes to identify priority conservation areas, preserve biodiversity and identify species potentially at risk. Other specialists in coral reef fish biology have also been contacted to help with the documenting the species distributions of other reef fish families.

Species occurrence of reef fish at different islands in the Pacific have been recorded by the IFRP and other sections of the Fisheries Programme. Further, the IFRP has access to a number of unpublished records of reef fish species at different locations in the South Pacific region. Based on this knowledge, IFRP reviewed in August a series of maps produced by the CRFSG that showed records of surgeonfish occurrence throughout the world. These maps form part of the CRFSG database on coral reef fish distributions. This information will be published as a report containing the maps of species distributions and be available as geographic information system (GIS) software.

## Literature generated by the SPC Inshore Fisheries Research Project (1988–1993)

As promised in the last issue of the *Fisheries Newsletter*, here is a list of the documents generated by the United Kingdom-funded Inshore Fisheries Research Project (IFRP) over the past few years.

The IFRP officially ends at the end of June 1994, and this list of mainly 'grey' literature is published as part of the winding-up process.

Between now and 30 June 1994, the IFRP will be able to respond to requests for copies of these reports, after which they will be deposited with the SPC library. Because many of these reports are not formal publications, they may not have been formally released from the confidentiality requirements of the country where the work was carried out. If requests are received for reports that are still confidential, the IFRP will endeavour to seek release from the commissioning Govern-

ment. In most cases, this will be a simple formality, but may lead to initial delays in responding to reprint requests.

If many reprint requests are received, we are likely to run into funding problems, as well as demands on staff time. For that reason we are unlikely to be able to accommodate requests from institutions such as libraries which want a copy of every item on the list. In the event of great demand, requests from SPC member country national fisheries administrations will be given top priority.

**List of reports authored, co-authored, or commissioned by the IFRP as of 22nd February 1994[1]**

1. **Survey of the deep water resources of the Northern Gilbert Islands, Kiribati**

   Authors: B. Bruz, G.L. Preston
   Fieldwork undertaken: February 1987

2. **Report of Workshop on Pacific Inshore Fishery Resources**

   Authors: A.D. Lewis, G.L. Preston
   Workshop held: March 1988
   Note: Published May 1988; SPC Meeting Report series. This workshop generated over 100 original papers: some are published but all are available in draft.

3. **The marine resources of Palmerston Atoll, Cook Islands**

   Authors: A.D. Lewis, G.L. Preston, A. Wright, N. Sims, W. Marsters, K. Passfield, N. Howard, I. Bertram, T. Teaurii, B. Yeeting, F. Viala, S. Maluofenua
   Fieldwork undertaken: September 1988

4. **Exploitation of the sea cucumber *Actinopyga miliaris* (blackfish, driloli) in Northern Fiji**

   Authors: G.L. Preston, V.Vakamoce, P. Lokani, F.Viala
   Fieldwork undertaken: November 1988

5. **A proposed sampling protocol for ciguatoxic reef fishes in the Federated States of Micronesia**

   Authors: P. Dalzell, M.J. Gawel
   Fieldwork undertaken: March 1989

6. **Pearl oysters in Christmas Island, Kiribati, and the potential for development of a pearl culture industry**

   Authors: N.A. Sims, G.L. Preston, B.M. Yeeting, R. Alfred
   Fieldwork undertaken: September 1989

7. **Inshore fishery resource management in Palau**

   Author: G.L. Preston
   Fieldwork undertaken: September 1989

8. **Evaluation of progress of the Inshore Reef Assessment and Monitoring Project, Tonga**

   Author: J.L. Munro
   Consultant fieldwork undertaken: November 1989

[1] does not include articles published outside SPC, workshop papers authored by non-IFRP staff, trip reports, Special Interest Group Bulletin articles, routine meeting papers or project progress reports.

9. **Deep reef slope fishery resources of the South Pacific**

Authors: P. Dalzell, G.L. Preston
Analytical work undertaken: June 1989–January 1992
Note: Published July 1992 as Inshore Fisheries Research Technical Document No.2.

10. **A review of fisheries research activities in the Republic of Vanuatu**

Author: P. Dalzell
Fieldwork undertaken: February 1990

11. **Preliminary account and analysis of the Government small scale fishing fleet on Funafuti Atoll, Tuvalu**

Authors: H. Patiale, P. Dalzell
Fieldwork undertaken: March 1990

12. **Issues in South Pacific fisheries development and management in the 1990s**

Authors: A. Wright, G.L. Preston
Note: Meeting paper undertaken jointly with the Forum Fisheries Agency.

13. **Report of a survey of pearl oyster resources at Nukulaelae atoll, Tuvalu**

Authors: G.L. Preston, M.T. Gentle, M. Kamatie, M. Naseli
Fieldwork undertaken: April 1990

14. **Report of a survey of the sea cucumber resources of Ha'apai, Tonga**

Authors: G.L. Preston, P. Lokani
Fieldwork undertaken: June 1990

15. **A review of the potential of aquaculture as a tool for inshore marine invertebrate resource enhancement in the Pacific Islands**

Authors: G.L. Preston, H. Tanaka
Note: Presented as Information Paper 5, 22nd SPC Regional Technical Meeting on Fisheries, August 1990.

16. **Preliminary observations on the incidence of ciguatera intoxication in the Federated States of Micronesia**

Authors: P. Dalzell, A. Edwards, A. Bowden-Kerby
Fieldwork undertaken: June 1990

17. **Fisheries resource survey of the island of Niue**

Authors: P. Dalzell, S.R. Lindsay, H. Patiale
Fieldwork undertaken: July 1990
Note: Published as IFRP Technical Document No.3 in July 1993.

18. **The Namdrik Pearl Oyster Project**

Author: J. Dashwood
Consultant fieldwork undertaken: November–December 1990

19. **Stock assessment of snappers and groupers in the Kingdom of Tonga**

Authors: T.F. Latu, S. Tulua
Attachment work undertaken: October 1990 and April 1991

20. **Fisheries resources and management investigations in Woleai Atoll, Yap State, Federated States of Micronesia**

Authors: A. Smith, P. Dalzell
Fieldwork undertaken: May–June 1991.
Note: Published as IFRP Technical Document 4 in December 1993.

21. **Summary of the NFC—OFCF survey of the deep slope resources of the outer banks and seamounts in the Federated States of Micronesia, September 1989 to February 1991**

Authors: J.H. Diplock, P.Dalzell
Fieldwork undertaken: August–September 1991

22. **A preliminary assessment of the status of inshore coral reef fish stocks in Palau**

Authors: A.H. Kitalong, P.Dalzell
Fieldwork undertaken: September 1991
Note: Draft to be published as IFRP Technical Document No 6

23. **Survey of pearl shell resources of Gilbert Islands, Republic of Kiribati**

Author: G.L.Preston
Fieldwork undertaken: May 1992

24. **A preliminary account of coastal fisheries in Nauru with an outline for a catch monitoring programme**

Authors: P. Dalzell, A. Debao, P. Jacobs
Fieldwork undertaken: July 1992

25. **Report of workshop on trochus resource, assessment, management & development, Vanuatu, 13 May—2 June 1991**

Editors: various
Workshop held: 13 May–2 June 1991
Note: Proceedings contain about 30 papers and country statements dealing with exploitation of trochus in the Pacific region. In press.

26. **Some suggested management initiatives in Palau's nearshore fisheries, and the relevance of traditional management**

Author: R. E. Johannes
Consultant fieldwork undertaken: July 1991

27. **Survey of the status of trochus and beche-de-mer resources in the Western Province of the Solomon Islands**

Authors: T.J.H. Adams, J. Leqata, P. Ramohia, M. Amos, P. Lokani
Fieldwork undertaken: June–July 1992

**28. The Aitutaki trochus fishery: a case study**

Authors: W. Nash, T.J.H.Adams, P.Tuara, D.Munro, M.Amos, J.Leqata, O.Terekia, N.Mataiti, M.Teopenga, J.Whitford
Fieldwork undertaken: August–September 1992
Note: Technical Report for wider distribution, in press.

**29. Papers on fisheries science from the Pacific Islands, Volume I.**

Authors: Various
Note: Several papers from the 1988 Inshore Fisheries Research Workshop plus one other contribution edited for publication as Inshore Fisheries Technical document No. 1 1992.

**30. Review of fisheries research and management activities in the Republic of Palau**

Author: T.J.H.Adams
Fieldwork undertaken: 8–18 March 1993

**31. Management of ciguatera fish poisoning in the South Pacific**

Author: *P.Dalzell*
Note: Paper presented at International Workshop on Ciguatera Management in Australia, 12–16 April. To be published in the Memoirs of the Queensland Museum.

**32. Some aspects of the biology of *Acanthurus nigrofuscus* (Pisces: Acanthuridae) at Woleai Atoll, Federated States of Micronesia**

Authors: P.Dalzell & A.Smith
Fieldwork undertaken: April–May 1991

**33. A practical comparison of three methods of estimating natural population size in a Cook Islands fishery**

Authors: T.J.H. Adams, W. Nash, P. Tuara, D. Munro, M. Amos, J. Leqata, O. Terekia, N. Mataiti, M. Teopenga, J. Whitford
Fieldwork undertaken: August 1992

**34. Introductions of commercially-significant aquatic organisms to the Pacific Islands**

Author: L.G. Eldredge
Consultancy work undertaken: Jan–Jun 1993
Note: Final draft in preparation for publication. Jointly financed by SPREP.

**35. Research in the Pacific Islands on coastal fisheries: An SPC perspective**

Author: T.J.H. Adams
Review undertaken: October 1993

**36. Guidelines for quarantine of fish and aquatic invertebrates introduced or translocated within the South Pacific region**

Author: J. Humphrey
Consultancy work undertaken: Nov. 93 and Feb. 94
Note: Draft in preparation for publication. Joint project with ACIAR.

**37. The status of South Pacific Island coastal fisheries: 1993**

Author: P.J. Dalzell & T.J.H. Adams
Work undertaken: Jan 93–Feb 94

**38. Workshop on people, society and Pacific Islands fisheries**

Authors: Various
Workshop held: August 1991, during RTMF 23.
Note: In press as IFRP Technical Document No.5.

## TUNA AND BILLFISH ASSESSMENT PROGRAMME

### Port sampling workshop in Chuuk

The Port Sampling Workshop was held in Moen, Chuuk, Federated States of Micronesia, from 17 to 21 January 1994. The participants included port samplers and supervisors of current and proposed port sampling programmes in American Samoa, Federated States of Micronesia, Fiji, Guam, Kiribati, Marshall Islands, New Caledonia, Palau, Papua New Guinea and Solomon Islands.

SPC organised the workshop with assistance from the Micronesian Maritime Authority. The meeting began with an overview of port sampling programmes in the SPC region. Several programmes were initiated during 1991 and 1992, in response to the increased presence in the Federated States of Micronesia, Marshall Islands and Palau of nearshore longliners (most less than 100 GRT) from Japan, the Republic of China (Taiwan) and the People's Republic of China.

More recently, Korean and Taiwanese purse seiners have been sampled on Chuuk and Kosrae following the June 1993 implementation of the ban on high seas transhipment imposed by South Pacific Forum member nations. Sampling programmes in Fiji, French Polynesia and New Caledonia were implemented as part of the TBAP Albacore Research Project. Coverage of the fleets unloading in the region is nearing completion. Purse seiners are also transhipping in Honiara and Tulagi, Solomon Islands, and sampling programmes will soon be implemented in those ports.

Programmes will also be extended to cover pole-and-line fleets in Fiji, Kiribati and Solomon Islands. The procedures followed in port sampling were discussed in detail. These included procedures for compiling unloading weights; sampling protocols for the collection of species composition and length frequency data; data collection forms; conversion factors; species codes; and procedures for submitting data to SPC.

The meeting agreed that the TBAP should prepare a regional port sampling manual, covering longline, pole-and-line, purse seine and troll operations. The manual should include examples of data collection forms and explanations for their use; species identification photos and keys; and examples of introductory letters, in all applicable languages, to enable samplers to explain their work to fishing vessel officers. The manual will be a high priority for the Port Sampler and Observer Manager, who will be recruited in the near future, under the Lomé IV-funded South Pacific Regional Tuna Resource Assessment and Monitoring Project (SPRTRAMP).

The participants were able to view the transhipment and sampling activities of both purse seiners and longliners. The Korean seiner, *Sajo Olympia*, was observed transhipping to the carrier, *Fortuna Explorer*, in the bay near Moen. The participants were actively involved in the sampling; their efforts were rewarded with an unexpected swim on the way back to shore. Two Micronesian longliners, *Chuuk* and *Pohnpei*, were observed transhipping yellowfin and bigeye bound for Japan via air freight.

## SOPAC PRODUCING SEABED MAPS

The South Pacific Applied Geoscience Commission (SOPAC) is currently undertaking a seabed mapping project which is expected to be completed early next year. When completed, it will make available for the first time accurate maps of the sea floor covering an area of nearly 350,000 square kilometres in the Exclusive Economic Zones (EEZ) of Fiji, Solomon Islands, Vanuatu and Tuvalu. The maps, produced using a new swath mapping technology, are unique in that they provide almost total coverage of the seabed.

The project, called SOPACMAPS, is funded by the European Community from the Lomé III Regional Marine Resources Development Programme for the Pacific.

The United Nations Convention on the Law of the Sea (UNCLOS) will come into force 12 months from now, following an announcement during the past month that Guyana had ratified the Convention. UNCLOS was opened for signature in December 1982, requiring 60 signatories to bring it into force.

While it can be argued that many of the provisions of UNCLOS have already become accepted in international law, for Pacific Island nations, the Law of the Sea will make into a reality their jurisdiction over 200-mile EEZs. This will, without doubt, require a renewed commitment by governments of Pacific Island nations to increase knowledge of ocean space, an essential first step for sound management of its resources.

These resources, which are so important to the future development and well-being of many Island nations, remain largely unknown. Having access to maps showing the shape of the seabed is critical in the region where the sea areas within the EEZ far outstrip the land in size and are still largely unknown.

National capacities for seabed mapping are developing through the establishment of hydrographic surveys. In countries where such surveys have been established, work is currently focused in coastal areas.

Mapping of EEZs, however, can best be achieved through a regional approach and SOPAC through its Offshore Programme of Activities provides its member countries with the opportunity for such an approach. It can, in a very cost-effective way, facilitate the necessary planning and co-ordination required to implement such large, technically difficult surveys.

The SOPACMAPS project bears witness to the benefits of this type of approach. During the project, approximately 350,000 square kilometres of seabed have been covered at a cost of F$ 3.4 million, an extremely large amount of data has been collected and the maps produced for a remarkably low cost of less than F$ 10 per square kilometre.

Systematic mapping of the seabed has experienced two revolutions in the twentieth century. In the 1930s, acoustic methods (echo-sounders) replaced soundings carried out with lead lines, allowing much more rapid collection of data on ocean depths.

The next major advance took place in the 1970s, when multibeam sounders and long range sidescan sonar devices were developed. These instruments, the forerunners of the current technology, significantly increased the amount of seafloor data able to be collected by a ship during one voyage. They also provided the possibility of full information from the seafloor, including the areas between ships' adjacent tracks.

The new swath mapping technology will make available for the first time maps of a scale and accuracy sufficent to understand the economic potential of the oceans. This new generation of maps is of enormous potential use for navigational engineering, seismic risk, hydrocarbon and mineral resource evaluations, as well as environmental, political, public safety purposes, and boundary assessment.

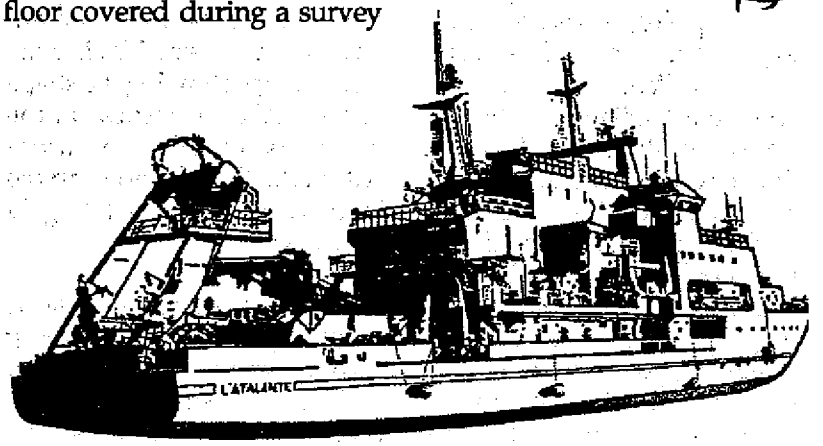
Data collection for SOPACMAPS began in August 1993 by the Institut français de recherche pour l'exploitation de la mer (IFREMER), a French government oceanographic organisation which owns the vessel *L'Atalante*, an oceanographic research vessel equipped for seabed mapping. IFREMER is under contract to SOPAC, and the *L'Atalante* has recently completed three cruise legs, each of 28 days.

IFREMER

In addition to collecting the data to produce the maps and related imagery, on board *L'Atalante* are geophysical equipment to collect gravitational, seismic and magnetic data and oceanographic equipment to collect data on currents, water temperature and salinity.

A few hours of swath mapping are far more productive and, with the new Global Positioning System (GPS) navigation, far more accurate than weeks of conventional echo-sounding work. The equipment on the *L'Atalante* not only allows an increase in the distance between adjacent ships' tracks, but also allows the ship to travel at speeds of 10 knots or more while collecting the data. This means that the amount of seafloor covered during a survey has increased while the costs of data collection per unit area have decreased.

(Source: *Fiji Times* )




## CORAL REEF VIS-A-VIS CLIMATE CHANGE

An irony of the impact of climate change on coral reefs is that the people dependent on reefs may be far more adversely affected than the reefs themselves. The Global Task Team on the Implications of Climate Change on Coral Reefs, at its meeting in June 1993, in Miami, USA, grappled with this problem.

The Task Team is sponsored by the United Nations Environment Program (UNEP), the International Ocean Institute (IOC) and the Association of South Pacific Environment Institutions (ASPEI)*.

The findings of the Task Team on the potential impacts of climate change will be made available, as a common effort by the sponsors, as follows:

— an overview document, compiled by Clive R. Wilkinson (Australian Institute of Marine Science) and Robert Buddemeier (University of Kansas, USA), and based on contributions from Task Team members, will be issued as a joint publication in the UNEP Regional Seas Reports and Studies series;

— a briefer executive report based on the above document will be issued jointly, on behalf of the sponsors, for wide distribution by IUCN at the World Coast '93 Conference in the Hague, Netherlands (November 1993).

In essence, it is believed that the majority of reefs will not suffer serious adverse effects from climate change; in fact, many may benefit from a rise in sea level. Many Indo-Pacific reefs are currently limited by exposure to air, and any rise in sea level will markedly increase their upward growth. Increases in sea temperatures may also broaden the potential latitudinal range for reef growth. Counteracting these benefits could be increased reef damage from bleaching of corals due to higher temperatures, and from increases in the incidences and severities of cyclonic storms.

Although reefs may not suffer greatly, reef islands are vulnerable. Expected sea-level rise in conjunction with global warming will affect many Pacific and Indian Ocean island countries, in particular due to: (i) sea water intrusion into fresh groundwater supplies needed for people and agriculture, and (ii) coastal erosion and flooding. It is thought unlikely that upward growth of the reefs will be translated into elevation of reef islands. Various measures are being proposed to counteract sea-level rise, but these should be carefully examined.

For example, a proposed solution of building dykes around the islands to keep out the sea will almost certainly fail because sea water will permeate through the porous structure of a coral reef island to contaminate the freshwater lens and water levels will rise inside the dykes. Cyclonic storms will

* Note: the International Union for the Conservation of Nature (IUCN) also actively supports the Task Team, and negotiations are under way to secure IUCN co-sponsorship thereof.

also cause increased erosion around sea walls and exacerbate the problem.

Models of detailed local aspects of climate change are still too rudimentary for reliable predictions of the likely effects on reefs and their people of variations in rainfall, shifts in ocean current patterns and increases in the incidence of cyclonic storms. At present the major threat to the existence of reefs, in the opinion of many specialists, does not seem to be climate-related; it more likely comes from what people themselves inflict upon these ecosystems, either directly or inadvertently.

This poses a difficulty for the Task Team, which is charged with providing advice on a programme of global monitoring of reefs with regard to climate change. The impacts of climate change will interact with those of other environmental changes, and will be difficult to detect separately from the effects of human stress. Climate change detection sites will have to be located far from human activities in order to compare climate effects with the combination of stresses found in populated areas.

The first stage in the process of creating an effective monitoring system will involve regional training courses to acquaint people with the application of the standard methods for:

— the examination of effects of climate change, found in *Monitoring of Coral Reefs for Global Change*, a methodology manual published, on behalf of the project sponsors, in April 1993 by UNEP (No. 61 in the series Reference Methods for Marine Pollution Studies); and

— the recording and analysis of data.

Some twenty countries have already expressed interest in participating in the Pilot Activity on Monitoring Coral Reef Ecosystems, co-ordinated by IOC, UNEP, WMO and IUCN. A copy of the action plan for the implementation of this pilot activity, prepared by a UNEP-IOC-WMO-IUCN expert meeting in 1991, and other information on this topic can be obtained from: GOOS Support Office, IOC of UNESCO, 1 rue Miollis, 75732 Paris Cedex 15, France.

(Source: *IMS Newsletter*)

## US$ 600,000 GRANT TO SUPPORT ASIA-PACIFIC AQUACULTURE

A US$ 600,000 technical assistance grant to support aquaculture in the Asia-Pacific region has been approved by the Asian Development Bank (ADB). The grant covers a study and workshop on aquaculture sustainability and the environment.

Since the 1970s, countries in the region have placed increased emphasis on developing aquaculture. Production in Asia reached 12.5 million metric tons in 1990 and accounted for almost 30 per cent of the region's fish production and half the global fish harvest. In 1990, aquaculture in Asia was valued at US$ 17.8 billion and accounted for more than 80 per cent of global production.

It is anticipated that aquaculture in Asia will gain even more importance as technologies develop further and fish supplies from 'capture fisheries' fail to meet the growing demand for fish because of resource constraints, particularly in coastal areas.

The rapid expansion of aquaculture is, however, increasingly held back by problems such as infectious diseases, contaminated products and losses caused by pollution and destruction of habitats, including mangrove forests.

The technical assistance will help ADB's developing member countries (DMCs) formulate policy guidelines for environmentally sustainable national aquaculture development. It will provide support for the private sector in controlling environmental degradation at farm level. It also aims to establish a regional database and co-ordination mechanism within the Network of Aquaculture Centres in Asia-Pacific (NACA) for information dissemination and follow-up action by DMC governments and the private sector.

Methodologies will be developed for collecting and analysing data on the current performance of selected farming systems and assisting DMCs in undertaking field surveys. A comparative assessment of sustainable productivity will be made to identify areas where improvement can be made through inter-country transfer of experience and co-operative research. The results will be discussed in a workshop. Finally, an action plan will be developed and the study results disseminated to the target groups. NACA will implement the technical assistance, which requires 14 months of consulting services.

(Source: *World Fishing*)

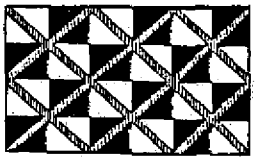
## BAN ON CORAL EXPORTS FROM TONGA

Although the export of raw coral from Tonga has been banned since 1987 by the Customs and Excise Act, a substantial amount of coral is apparently being exported. To reinforce the ban, Cabinet, following the recommendations of the Ministry of Fisheries, has recently decided to clarify the policy on coral exports. On 15 December 1993 it was decided that the export of reef corals (orders Scleractinia, Coenothecalia, Athecata, and Stolonifera) be prohibited. The ban is not applicable to processed precious/semi-precious corals.

In recommending such a policy, the Ministry of Fisheries had to weigh the benefits of coral harvesting against the negative effects. The negative effects of harvesting include degradation to reefs, reduction of the capacity of reefs to recover from other impacts (cyclones, crown-of-thorns starfish, etc.), possible increased coastal erosion, negative impacts on fish catches, and reduced value of reefs for tourism purposes. The increased costs to the Ministry of Fisheries for a programme to monitor/assess the effects of harvesting should also be noted. The benefits appear to include profits to businessmen and some increase in employment.

The Ministry of Fisheries feels that the costs to Tonga associated with the harvesting and export of coral are much greater than the benefits. This is consistent with the advice obtained from the South Pacific Regional Environment Programme: 'The income to be derived from ornamental coral for the curio trade or for marine aquaria may be insignificant compared to the value of reefs in fisheries, the tourist industry, and the protection of coasts and low-lying islands.'

(Source: Ministry of Fisheries)



## BAN ON GIANT CLAM EXPORTS FROM TONGA

The abundance of giant clams (**vasuva**) in Tonga has markedly decreased in recent years. This resource which has been valuable to Tongans for centuries is under threat and unless conservation action is now taken it is likely that this important traditional food will not be readily available to future generations.

The commercial export of clams is thought to be a major factor contributing to the decreased abundance of clams in the past and may become even a greater threat in the future. As early as 1980 research carried out by the Fisheries Division recommended that 'the export of giant clams or their meat (apart from shells for the souvenir trade) be prohibited'. The recommendation was made again in 1990 by the Ministry of Lands, Survey and Natural Resources. This view is supported by the Forum Fisheries Agency, the JICA Aquaculture Programme, and advice from the Food and Agriculture Organization of the United Nations. It should be noted that, in response to a rapid decline in giant clam abundance in Fiji, a ban on the commercial exports of wild clams was declared by the government of that country in the 1980s. Similar commercial bans have been declared in Papua New Guinea and Palau.

On 22 December 1993, His Majesty's Cabinet decided that the harvesting of clams for commercial export shall be forbidden. This regulation is not applicable to (a) domestic consumption, (b) giant clams produced by aquaculture and (c) shells for the souvenir trade.

(Source: Ministry of Fisheries)

## CLAMS GROWN IN MARSHALLS GOING TO KOSRAE, POHNPEI

The only privately owned clam hatchery in Micronesia, located on an isolated atoll in the Marshall Islands, has begun exporting clams to the Federated States of Micronesia.

A batch of 50,000 baby clams was shipped to Kosrae to stock a hatchery there, while hundreds are being shipped regularly to restaurants in Pohnpei, acccording to Ramsey Reimers, chief executive officer of Robert Reimers Enterprises (RRE). RRE has been growing clams at its Wau island, Mili atoll, hatchery since the mid-1980s – at first by the dozen and now by the tens of thousands.

The Majuro-based company moved quietly into the export business several years ago by feeding live clams into the American aquarium market. But now the company is work-

ing to increase the pace of its marketing and export operations, which are picking up, Reimers said.

Recently, a set of holding tanks for live clams was built in the company's business complex in Majuro that is providing fresh clams for customers at the Tide Table Restaurant. Clams are being brought up from Wau island regularly to restock the tanks.

'Fresh clams are available here in Majuro on a regular basis for the first time', Reimers said. He said shells are also being sold as handicraft items in Reimers' main store in Majuro.

There are about a dozen clam hatcheries in the Pacific Islands, but all but this one are government-sponsored. The Government of the Marshalls is operating an experimental clam farm on Likiep atoll.

(Source: *Pacific Magazine*)

## FIRST OF 50 LONGLINERS DUE FROM CHINA IN 1994

The first of 50 longline fishing vessels from China could begin arriving in the Marshall Islands next year if a preliminary agreement signed in Majuro in June works out.

The Marshall Islands Development Authority and officials from the China Shanghai Corporation for Foreign Economic and Technological Cooperation signed a memorandum of understanding to bring a fleet of the vessels, according to Justin deBrum, MIDA's general manager.

'The deal with the Chinese looks good', deBrum said. He joined Foreign Minister Tom Kijiner on a trip to China in early June to see the fishing boats. The arrival of 50 boats to bolster the present fleet of 13 would have tremendous impact on the country's fledgling fishing industry, he said. A fleet this size would turn the fishing base and Air Marshall Islands jet service into money-making ventures.

'We're so close to making the airline profitable', deBrum continued. 'Once we get more boats here to fish, it will be. We're interested in the Chinese fleet because they have the boats. We have the fish base, but not enough boats feed it with fish.'

At present, the 13 local boats supply tuna to the Majuro base from where the fish is exported to Hawaii and Japan via twice-weekly Air Marshall Islands flights to Honolulu. Hawaii businessman Larry Mehau recently brought in five of his own longliners to boost tuna exports.

While things are looking rosy for the longline industry, the purse-seine fishing business is in the throes of an extended slump. In fact, the government has put its two purse-seiners, *Korale* and *Bold Fleet* up for sale. They were part of a joint venture with American tuna fishermen.

(Source: *Pacific Magazine*)

## A US$ 35 MILLION TUNA CANNERY FOR CHUUK

A professional services contract has been executed between the State of Chuuk, Federated States of Micronesia, and three California firms for the design of a US $35 million tuna cannery to be built on Tonoas Island.

The 307,500 sq ft cannery will be capable of processing 100 tons of tuna a day and will employ more than 1,000 Chuuk residents, making it the largest private sector employer in FSM. The cannery also will become the largest business enterprise in the country, with annual sales estimated at more than US$ 70 million a year. The state-of-the-art facility will be the first full-scale cannery in Micronesia.

'Chuuk has been at the forefront of Pacific Island governments in aggressively pursuing sound business strategies to develop their natural resources', said Eric Brown of Cabason Inc., tuna industry consultant.

In addition to the cannery, the state has purchased three purse-seiner fishing boats to provide the fish for processing. The boats will be managed by G.S. Fisheries, a purse-seiner management company in San Diego, California. Led by George Sousa, the firm has more than 45 years of experience in purse-seiner management.

The Governor of Chuuk, Sasao Gouland, was in San Diego to dedicate the three vessels, which are being refurbished there.

The Chuuk cannery project reflects recent trends within the tuna industry in which production facilities are moving closer to the major fishing grounds.

Cabason is providing Chuuk with overall project management services relating to the design, construction and operation of the cannery. IPC Systems Engineering and Barrett Consulting Group will be jointly responsible for the design of internal cannery processing systems, architectural and structural building design, project electrical systems and overall project design co-ordination.

Barrett will be responsible for site surveys, site plan preparation, design of local water treatment, desalinisation and waste water disposal systems, fuel system plans and dock rehabilitation associated with the cannery.

(Source: *Pacific Magazine*)

## HUNTING OF KILLER SHARKS STIRS CONTROVERSY

In Hawaii, a debate has been raging over the killing of sharks.

Although it is well known that the ferocious white tiger shark is present in Hawaii's waters, swimmers and surfers enjoy Hawaii's beaches with abandon. No shark nets ring the beaches nor are shark patrols mounted.

On the relatively few occasions of a shark attack, a clamour is normally raised for the state to launch an organised shark-catching programme as a way to remove these feared monster denizens from Hawaii's waters.

And just as predictable will be the opposition mounted by some of Hawaii's Polynesian population who view such indiscriminate shark killing as a religious desecration.

The shark had a recognised place in the traditional Hawaiian religion. For one thing, they can be **aumakua**, spiritual beings concerned with the welfare of their respective families. According to Hawaiian myth, such **aumakua** might be born of human parents or even be humans assuming the form of a shark.

A respected ancestor or a recently deceased person might be transfigured into an **aumakua**, taking a corporeal form, such as the shape of a shark. On the island of Hawaii, off Kawaihao, there is reputed to be an old underwater **heiau** (temple) dedicated to sharks at which they once were regularly fed.

The extent to which sharks as **aumakua** are still honoured and respected by Hawaiians in unknown, contributing one of the ill-defined dimensions to the problem of how the state should respond when a shark attack occurs.

Another factor contributing to the confusion over the adoption of such policy is the dearth of scientific knowledge about sharks. There is little information on the cruising range of tiger sharks, their rate of reproduction, the functional niche they occupy in the ecology of the ocean, etc.

Consequently, it is difficult to justify the expenditure of the funds necessary to engage shark-fishing boats and crews against the contention that it represents a mere knee-jerk reaction.

While more information on tiger sharks in both the scientific and traditional sphere is being gathered, a modus vivendi seems to be taking shape in Hawaii. Hawaiian mythology recognises the possible existence of a rogue shark **aumakua** driven by an uncontrollable desire to attack humans – thus its elimination, while regrettable, may be necessary.

Now, when an attack does occur under conducive conditions, such as in waters where carcases are floating about, the risk in such situations ought to have been foreseen and the attack could have been avoided; there the matter is allowed to rest.

Depending on this congruence of tradition and practical determination of the situation, a potentially explosive confrontation is being defused.

(Source: *Pacific Magazine*)

## AGE AND GROWTH OF BLACKFIN TUNA USING A NEW APPROACH

A fundamental problem in sampling of otoliths ('earstones', the usual structure used for age and growth studies) from highly valued species such as tunas is the possibility that the cutting of the head might affect the marketability of the fish. While different methods of cutting the head have been developed to minimise the problem, they are time-consuming and require the trust and co-operation of the fishermen or the vendor. The costly alternative is to purchase the whole fish.

Drs John (CFRAMP) and Sherry Heileman (Institute of Marine Affairs), at the International Fish Otolith Research and Application Symposium in South Carolina, learned new approaches for determining the age of tunas using non-traditional hard parts. For example, the fin spines of albacore have been demonstrated to be of use for determining the age of the fish. The implications of this finding are considerable: a technician need now only cut off a fin spine and take the length of the fish to get information required for an age and growth study. The time required per fish is now seconds instead of the many minutes involved in cutting and dissecting the head.

Dr John Neilson and Dr Susan Singh-Renton of the CFRAMP Pelagics and Reef Fish RAU are testing the application of this new approach to an important pelagic resource in the CARICOM area, blackfin tuna. They have been sampling various hard parts from blackfin tuna obtained at the Kingstown Fish Market in St Vincent, to compare the interpretations of age obtained using fin spines and fin rays to that using otoliths. If fin spines show a pattern of banding which is consistent with the otoliths, a second study which demonstrates the frequency of band formation would then be required. If it can be shown that the bands are formed each year, then collection of fin rays or spines, as reliable indicators of fish age, could be a routine part of CFRAMP's biological sampling program.

(Source: *CARICOM Fisheries Newsletter*)

## MERCURY AND FISH: A DISQUIETING NEW STUDY

Illegal levels of methyl mercury, a toxic metal that poses special health risks to infants, children and pregnant women, was found in one in five samples of commercially caught swordfish and shark in a three-year review by the U.S. Food and Drug Administration (FDA).

The findings prompted a special year-long review by the FDA in 1992; the results are pending.

Methyl mercury, like lead, is found throughout the environment. Once consumed, the heavy metal can accumulate in the tissue of fish, animals and humans. At elevated levels, poisoning can occur. Foetuses exposed to elevated mercury levels can suffer from mental retardation, lack of physical development and seizures. In adults, the symptoms include sensory damage, skin abnormalities and lack of motor skills. Highly elevated levels can cause death.

Seafood is the single largest dietary source of methyl mercury. Because shark and swordfish are at the top of the ocean's food chain and regularly consume smaller fish that contain mercury, they tend to have higher concentrations of the metal then other fish.

FDA laboratories are currently analysing 200 samples of imported and domestic shark and 200 samples of imported and domestic swordfish. Each sample is a composite of an entire shipment or lot and contains fish of various sizes in order to achieve a representative mix. These results have yet to be released.

However, as much as 26 per cent of samples tested as recently as 1989 exceeded the allowable level of one part per million of methyl mercury.

'Anytime we see a 15 to 25 per cent violation range, we don't like it', says John Jones, FDA's strategic manager of pesticide and chemical contaminants.

What's more, if the tests had used the more conservative Canadian standard (Canada allows only 0.5 ppm of mercury in seafood), none of the shark and swordfish sampled by FDA would have passed (all exceeded 0.8 ppm). Public Voice for Food & Health Policy, a Washington-based consumer group, petitioned the FDA more than a year ago to lower the amount of mercury permitted in seafood.

Smith DeWaal says that when the FDA established the current one ppm limit, it considered

what may cause mercury poisoning in adult males, not foetuses, infants or children. (Many environmentalists point out that the government's allowable pesticide levels in food similarly do not take into account infants' and children's heightened sensitivity to toxic chemicals.)

Tom Billy, director of FDA's Office of Seafood, says the agency has reviewed all the scientific literature on methyl mercury and will shortly begin the regulatory process that may pave the way for reductions in the allowable levels of the toxin in food.

The FDA has worked with the Environmental Protection Agency to improve its risk assessment capabilities. One such effort is a major study of methyl mercury's effects on mothers and young children with high seafood consumption rates. The study, expected to be concluded later this year, is being conducted in the Seychelles Islands in the Indian ocean.

Despite the concerns about methyl mercury in fish, the FDA says the detectable levels have remained the same throughout this century and are not on the rise. Billy says that in the early 1970s, when methyl mercury was recognised as a serious contaminant in canned tuna, the Smithsonian Institution provided data indicating that mercury levels in tuna were the same as in the 1800s.

Although canned tuna has only one-tenth the levels being found in fresh swordfish and shark, the greatest source of methyl mercury in the diet may still be from canned tuna. Even so, FDA officials say that recent measures enacted by the seafood industry have resulted in reduction of mercury levels in tuna. The practice of dolphin-friendly tuna fishing has inadvertently resulted in a shift in the target catch from species with high mercury levels to those with lower concentrations.

Billy adds that regular laboratory testing by domestic processors and seafood importers can also play a role in reducing the number of fish with elevated methyl mercury levels that enter the commercial food chain.

Not every group feels that increased testing is necessary. The National Fisheries Institute, a seafood industry trade group, takes the position that all the available scientific literature indicates mercury levels in fish do not pose a hazard. 'People who are at risk for mercury should limit or restrict their consumption of certain fish – such as swordfish and shark – to once a month', says Clare Vanderbeek, vice-president of the trade group. 'In the event, it would be unique for someone to eat shark or swordfish much more than that since present consumption rates indicate the typical consumer is eating seafood about twice a month.'

Vanderbeek also says that the Fisheries Institute opposes any reduction in the federal government's allowable levels of mercury in seafood.

'In 20 years of attention to this issue, there is no indication of a health problem', she says. 'There is no evidence that warrants lowering the one ppm level (of mercurity allowed in seafood). And if there were such evidence then we would be the first ones to request a reduction.'

(Source: *Los Angeles Times*)

## INDIAN OCEAN TUNA – FAO ACTS TO SET UP A COMMISSION

On 25th November, 1993 the Council of the United Nations Food and Agriculture Organization (FAO) adopted an international agreement establishing the Indian Ocean Tuna Commission. The purpose of this document is to meet a two-fold challenge: management and conservation of Indian Ocean tuna stocks. It aims to foster international co-operation for the conservation and optimum use of tuna and related species in this area through sound management practices, while contributing to sustainable fishery development.

According to FAO, both tuna conservation and the sustainable and rational use of the resource would be considerably enhanced if co-operation arrangements were entered into by coastal and other states and regional economic integration organisations, as well as regional tuna fisherfolk.

The Agreement covers both the Indian Ocean and also adjacent seas to the north of the Antarctic Convergence for the purposes of conservation and management of stocks migrating into or out of the Indian Ocean.

(Source: *Le Marin*)

## CATCH MORE WITH FLYING FISH

When trolling offshore for large fish such as tuna, mahimahi, billfish or wahoo, the catch could be increased substantially by using a good bait. Flyingfish (**malolo**) are quite common in Tonga and are an excellent trolling bait.

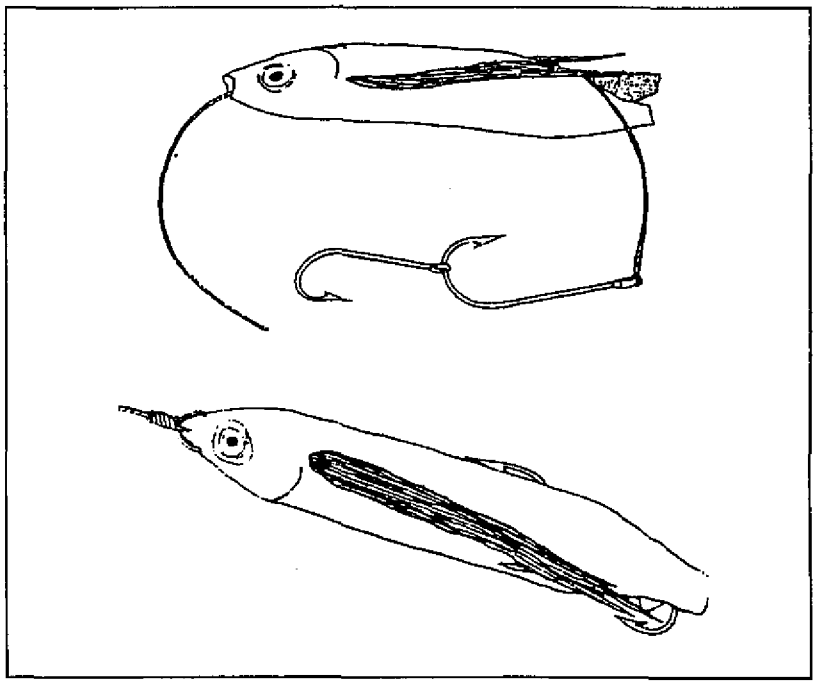
Paul Mead, now based in Vava'u, was a masterfishermen with the South Pacific Commission and worked for them for more than 16 years. In short, Paul is a fisherman's fisherman who really knows what he's doing. From his work, Paul has concluded that a properly rigged flyingfish can be more than 10 times as effective as an artificial lure. Considering that an artificial lure can cost up to $40 in Tonga, it makes even more sense to use flyingfish as a trolling bait.

To get good results, the flyingfish must be properly rigged. Just inserting hooks into the flyingfish usually appears unnatural to prospective customers. The hook attached is inserted into the tail cut, pulled through the mouth, and the leader is then wired to the mouth of the bait. The Ministry of Fisheries can provide an illustrated instruction sheet of easy-to-follow rigging instructions (see below).

It is thought the peculiar oily smell of flyingfish may be the reason this bait is so effective. A major advantage of flyingfish over other baits is its freezing qualities; it can be frozen, thawed, trolled, and then refrozen many times.

The optimum trolling speed for a rigged flyingfish is about 4 knots. At higher speeds the bait behaves erratically, lowering its effectiveness. Flyingfish should be trolled 60 metres astern.

(Source: *Tongan Weekly*)



## NEARSHORE MARINE RESOURCES OF THE SOUTH PACIFIC

At long last! The volume we have been waiting for. *Nearshore Marine Resources of the South Pacific* tips the scales at over one kilogram and contains 710 pages, with contributions from 20 authors. A great amount of work has gone into making this book a definitive reference: an essential purchase for anyone with any interest in the coastal fisheries of the Pacific Islands.

The format of this book has been defined by the needs of Pacific Island fisheries officers. Other books on coral reef fisheries take a process-oriented approach, full of generalities that are difficult to translate to real life, but Wright and Hill have dictated a resource-specific approach which lays out the essential details in an easily-referrable format. This volume will not provide you with complete advice on how to manage these fisheries – that is for a 'sequel' volume, which will probably arise out of SPC/FFA joint plans for a coastal fishery management-oriented workshop later in 1994 – but *Nearshore Marine Resources* will provide you with access to the complete range of known information on the biology, assessment and fisheries for almost the entire range of Pacific Island coastal fisheries.

These are: deepwater demersal fish (Robert Moffitt), small pelagic fishes (Paul Dalzell), marine aquarium fish (Richard Pyle), flying fish (Bob Gillett and Jim Ianelli), shallow-water reef-associated finfish (Drew Wright), sharks (Paul Nichols), marine turtles (Harold Hirth), bêche-de-mer (Garry Preston), pearl oysters (Neil Sims), giant clams (John Munro), trochus (Warwick Nash), green snail (Masashi Yamaguchi), deepwater shrimp (Mike King), spiny lobster (Roland Pitcher), mangrove crabs (Ian Brown), coconut crabs (Warwick Fletcher), and seaweeds (Robin South).

There are also two general chapters by John Munro and Semisi Fakahau, one covering the need for assessment of resources, and outlining a realistic and cost-effective plan for accomplishing this, and the other providing a brief outline of available fishery management measures.

As the editors make clear in the acknowledgements, the main support for this project came from ICOD – the International Centre for Ocean Development in Canada – and many of us regret that a Canadian Parliament decision closed the Centre in 1992. This volume is a very appropriate memorial to an organisation that achieved a great deal in a very short space of time.

*Nearshore Marine Resources of the South Pacific*; edited by Andrew Wright and Lance Hill; Institute of Pacific Studies, Suva; Forum Fisheries Agency, Honiara; International Centre for Ocean Development, Canada. 1993; ISBN 982-02-0082-2.

## SURFACE TUNA FISHING WITH *BONITIERS* IN FRENCH POLYNESIA

Surface tuna fishing with *bonitiers* (literally 'skipjackers') is an artisanal fishery which has developed in various islands of French Polynesia with large populations. The ports of Papeete and Uturoa, French Polynesia's two main urban centres, are the main fishing bases. Activities were monitored from 1986 to 1992 in Papeete and from 1987 to 1992 in Uturoa.

The *bonitiers* are powerful 12 m launches. A mother-of-pearl lure is used to attract the fish, which are captured by this baitless pole-and-line method. The boats usually leave port in the morning and return during the afternoon.

The Papeete fleet declined from 52 boats in 1987 to 27 in 1992, mainly because some vessels were converted into longliners targeting deep-swimming tuna. Fishing effort dropped from 9,513 days in 1986 to 4,977 in 1992. More than half the annual effort is concentrated less than 30 miles out, but 10 to 20 per cent takes place more than 60 miles away from the port. This offshore fishing takes place primarily from June to November.

The skipjack (*Katsuwonus pelamis*) accounts for the lion's share of catches (approximately 90% in terms of number and 80% in terms of weight, except in non-typical years.). The yellowfin tuna (*Thunnus albacares*) is the second largest catch component. Landings also comprise mahi mahi or dolphinfish (*Coryphaena hippurus*) and a variety of other species (approximately 1% in terms of number and 5% in terms of weight).

Annual fish landings in the port of Papeete dropped from 984 mt in 1986 to 574 mt in 1992.

Catch per unit of effort (CPUE) has remained relatively stable: 29.6 to 35.8 fish per boat per day, 99 to 116 kg per boat per day. The best fishing season generally occurs from December to April and the least favourable from June to October. CPUE increases with distance from shore.

Skipjack catches vary from 441 mt to 729 mt per year. Annual CPUE figures fluctuate between 27.2 and 32.5 fish per day (71 to 94 kg per day) except in 1988 when they dropped to 22.0 skipjack per day (58 kg per day). The best skipjack fishing season is generally from January to April and the least favourable from July to November. CPUE can fluctuate considerably from month to month. Yields increase with distance from shore all year around.

The size of skipjack caught ranges from 30 to 93 cm 'curved length'*. Most catches consist of fish measuring between 40 and 65 cm. Another group worthy of note is that of large skipjack over 75 cm in length. 1986 and 1987 were characterised by a large proportion of small skipjack (modes under 50 cm). 1990, 1991 and 1992 were characterised by an abundance of large skipjack. Annual average weights of fish caught range from 2.4 to 3.5 kg.

Annual yellowfin tuna catches vary from 55 to 274 mt. Annual CPUE varies for the most part from 1.8 to 9.2 fish per day (7 to 36 kg per day). The best fishing season generally extends from January to April and the least rewarding from July to October. Yields increase with distance from shore all the year round.

The size of tuna caught ranges from 29 to 168 cm 'curved body length'. The largest group is formed of fish measuring between 45 and 75 cm. Large tuna (over 90 cm in length) were abundant in 1986. That year, the average weight of the tuna fished was 9.3 kg, whereas it varied from 3.9 to 5.9 kg in other years.

Mahi mahi catches (from the troll fishery) varied from 6 to 32 mt. The best fishing season extends from July to September. Yields increase with distance from the shore. The length of fish caught ranges from 68 to 154 cm. Most catches are between 100 and 135 cm in length. The average annual weight of mahi mahi caught ranges from 12.1 to 14.4 kg.

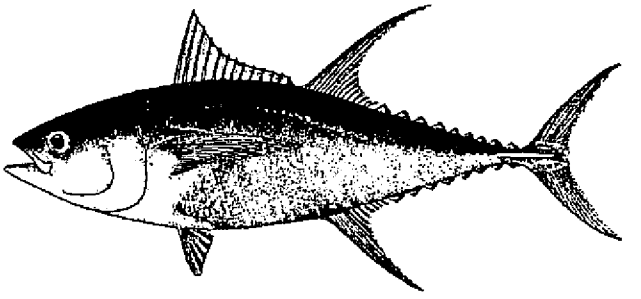
Between 4 and 8 active *bonitiers* are based at the port of Uturoa on the island of Raiatea. Fishing effort oscillates around 1,000 fishing days per year. The fishing grounds are very close to the island. Catch composition is similar to that of the Papeete *bonitiers*.

Total catches vary from 75 to 158 mt per year, while CPUE ranges from 25.6 to 82.1 fish per day (82 to 140 kg per day). These large CPUE fluctuations are due to skipjack. Catches of these species were high in 1987 (122 mt, 71.3 fish per day) or approximately double that recorded in other years (54 to 78 mt, 21.7 to 35.3 fish per day). The high CPUEs come from young skipjacks (average weight: 1.5 kg). During the year, the CPUEs reached their highest level between March and June and dropped to their lowest between July and November. Annual yellowfin tuna catches range from 10 to 35 mt and CPUEs from 2.3 to 10.7 fish per day. Young tuna were abundant in 1987 and 1988. The best fishing season occurs from December to April. Mahi mahi catches are from 5 to 9 mt per year. The best fishing season is from July to November.

Data for other ports of French Polynesia are often restricted to the number of *bonitiers* holding a fishing permit. Estimates of catches in these ports were made to try and calculate the extent of fishing activity for French Polynesia as a whole. Total surface skipjack fishery catches were estimated at 1,300 to 1,500 mt per year, skipjack catches from 750 to 1,200 mt and yellowfin catches from 100 to 500 mt.

**Translator's Note: Curved body length is fork length measured along the curve of the body rather than in linear terms on a flat board.*

Chabanne, J. & E. Josse (1993). La pêche bonitière des thonidés de surface en Polynésie française de 1986 à 1992. Océanographie. Notes et documents n°41. 51 p.



# PACIFIC ISLANDS LOBSTER FISHERIES: BONANZA OR BANKRUPTCY?

by Tim Adams & Paul Dalzell
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Noumea, New Caledonia

Pacific Island spiny lobsters (*Panulirus* species) have been a magnet for New Zealand and Australian fishermen for years. Fisheries officers in most Pacific Island countries have at least one story to tell about a failed Antipodean lobster-fishing or exporting venture, and will cheerfully point out that the only people who continue to make regular pin-money out of Pacific Island spiny lobsters are the local fishermen who occasionally supply nearby tourist hotels (and fishermen in the Gulf of Papua and Torres Strait, but we will come to them later). The stories include:

— a joint-venture company that brought in a foreign-registered motherboat to travel round the islands buying trochus shell and lobster from villages. Under the terms of the business permit, they were not allowed to fish themselves, but only to buy from local villagers. Unfortunately, the company could not pay even the concessionary rate of import duty on the motherboat, and was later reported to be fishing on one of the islands, not for lobster, but for bêche-de-mer, to try and raise this capital;

— at the same time as the above, another operation wanted to bring in another motherboat for an identical operation, but didn't bother to follow up the project proposal when the prospects became clear;

— a joint venture that brought in a foreign fishing vessel to fish, primarily for lobster, on an outer island. After experiencing coral reef fishery conditions at first hand, during main-island trials, they didn't even stick around to visit the outer island;

— a marketing man, 'with excellent contacts in Australia, Asia and the West Coast,' who reckoned that export marketing was the main constraint on opening up the 'vast potential of the Pacific Islands lobster fishery'. A joint-venture was set up and struggled for some months experimental fishing over a wider and wider area without apparently making an export shipment;

— the foreign fisherman who would not believe that trapping was not an economically viable form of fishing for spiny lobster on that island, and said that he had a new kind of trap that was proven to work. He insisted on importing a large number of a well-known variety of commercial trap from Hawaii and nothing more was heard (this story is repeated several times from several countries);

— a vessel that was recently arrested in an SPC member country close to a reef which has long been fabled as the *El Dorado* of South Pacific lobster fisheries. Several press reports on the case failed to mention anything apart from fish amongst the catch aboard;

— a foreign vessel which got into a joint venture to collect trochus and lobster, using several sets of hookah gear. The vessel had to be boarded several times by the fishing authorities after complaints by villages about the boat fishing in their traditional fishing grounds. It ended up fishing, not for lobster and trochus, but for giant clam, taking over 20,000 clams off one reef in one trip. That reef has still not recovered;

— a single consignment of live lobsters to Japan from a remote outer island group in the early 1980s that was hailed as the start of major income earning opportunity for these islands. No further consignments have been made; and

— the senior Pacific Islands fisheries officer who estimated that at least one third, maybe half, of the overseas visitors to his office were interested in exploiting the 'untapped potential' of his country's lobster resource, but none of whom actually made it to the export profits stage.

Given this history of failed commercial enterprise, why do Australians and New Zealanders continue to throw themselves, lemming-like, into Pacific Island lobster ventures?

One reason is that it is perhaps difficult for them to believe that Pacific Island ecosystems are so unproductive compared to

their own countries. With the exception of Papua New Guinea, Pacific Islands are not set on continental shelves. A simple comparison of exclusive economic zone (EEZ) area (e.g. French Polynesia 5,030,000 km$^2$, Kiribati 3,550,000 km$^2$, New Zealand 4,050,000 km$^2$) might lead one to conclude that the fishery potentials are similar, but does not reveal the fact that only a minuscule proportion of the EEZ of any Pacific Island consists of shallow water and reefs suitable for conventional lobster fisheries.

It is also not a common item of knowledge that even this suitable area of shallow water is not nearly as productive as an equivalent area would be if it were close to a large land mass, or if it were set in more plankton-rich temperate waters. Most colder-water fishermen are aware that tropical waters harbour a great variety of coral reef species, but not that these species each constitute comparatively small biomasses. When comparing primary productivity with temperate and shelf fisheries, coral reefs are more like deserts than forests.

The net result is that many non-Pacific Island fishermen look at the small volumes produced by island lobster fisheries and assume that they must be grossly under-exploited. It is easy enough to understand why this misconception occurs. *Panulirus cygnus* (western rock lobster) is Australia's most valuable single-species fishery (Kailola et. al. 1993). The major southern lobster fisheries (South Africa, Australia, New Zealand) are at least an order of magnitude larger than their Pacific Island equivalents (see Table 1), and it may seem obvious that warmer waters *should* be more productive than cooler waters. There are many potential local joint-venture partners who are more than willing to believe this optimistic prognosis, particularly if they are not fishermen. Even if they *are* fishermen, they may not be averse to financing a new boat, or a pick-up truck, out of the preferential bank-loan that helps set up many joint ventures.

Often, attempts by Pacific Island fisheries officers to alert impending investors to the poor prospects are either construed as attempts to deliberately conceal the nature of the bonanza; as hidebound official obstructionism; or even as personal prejudice against the local component of the joint venture.

Apart from general explanations about the low comparative productivity of non-shelf coral reef ecosystems and the comparatively small areas available for lobsters to live in, there are also some more specific reasons why Pacific Island lobster is a 'difficult' fishery:

— The main spiny lobster species present in the islands, particularly the lagoon species, do not enter traps or pots readily. Not many outside fishermen believe this, but it has been extensively tested, using all kinds of traps, in all locations, and with all kinds of baits (even the traditional baits of chiton and urchin). Some lobsters *are* caught, but at a far lower density than would be needed to support a joint venture. Methods used successfully in Western Australia (on *P. cygnus*) and Hawaii (on *P. marginatus*) have all been tried to no avail, but not much of this work has been documented, perhaps because nobody likes to report a failure. The main fishery method remains hand-collection. Note that the lower-value slipper lobsters – *Scyllarides* and *Parribacus* spp. – sometimes enter these experimental traps (e.g. Prescott 1993), but apparently not in large enough quantities to form the prime target of a fishery, although in Hawaii *S. squammosus*, originally a bycatch, is now a major component of the commercial lobster catch;

— Most Pacific Islands reef and lagoon fisheries are subject to some form of customary fishing rights. Even if national legislation does not make this explicit, it usually severely restricts the scope of non-local harvesters. Because available lobster habitats are small, and abundances often fairly low per unit of reef area, a commercial operation would have to collect lobsters from a very broad catchment area for a sustainable fishery, and this may require maintaining a whole set of agreements with many different villages, plus a separate set of harvesters in each village;

— Difficult as it is for any western entrepreneur to understand, most village harvesters do not *want* to make lots of money. Once they have enough to supply their immediate cash needs – to pay the kids' school fees, to buy a bag of flour and a can of kerosene – they leave off commercial fishing until they need some more money, and they put their time into doing the real work of looking after the garden or fishing for the table. Companies that rely on collecting products from village harvesters inevitably find that catches tend to tail

off after the first couple of trips. It is THEN that the financial projections should be made;

— Even if a commercial operator has no intention of trying to maintain a long-term sustainable fishery, most Pacific Island lobster stocks are already subject to a certain level of local exploitation; catch-rates will thus not be very high, and a broad catchment area must still be maintained for economic viability. Only very remote reefs have the possibility of supporting 'virgin' stocks with densities high enough to support the expenses of a trip by a large vessel, and *all* of these have been prospected at least once already. The average recovery rate of these isolated reefs after being hit is unknown, but would be several years;

— Many Pacific Island lobsters are now caught with spears, which severely reduces the commercial value of the product, and virtually rules out exports based on such a local fishery. A considerable and sustained educational effort would be needed to obtain unblemished lobsters, and catch rates would inevitably suffer. (The virtual disappearance of traditional lobster trapping methods in favour of spears may also say something about the relative efficiency of these different methods);

— Lobster larvae can float around as pelagic plankton for a year or more, and recruits may thus come from a considerable distance away. Even if one country tries to implement a policy of minimal harvesting in an effort to maintain the fishery, its stock may decline if other island groups have depleted their own lobster resources. Lobster recruitment, at least in Hawaii, also appears to be affected by long-term climatic cycles, and total allowable catches may have to changed from year to year to maintain a sustainable fishery. There has been a management plan in place for the *P. marginatus* trap-fishery in Hawaii since 1982 (WPRFMC 1991), but the plan could not account for a recently elucidated connection between climatic events and recruitment and there has been a decline in stocks that has necessitated drastic restrictions on fishing (see Figure 1).

Across most of the Pacific Islands the three most abundant species of spiny lobster are *P. ornatus*, *P. penicillatus*, and *P. versicolor*. *P. penicillatus* is the most common species in Oceania, except for Papua New Guinea and northern Australia, where *P. ornatus* forms a major dive fishery and produced 400 tonnes of tails in 1986 (Prescott 1988). Prawn trawlers also used to catch large amounts of these lobsters until a moratorium was declared following the 1984 season (Coates & Lock 1985). Note that Papua New Guinea is the only Pacific Island country set on a continental shelf, and the *P. ornatus* populations can make quite extensive migrations across the Gulf of Papua, similar to the migrations of *P. argus* in the Caribbean. Because of the clustering of lobsters that occurs during these migrations, catch rates can be quite high. But spiny lobsters in the oceanic Pacific Islands, including *P. ornatus*, do not make these large-scale migrations.

As with all taxonomic groups, the total number of lobster species is greater in western Pacific countries than in the eastern Pacific. There are six *Panulirus* species in Solomon Islands, but only *P. penicillatus* ranges out to eastern Polynesia. Two other species, *P. marginatus* and *P. pascuensis* have very restricted distributions and are only reported from the Hawai-

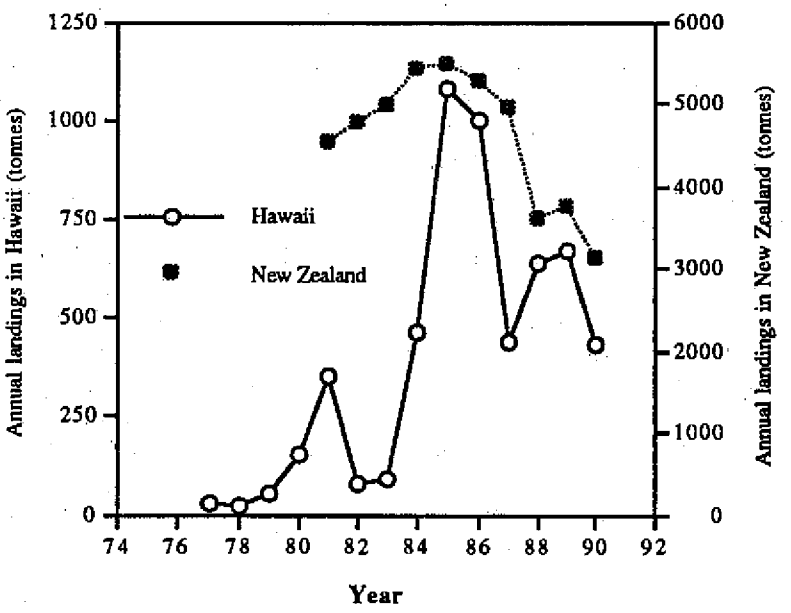


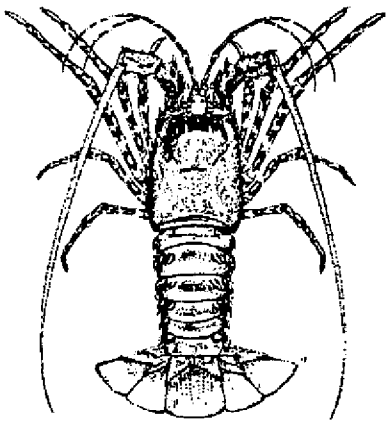

**Figure 1. Annual landings in the Hawaiian and New Zealand lobster fisheries**

ian archipelago and Easter Island respectively. But note that *P. marginatus* is readily caught in traps and is the basis of a commercial fishery in Hawaii (*P. pascuensis* is also reportedly caught in traps, although we have not yet been able to get any information about the Easter Island fishery), whilst the more widespread species in this genus are somewhat harder to catch.

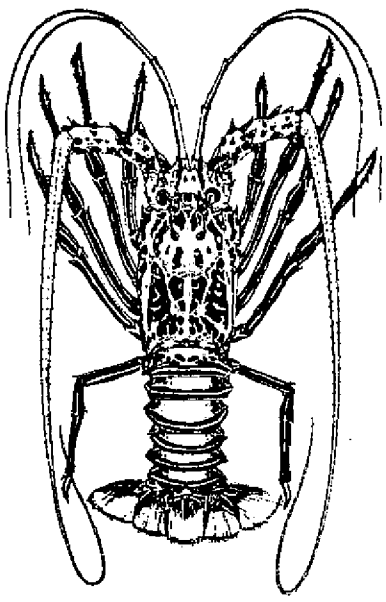
The main Pacific Island spiny lobster fishery, with the exception of Papua, Hawaii and Easter Island, is a *P. penicillatus* fishery. *P. penicillatus* catches are usually mixed with some *P. longipes*, which has a similar ecological range, along outer reef-faces and barrier reefs, favouring more topologically complex formations on windward reefs. These lobsters are mainly hand-collected when they come to the reef-top at certain combinations of moon and tide. Of minor commercial importance, *P. versicolor* is more of a lagoon species, found in holes under coral heads, and mainly caught by spearing. *P. ornatus* is usually coastal, found on shore reefs in lagoons and more sheltered habitats and, of course, continental shelves.

Information on stock densities or abundance for Pacific Island spiny lobsters is hard to find, and most 'rule-of-thumb' fisheries estimations derive from the two studies made by Prescott (1980) in Solomon Islands and three by Ebert and Ford (1986) at Eniwetak. In Solomon Islands, during the SPC-sponsored study of lobster storage methods, a mark-recapture estimate of 46–57 *P. penicillatus* per hectare of suitable lobster habitat was made on two particular reefs. Since *P. penicillatus* is found mainly in a narrow band along the face of reefs, this population estimate could also be expressed as 111–128 lobsters per kilometre of reef-edge. At Eniwetak, abundance was estimated from catch per unit effort trends, from 35–164 (with an average of 126) lobsters per kilometre of reef-edge by Ebert and Ford, who reckoned this could support a sustainable catch of around 20 kg of whole lobster per kilometre of reef-face per year. We have a great need for further information on Pacific Island spiny lobster densities, and any pointers to additional information would be most welcome.

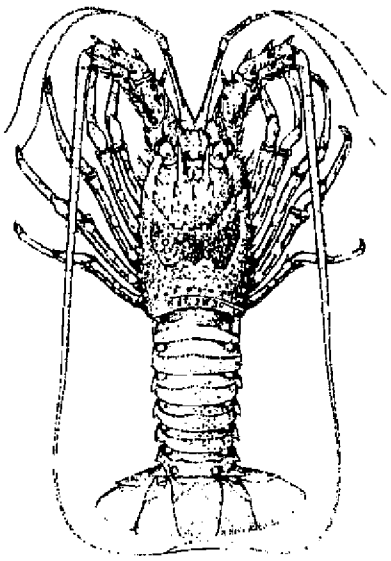
There is no doubt that there is money to be made out of Pacific Island spiny lobsters, but it is just not in the same league as the *Jasus* fisheries further south, or even the *Panulirus* fisheries of Papua New Guinea and Hawaii. It is certainly not going to support anything like big business. Even if a reliable, easy and economical method of capturing these lobsters is developed, the overall stock sizes are so small that a major business just could not be sustainable. Commercial spiny lobster harvesting in the Pacific Islands either has



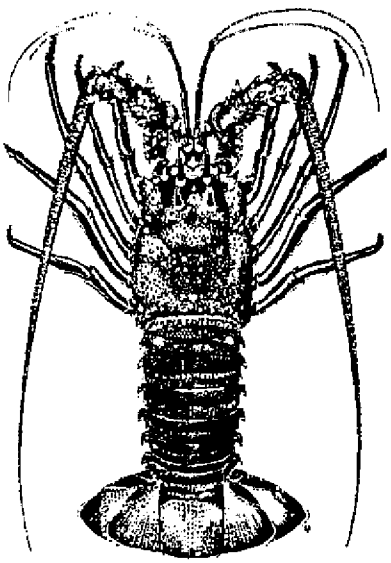
*Panulirus ornatus*



*Panulirus versicolor*



*Panulirus longipes*



*Panulirus penicillatus*

to be small-scale or has to be part of a multispecies fishing operation – it can only succeed briefly as a prime target in occasional unsustainable 'pulse' fishing of remote reefs and banks. With the social set-up of most Pacific Islands, and Government restrictions on the use of non-local divers, there is very little scope for outsiders in the actual fishing operation around inhabited islands. With the low catch levels experienced, it is difficult to sustain an adequate throughput for an export market, particularly with the problems that are normally experienced in getting lobsters in good condition (unspeared, and still kicking) from broad catchment areas.

Small quantities of live lobsters are exported from Papua New Guinea (Andy Richards, FFA, pers. comm.) to Hong Kong, but only as part of a broader operation involving live stonefish (*Synanceia* spp.) and other reef fish. In general, at present, the most viable marketing prospects for Pacific Island lobsters are local. The local tourist industry, if well developed, can easily absorb the entire spiny lobster production of an island, or seaboard.

Lobster fisheries have declined markedly in New Zealand, and the Hawaiian spiny lobster fishery is the subject of increasing restrictions in an effort to restore productivity (Figure 1). It has been the case in the past that the imposition of closures and restrictions on Australian, US, and New Zealand fisheries has led to increased numbers of fishermen trying to migrate their businesses to the Pacific Islands, and there is no reason why lobster fishermen should be any different. Pacific Island fisheries officers should expect the number of joint-venture proposals involving lobster to continue to increase.

This short article is a plea for Pacific rim lobster fishermen and Pacific Islanders alike to embark on any joint ventures with their eyes open. Estimate what length of reef-face you can obtain spiny lobsters from and, if you can't do (or sponsor) some trial fishing to get an idea of stock abundance, use a rule of thumb of 20 kg whole lobster per km reef-face per year as your estimate of sustainable production. If the area is already heavily fished, expect less, or if the stock appears unusually dense (greater than, say, 120 per km of reef-edge) then revise your production estimate upwards slightly.

For example, Tonga has (very) approximately 1090 km of reef-face. Multiplied by 20 kg annual lobster production per kilometre, this estimates the total sustainable potential spiny lobster catch for Tonga as 21.8 tonnes, which is not too far away from the rough estimate of 20 tonnes actual catch reported by Leon Zann in 1984. Obviously, this sort of rule of thumb should NOT be used for stock assessment, but it can be useful for the rough estimation of possible commercial potential when assessing an investment proposal, and for weeding out obviously outrageous claims.

This article, although it may sound provocative, is based on hard experience. If there are actually any great success stories out there – joint-venture oceanic-island businesses which have lobster fishing as their main focus, and which have been making sustained profits out of exporting catches of spiny lobster from the same area for more than three years – then please let us know and we will happily change our views. But all such claims should be backed up with an audited set of account books.

**Further reading**

Anon. (1992). *FAO Yearbook: Fishery Statistics: Vol 70: 1990.* FAO Fisheries Series No.38. FAO Statistics Series No.105. Food and Agriculture Organization of the United Nations, Rome. 647 p.

Coates, D. & J. Lock (1985). Fisheries Research Annual Report for 1984. *Technical Report* 85/5, Papua New Guinea Department of Primary Industry, Port Moresby.

Ebert, T.A. & R.F. Ford. (1986). Population ecology and fishery potential of the spiny lobster *Panulirus penicillatus* at Enewetak Atoll, Marshall Islands. *Bulletin of Marine Science* 38 (1): 56-57.

Kailola, P.J., M.J. Williams, P.C. Stewart, R.E. Reichelt, A. McNee and C.Grieve. (1993). *Australian Fisheries Resources.* Commonwealth of Australia Bureau of Resource Sciences and the Fisheries Research & Development Corporation. 422 p.

Prescott, J. (1980). Report on the South Pacific Commission lobster project in Solomon Islands. SPC Report 205/80, Noumea, New Caledonia.

Prescott, J. (1988). Tropical Spiny Lobster: An overview of their biology, the fisheries and the economics with particular reference to the double-spined rock lobster *P.penicillatus*. SPC Workshop on Pacific Inshore Fishery Resources Working Paper 18.

Prescott, J. (1993). A survey of the lobster resources of the Ha'apai Group, Kingdom of Tonga. FFA Report 90/93. Forum Fisheries Agency, PO BOX 629, Honiara, Solomon Islands. 80 p

WPFMC. (1991). Amendment 7: Fishery Management Plan for the Crustacean Fisheries of the Western Pacific Region (includes Environmental Assessment, Regulatory Impact Review and Proposed Regulations). Western Pacific Fisheries Management Council, Honolulu, Hawaii. 110 p.

Zann, L.P. (1984). A preliminary investigation of the biology and fisheries of the spiny lobsters (Palinuridae) in the Kingdom of Tonga. Institute of Marine Resources, University of the South Pacific. 55 p.

**Table 1. Annual production of spiny lobsters by some of the southern hemisphere's major producers versus production from some Pacific Island countries**

| Lobster species | Location | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Continental shelf and non | *Panulirus penicillatus* | target fisheries | | catches in metric tonnes | | | | | | | |
| *Panulirus argus* | Caribbean | 21,974 | 22,177 | 24,576 | 26,499 | 29,929 | 28,154 | 25,905 | 24,896 | 26,569 | 22,185 |
| *Panulirus cygnus* | W. Australia | 9,956 | 10,483 | 12,456 | 10,689 | 11,254 | 11,000 | 11,025 | 11,569 | 9,668 | 12,998 |
| *Panulirus* spp. | Philippines | 529 | 962 | 1,008 | 1,345 | 843 | 1,115 | 549 | 501 | 604 | 576 |
| *Panulirus* spp. | Malaysia | 0 | 224 | 428 | 608 | 566 | 644 | 644 | 644 | 640 | 640 |
| *Panulirus* spp. | Indonesia | 996 | 562 | 763 | 473 | 448 | 1,257 | 965 | 1,319 | 925 | 1,590 |
| *Panulirus ornatus* | PNG/N. Australia | 330 | 460 | 250 | 175 | 290 | 450 | 300 | 260 | 320 | 255 |
| *Panulirus marginatus* | Hawaii | 350 | 80 | 90 | 425 | 654 | 521 | 241 | 553 | 576 | 356 |
| Pacific Islands (mainly) | *Panulirus penicillatus* | fisheries | | | | | | | | | |
| *Panulirus* spp. | Fiji | 7 | 26 | 30 | 81 | 24 | 39 | 32 | 37 | 53 | 90 |
| *Panulirus* spp. | Marshall Islands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Panulirus* spp. | American Samoa | 3 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| *Panulirus* spp. | Fed. St. of Micronesia | 5 | 7 | 7 | 7 | 8 | 8 | 10 | 10 | 10 | 10 |
| *Panulirus* spp. | New Caledonia | 7 | 18 | 13 | 13 | 19 | 35 | 50 | 26 | 25 | 12 |
| *Panulirus* spp. | French Polynesia | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| *Panulirus* spp. | Northern Marianas | 1 | 1 | 2 | 5 | 2 | 3 | 2 | 2 | 2 | 2 |
| *Panulirus* spp. | Palau | 0 | 0 | 2 | 2 | 5 | 5 | 5 | 5 | 5 | 5 |
| Southern temperate rock lobster fisheries | | | | | | | | | | | |
| *Jasus edwardsii* | Australia | 4,862 | 5,192 | 5,221 | 4,964 | 5,232 | 4,650 | 5,200 | 5,457 | 4,560 | 5,799 |
| *Jasus edwardsii* | New Zealand | 4,513 | 4,750 | 4,963 | 5,422 | 5,474 | 5,259 | 4,937 | 3,594 | 3,754 | 3,120 |
| *Jasus lalandii* | South Africa | 6,914 | 5,058 | 4,726 | 5,595 | 5,735 | 4,623 | 5,189 | 5,320 | 3,935 | 3,790 |
| *Jasus lalandii* | Namibia | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,379 | 1,825 | 830 | 516 |

Notes:

— Catch data is after Anon. (1992), except Fiji which is from Fiji Government sources, and *P. ornatus* in PNG/N.Australia which is after Kailola et. al. (1993).

— *P. ornatus* figures (PNG/N.Australia) are for tail weight only. Pacific Island *Panulirus* spp. figures (central section of table) are almost certainly for whole weight, but it is not known whether some of the other tonnages reported by FAO refer to tail weight or whole weight.

# LIVE REEF FISH EXPORTS TO SOUTH-EAST ASIA FROM THE SOUTH PACIFIC

by Andrew Richards
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Honiara, Solomon Islands

## Introduction

Fishing companies based in Hong Kong, Singapore and Taiwan engaged in the supply of live reef fish (chiefly rock cods and groupers of the genus *Epinephelus* and maori wrasse, *Cheilinus undulatus)* to restaurants in those cities and elsewhere in South-East Asia have traditionally operated in countries such as the Philippines and Indonesia. Recently, companies supplying South-East Asian markets have extended their operations further west of the South China Sea into the Indian Ocean and east through Palau and Papua New Guinea (PNG) to Tuvalu and as far south as Australia's Great Barrier Reef. There have also been recent expressions of interest in commencing similar operations in Solomon Islands and Fiji. This has probably occurred because stocks of target species have been seriously depleted in the South China Sea fishing grounds near the main market ports.

## Target species and methods of capture

Though a typical list of target reef-fish species may contain up to fourteen names, this is usually abbreviated to four or five 'product groups', such as grouper, coral trout, coral cod, wrasse and tuskfish. One of the PNG-based operations concentrates on hump-headed maori wrasse *(Cheilinus undulatus)*, malabar cod or grouper *(Epinephelus malabaricus)*, small-toothed or camouflage cod *(E. polyphekadion)* and coral trout *(Plectropomus leopardus)*. Another PNG-based company originally targeted estuarine stonefish *(Synanceia horrida)* and reef stonefish (S. *verrucosa)*, the venom of which is used in Chinese traditional medicine, before switching to the more 'traditional' reef-fish species when stonefish stocks were exhausted.

Species taken in shallow water down to 25 m with hook-and-line include coral trout, groupers and wrasse, while wrasse are the predominant catch in deeper water. Fish in deeper water are taken by divers holding sticks with hooks on the end, supported by hookah underwater breathing apparatus. Operations usually commence with an undertaking by the operator that all fishing will be carried out by local fishermen, the catch being sold to the company. However, in many cases foreign crew have become involved in fishing operations because in their opinion, local fishermen are not capable of achieving profitable catch rates of the target species.

## The live reef fish trade

Live reef fish are air-freighted by commercial airlines or sea-freighted by custom-made carrier vessels to markets in South-East Asia from their point of capture. The air-freighted fish are commonly chilled prior to shipment to lower their metabolic rate. The carrier vessels rely on circulating sea-water systems to keep the fish alive, during sea voyages that in the case of the PNG operations, could last 12 days.

Prices paid for premium quality live reef fish (particularly groupers and maori wrasse) in S.E.Asian markets have been increasing steadily for the last few years and currently range from US$ 10–50 per kilogram. Some relatively uncommon species such as barramundi cod *(Cromileptes altivelis)* command exceptional prices, in the vicinity of US$ 100 per kilogram.

Until recently, the main market has been Hong Kong, but markets in Taiwan and Japan are expected to show increased development. In Japan, for example, a coral trout sashimi is being promoted which shows strong market potential. Quangdong Province in mainland China near Hong Kong is already a major market for live reef fish and it is expected that the trade will expand from there throughout mainland China.

## Live reef fish export operations in South Pacific countries

### *Palau*

In the mid-1980s, an agreement was made between the Palau Government and a Hong Kong-based live reef fish exporting company whereby Palauans would be trained for six months in fishing techniques, after which time they would replace company fishermen and the company would be restricted to buying fish. This agreement was not honoured by the company, whose fishermen continued to fish after the agreed pe-

riod. The operation continued for approximately three years, during which time one of two grouper spawning aggregations situated near Koror, Palau's capital, was 'fished out'. To date, the number of grouper involved in this spawning aggregation has not recovered to its pre-fishing level.

Eventually the Palau fisheries authorities persuaded villagers to deny the company access to their reefs. Without access to productive fishing grounds in Palau and nearby in Yap (Federated States of Micronesia) where there is a complicated reef tenure system, the company resorted to poaching in the south-west islands of Palau. Their vessel was later apprehended there with 11 mt of live wrasse and groupers on board. The captain was convicted of illegal fishing and subsequently the company's operations in Palau were terminated by the fisheries authorities.

*Papua New Guinea*

Exporters of live reef fish have been operating in PNG since 1991, when a company was established by Port Moresby business interests in association with a local business group to catch and export live wrasse and groupers from the Hermit Islands, Manus Province. This remote location was selected because of its rich fishing grounds and proximity to the sea route to Hong Kong. Since then, other live reef-fish export operations have commenced in the Central, New Ireland and Milne Bay Provinces and are expected to commence in other maritime provinces of PNG. It is suspected that some of the companies have not honoured their commitment to only buy fish from local fisherman and have instead used foreign crews and unsustainable fishing practices to catch reef fish.

*Tuvalu*

In late 1991, a Malaysian-based fishing company approached the Tuvalu Government seeking to employ local fishermen in the outer islands to catch reef fish which would be exported live. The initial stages of the project would involve the company bringing in their own personnel to fish. After a month or so, subject to the capability of the local fishermen, the foreign personnel would have to leave Tuvalu, and the local fishermen would take over the fishing.

By mid-1992 the business proposal had been accepted by the people of Nui atoll but not by those on larger Nukufetau atoll. A year after the initial approach, it was agreed that a stock assessment of reef finfish be conducted and management measures formulated before the company could commence fishing operations on any island in Tuvalu.

No fishing rights were granted to the company, merely a licence to purchase live reef fish from local fishermen. Company personnel were permitted to train local fishermen but not to catch fish commercially. The company was invited to post a substantial financial bond, as a gesture of good faith and to ensure that local fishermen would be paid for the fish caught. Although the company was expected to commence operations in March 1993, this has not occurred.

*Australia*

In July 1993, approval was granted for a live reef fish export operation on Australia's Great Barrier Reef in far north Queensland. It is a joint venture between an Australian businessman and Hong Kong interests which will collect and store live fish for later air-freighting to Hong Kong and the southern provinces of mainland China. Target species include coral trout *(Plectropomus* spp.), red emperor *(Lutjanus sebae)*, wrasse (family Labridae) and Spanish mackerel *(Scomberomorus* spp.). Though the company is only licensed to buy live fish from commercial fishermen and may not become involved in its own fishing operations, commercial and recreational fishermen have publicly expressed their concern about the proposed operation.

## Possible beneficial and detrimental effects of live reef fish export operations

At first glance, live reef fish export fisheries appear to offer much-needed income to coastal villagers in remote locations, at no risk to reef-fish stocks. Buying prices of target species range from US$ 0.75-3.00 per kilogram in the countries mentioned. However, by the very nature of their operations and the fish they target, live reef-fish exporting companies have the potential to cause severely negative impacts on reef-fish resources and bring social upheaval to village communities.

*Unsustainable fishing practices*

In PNG, it is suspected that breeding aggregations of grouper and coral trout have been heavily fished by one of the companies operating there, to the inevitable detriment of the breeding stock. This is one of the reasons why exporters of live reef-fish are banned from operating in Palau.

The suspected use of hookah

underwater diving equipment and other fishing gear by foreign crews contravenes their licence conditions, but from their point of view is essential if they are to achieve their predicted catch rates and catch. The uncontrolled introduction of hookah to village fishermen puts them at considerable personal risk.

From detailed studies of two reef fisheries in PNG, it is likely that only 10 per cent of the hook-and-line catch consists of target species. This leaves a considerable by-catch which may have to be discarded, since it cannot be entirely consumed by villagers or easily preserved for later consumption.

*Potential for social upheaval*

The effects of live reef fish export fishing operations on the social life of villagers in coastal areas of PNG promises to be at least as disruptive as that caused by the taking of baitfish by foreign tuna fishing companies in the late 1970s and early 1980s. Jealousy over payments to fishermen and arguments over the suspected fate of nearshore fish resources have led in some cases to physical confrontation between groups which support the fishing operations and those that oppose them.

## Management options for live reef fish export operations

In Palau, fisheries authorities have apparently decided that live reef-fish export fisheries involving foreign operators are unmanageable and have banned such operations. Tuvalu has imposed reasonable conditions on potential live reef-fish exporters prior to commencement of fishing operations, which may have deterred further unwelcome interest.

In PNG, the potentially damaging effects of live reef-fish export fisheries may be mitigated by a range of suggested actions. These include the banning of hookahs for live reef-fish collection, provision of advice to coastal villagers on the likely costs and benefits of this type of fishing operation, institution of an economic study of live reef-fish exporting, improvement of the scrutiny of these fisheries, and the use of traditional knowledge of reef-fish spawning aggregations to draft management measures such as area and seasonal closures.

**The following contribution has been summarised by Paul Dalzell from an article in the November 1993 issue of *Fishing News International*.**

**Village fishermen living near Kendari in south-eastern Sulawesi, Indonesia, have greatly increased their incomes since 1991 by catching reef fish for live export. The fishermen target mainly parrotfish and groupers, which are then kept alive and sent by ship 3,200 km for the Hong Kong restaurant trade. Prior to establishment of the two companies involved in this fishery, these Sulawesi fishermen sold their catches at local markets and auctions for limited subsistence incomes. The greatly improved revenues from the live reef fish catches have led to a better standard of living for these Indonesian fishermen.**

**The two fishing companies, PT Supra Utamina and PT Minaqua, have their headquarters in Jakarta with local branches in Kendari. Besides Sulawesi, the companies also extend fishing operations to Irian Jaya, the easternmost province of Indonesia. The companies claim to have invested about US$ 1 million in the fishing venture, which includes the construction of holding pens and a carrier vessel, the *Wing Sang 3*. To date, the companies have shipped about 150 tonnes of live fish to Hong Kong. Each shipment averages about seven tonnes, with a value of US$ 80,000, or about US$ 11.5 per kg of live fish.**

**Fish are caught by fish traps then transferred to the holding pens. During an average 20-day fishing trip, a group of around 14 fishermen catch fish to the value of US$ 6,000 or about US$ 400 per man. Gross incomes range from US$ 150–500 per man per trip, but when all costs are deducted, this usually results in a monthly net income of US$ 50 per man, although this is considered a good income for fishermen in sparsely populated eastern Indonesia. The improvement in incomes has also fostered a greater conservation ethic amongst the fishermen, resulting in a decline of destructive fishing practices such as dynamite fishing.**

# AQUACULTURE IN THE US-AFFILIATED PACIFIC ISLANDS

by Steve Lindsay *
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## Introduction

The area of responsibility of the Aquaculture Extension Agent for the US-affiliated Pacific Islands includes the Republic of Palau, Federated States of Micronesia, Northern Mariana Islands, Republic of the Marshall Islands and American Samoa.

The position has been funded by a variety of US federal agencies including the Center for Tropical and Subtropical Aquaculture (CTSA), Pacific Aquaculture Association (PAA), Pacific Island Network (PIN), University of Hawaii Sea Grant Programme and the College of Micronesia Land Grant Programme (COM Land Grant). The position is jointly administered by the COM Land Grant and the various funding agencies noted above and is based in Pohnpei, FSM. The position is intended to promote and develop marine and freshwater subsistence and commercial aquaculture within these islands for both government and private organisations. The position is also the aquaculture-biologist adviser to the FSM National Aquaculture Center (NAC) in Kosrae. Most of my time is spent conducting training courses on production of the various organisms and assisting in planning and constructing aquaculture facilities.

## Republic of Palau

Palau has the largest giant clam hatchery in the world, the Micronesian Mariculture Demonstration Center (MMDC), operated by the Palau Marine Resource Division. MMDC staff have cultured seven species of giant clams, trochus, marine groupers, turtles, soft corals and an assortment of other marine organisms for research and commercial purposes.

Giant clams are the main culture organism; the MMDC currently produces more than 200,000 annually. These animals are sold locally and internationally (Japan and Saipan) for food, to aquarium markets in the United States and Europe, to various Pacific islands for aquaculture and replenishing wild stocks and are also sold locally for the handicraft shell trade.

The facility still receives federal funding support but is closer to being commercially viable than any other giant clam hatcheries/farms. The main involvement of the Aquaculture Extension Project with MMDC is information exchange with the manager, Mr Gerald Heslinga.

There is also a private giant clam hatchery currently being developed in Palau and in time this will attempt to tap into the markets developed by the MMDC. From the latest information available, ground has been cleared and the next stage will be to construct the tanks and other infrastructure. There has been no involvement by this project with this private hatchery to date.

Other aquaculture developments in Palau include a small crocodile farm which is a tourist attraction as well as a breeding and rearing facility. There are several local people interested in aquaculture projects designed to take advantage of the ever-increasing Japanese tourist trade, i.e. farming fish that tourists can catch in ponds, etc. There is also a reef aquarium planned, however details are not known.

## Federated States of Micronesia

### *Yap State*

Over the last decade Yap has received over 80,000 giant clams designed to restock its reefs. Both the main island and Yap's outer atolls have received clams from the MMDC via federal funds, but very few of these have survived because of storms and maintenance problems. There are no other aquaculture ventures currently operating in Yap. In the past, culture of rabbitfish and seaweed has been attempted. Some interest was generated in culture of giant freshwater prawns (*Macrobrachium* sp.) but this has not developed as yet. Marketing of the product remains the main problem.

### *Chuuk State*

Chuuk has also received thousands of clams for reseeding purposes over the years, the majority from the MMDC and the FSM National Aquaculture Center (NAC). As in Yap, most of the clams were issued to the State Marine Resource Division and very few currently survive. Presently there are two privately owned giant clam grow-out facilities within Chuuk lagoon, housing <1,500 clams

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each. These are to be sold to the local food markets in Weno. Possibly, they may sell clams to the local restaurants, but currently interest is low.

An attempt by the NAC to promote giant clams for sashimi in several local tourist restaurants was not successful. However, this may change if two local clam farmers can provide animals on a regular basis. Currently, they are experiencing difficulties keeping their animals alive; survival rates of between 15 and 30 per cent are the norm.

The Ting-Hong longline tuna fishing company plans to culture milkfish (*Chanos chanos*) for live bait for their longline fleet. Little information is available on this developent at this time.

*Pohnpei State*

The State Marine Resource Division maintains a trochus hatchery on Langer Island. Currently it is in a state of disrepair; however, they are maintaining a stock of about 500 clams and a small number of trochus. A Japanese volunteer has just arrived to culture trochus at this facility. This is the only project operating at this time. Several aquaculture projects were begun in the past, including culture of rabbitfish, seaweed, pearl oysters, etc., but all were unsuccessful due to funding constraints and other infrastructural problems.

Clams have also been donated to Pohnpei over the years but the whereabouts and survival rate of these animals is unknown.

The FSM National Government is not directly involved with any aquaculture activities. They do fund the majority of the NAC budget and have previously been involved with culture of rabbitfish, sponges, etc.

Sponge culture (*Spongia officinalis*) is currently the main aquaculture activity in Pohnpei. This has been funded by various agencies: National Marine Fisheries Service (NMFS) in Hawaii, CTSA, PAA, COM Land Grant and the National Government. There are currently nine sponge farms, two demonstration farms and the rest privately owned. The average farm contains between 10,000 and 30,000 sponges. Most of the work has been developed and carried out by Mr Richard Croft.

*Spongia officinalis* is very suitable for local farming as it requires little capital outlay and day to day maintenance is low. Pohnpeian people use this particular sponge traditionally as gifts to women who have just given birth. Natural stocks are low and require extensive time on SCUBA to locate. The local and international tourist trade is the main recipient of these products at the present time. However, it will be several years before there are large enough numbers of cultured sponges to cater to international market demand. There is a large market for this sponge but it would require several thousand units to be shipped per month for it to be profitable. The sponge quality is graded as above average by Caribbean sponge importers and a successful industry could be developed. Hopefully, fungal disease problems will not cause major losses to these stocks as they have in the Mediterranean.

There is a family who have just started to construct cages to hold an assortment of baitfish for sale to local tuna fishermen. The idea is to reduce the time the fishermen take to collect their bait and increase fishing time. They will use any species of baitfish that will be purchased by the local fisherman. This project should be under way by early 1994. If this project is successful the extension agent will then suggest small-scale culture of food fish, such as groupers and rabbitfish.

The NAC has conducted several surveys in the local restaurants to see if giant clam meat can be sold. The outcome of these surveys is the sale of 30 clams a week to several restaurants in Kolonia for the last five months. This market is currently very small. A demonstration clam grow-out farm will be set up soon to supply this market. The clams will be purchased from the NAC at approximately one year of age, grown at this farm by a local family to market size (2–2.5 years of age) and then sold to the restaurants. At the moment, interest in clam farming is low due to the low number being sold; this may change in time.

Several private individuals are interested in cultivating *Macrobrachium* sp. However, as in Yap, this has not developed further. The project is currently assisting a local mangrove crab (*Scylla serrata*) exporter to design and set up holding/fattening pens.

*Kosrae State*

The FSM National Aquaculture Center has been operating now for the past two and a half years, however, it has only been during the last six months that the center has produced its own clams (*Hippopus hippopus*), which are currently six months old. Kosrae has only one species of clam (*Tridacna maxima*) and

thus broodstock and juvenile clams for aquaculture have to be brought in. The Center is about half the size of the MMDC and its primary goals are to produce giant clams for sale to local and international markets. The Center recently changed from being a training, educational, clam give-away facility to becoming self-supporting operation via sales of clams.

Several local farmers in Kosrae, as well as in the other states, are currently growing clams. These farmers purchase the animals from the Center at approximately one year of age (US$ 1.00) and grow them for about one year to be sold to local restaurants (US$ 2–2.30). Pricing is a problem. The clams are too expensive, according to the restaurant owners, and the NAC at this present stage is negotiating selling prices. The Center is still heavily reliant on expatriate assistance to conduct the aquaculture/biology side of the operation. Hopefully in the next several years the staff may take over some of these responsibilities.

There is a Japanese volunteer based at the centre who is producing *Trochus niloticus* for a reseeding programme. His programme is very successful, but there seems to be little local interest in carrying on this work. There is no other aquaculture being conducted in Kosrae. Kosrae Marine Resources has received some clams from the MMDC over the years and survival rates are much higher than in the other states (due to the assistance of the staff of the NAC).

### Northern Mariana Islands

This group of islands has limited aquaculture potential due to the lack of suitable lagoons, and frequent typhoons. However, due to the large (mainly Japanese) tourist trade these islands receive aquaculture products from the other Micronesian islands. They receive giant clams from the MMDC and will, in the near future, also obtain them from the NAC. The market is quite large and should develop as the tourist trade increases. The major problem for the clam producers is that most shipments have to pass through Guam. Thus all shipments must have a CITES inspection at a cost per shipment of US$ 125. This cost, plus associated administrative delays, reduces profitability. This of course is one of the major impediments to accessing markets in Guam and Hawaii.

The other major problem for these two markets is the FDA requirements for importing shellfish into the USA. The islands do not have US-approved shellfish sanitation programs. Kosrae and Palau are working on these at the moment. A possible solution would be to fly the clams directly into Saipan. This may be possible with the co-operation of the tuna fishing companies based in Micronesia which have private aircraft for shipment of tuna to Japan and regularly fly between the islands.

### Marshall Islands

The Marshall Islands Marine Resource Authority (MIMRA) currently has two aquaculture projects operating in the outer atolls: a giant clam hatchery on Likiep atoll and a pearl oyster project on Namdrik atoll. These have been quite successful.

The giant clam hatchery is small and is operated by an American biologist. The aim is to produce clams that will be given or sold to local farmers to grow and then sell. MIMRA have decided to target clam species that can be sold into the aquarium market. They are culturing *Tridacna squamosa* and *T. maxima*. The grower can expect to earn US$ 3–4 for a 2–2.5 year old animal. A *T. derasa* of the same age will bring about US$ 2–2.5. They have approximately 6,000 one-year old *T. squamosa* at the moment.

A pearl oyster (*Pinctada margaritifera*) project has just started, under the supervision of a technical advisor from Black Pearls, Inc. (Hawaii) and NMFS. The idea is to teach the local community how to collect and care for spat produced by wild stock, with the eventual aim of growing them for implanting with pearls. The community is very supportive of this project and is happy to conduct the required regular maintenance programme. If this continues then this project should be a success.

Robert Reimer Enterprises, one of the largest private companies in the Marshall Islands, has a giant clam hatchery on Milli atoll. This hatchery has been producing clams for the last 5-7 years and is now producing them on a regular basis.

The project visits this farm about twice a year to teach hatchery techniques and usually fills its tanks with juveniles. They are also currently targeting the aquarium market with *T. maxima* and *T. squamosa*. They are working on the requirements to import clams into Hawaii (as mentioned previously) and once these legalities have been sorted out, they will also ship *T. gigas* into Hawaii for the restaurant trade.

They have approximately 30,000–40,000 animals in stock and are planning to expand their facility in the near future. Two American biologists run the operation. This is the only private hatchery in this region and is presently the second most successful culture facility to the MMDC. They may venture into other aquaculture products in time. Culture of both sponge and pearl oyster have been discussed.

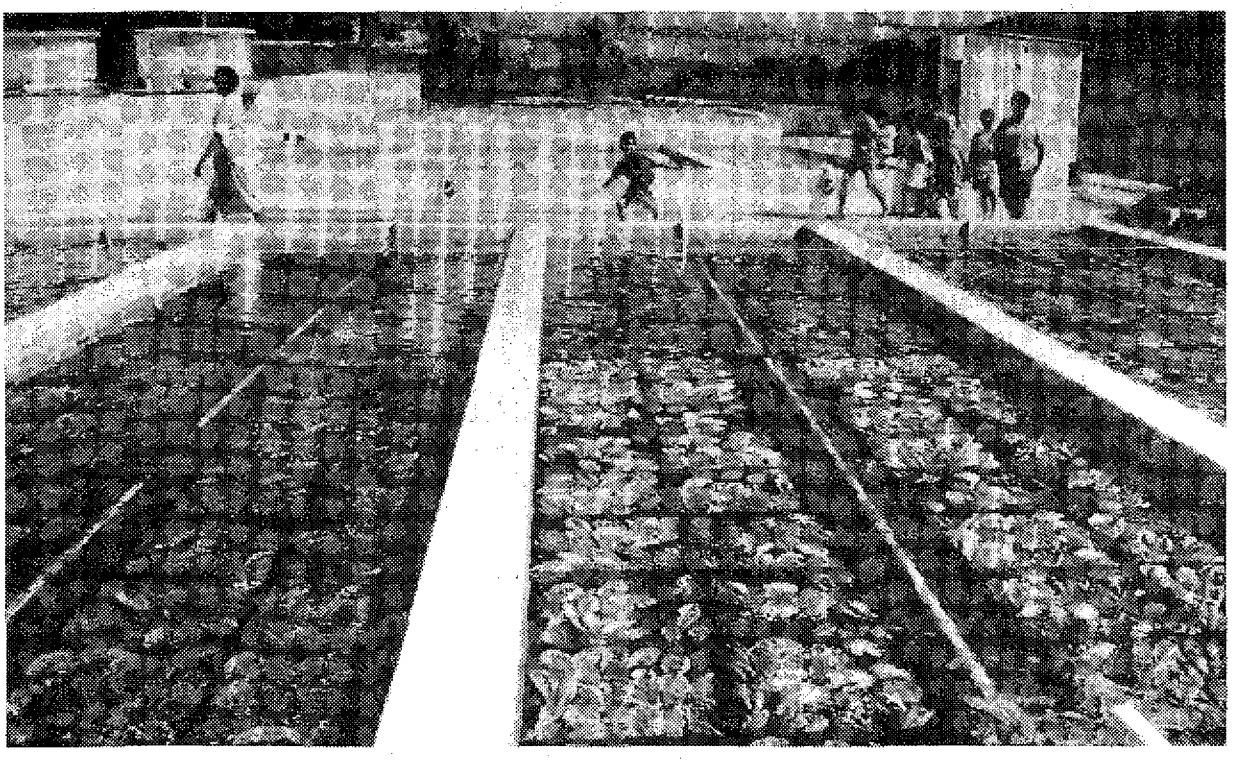
**American Samoa**

The Department of Fish and Wildlife has a giant clam hatchery situated on the main island, near Pago Pago airport. This facility has not been operating since 1992 due to a variety of administrative problems. The manager's position is vacant, although it has been advertised. In the past, various marine and freshwater aquaculture projects have been attempted in American Samoa but without much success.

**Conclusions**

The aquaculture projects that are progressing and are achieving goals are either privately owned, employing expatriates to manage them, or government facilities managed by expatriates.

However, in each of the island groups there are personnel who in time should be capable of managing these facilities. They still all require extensive training courses and more experience in animal husbandry, managerial and work related skills. Present knowledge of biology and aquaculture is extremely poor in the US-affiliated islands; this can only improve with better school science curricula and tertiary qualifications. However, the situation continues to improve and in a short period of time this region should see local people earning incomes and profits from aquaculture.



**Tridacna grow-out tanks at the Micronesian Mariculture Demonstration Center, Koror, Palau**



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