

FISHERIES

Newsletter

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Alastair Robertson (NZ School of Fisheries tutor) and Western Samoa trainee Aupalavou Fili making up a 40-hook bottom longline, during the SPC/Nelson Polytechnic course, held in Kiribati from 26 June to 26 July 1996



South Pacific Commission
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RESOURCE ASSESSMENT SECTION

Field work in Tonga and Fiji

The Resource Assessment Section spent most of April to June this year conducting field work or participating in meetings. During April, preparations were made for a field assignment in Tonga, to gather information for developing management plans for the aquarium-fish fishery around Tongatapu and the Ha'apai beche-de-mer fishery.

As outlined in a previous *Fisheries Newsletter*, the Integrated Coastal Fisheries Management Project (ICFMaP), which operates within the Resource Assessment Section, has a programme of field assignments in six member countries (Cook Islands, Fiji, Palau, Papua New Guinea, Tokelau and Tonga).

These field assignments are designed to collect information for the development of management plans for specific coastal fisheries in each member country.

Collecting of small, colourful coral reef fishes for the aquarium trade commenced on Tongatapu, the main island in the Tongan archipelago, in the late 1980s.

Several companies have been involved in the aquarium industry on Tongatapu, but by the mid-1990s only two of these had continued to operate successfully. These companies collect not only fish, but also a variety of invertebrates such as sea anemones and soft corals, and dead coral rock encrusted with algae ('live rock').

Prior to 1995, the aquarium companies were also exporting pieces of live coral, however

concerns about the effect of coral harvesting on reef fisheries prompted a moratorium which was imposed by the Government on live coral export.

A further impediment imposed on the aquarium trade was a ban on the use of SCUBA apparatus for catching and harvesting in deep waters.



This resulted from a blanket ban on SCUBA imposed on all fishing activities as a result of several deaths and injuries in the beche-de-mer fishery, where untrained fishermen were using hookah gear for prolonged periods without proper knowledge of decompression protocols.

The Ministry of Fisheries, recognising that there were several issues that needed to be resolved for the effective management of the Tonga aquarium trade, approached the Commission to secure the assistance of ICFMaP in drafting a management plan.

The ICFMaP team spent most of May in Tonga, conducting

field work to gather information necessary for input into decisions for managing the aquarium trade.

The ICFMaP team included a technical officer, Mr Gerard Mou-Tham, from the French scientific organisation ORSTOM. Mr Mou-Tham has worked extensively with ORSTOM scientist, Mr Michel Kulbicki, on estimation of reef-fish population densities and biomass in New Caledonia and French Polynesia.

It was felt that unlike previous studies of the aquarium trade in Tonga, it was essential to report conclusively on the status of the target species in the aquarium trade and on the general condition of the reefs. Mr Mou-Tham's participation was secured from ORSTOM, and generously supported by funding from the French Government.

The field work for this project consisted mainly of conducting underwater visual census (UVC) transects of the reef-fish populations on the Tongatapu reefs. This work was carried out by Mr Mou-Tham and the two ICFMaP Fisheries Research Associates, Sione Matoto and Esaroma Ledua.

Also included in the team was Inshore Fisheries Scientist, Paul Dalzell, who conducted most of the shore-based activities such as interviewing aquarium traders and collecting information on exports of aquarium fish, invertebrates and live rock.

Two staff from the Ministry of Fisheries, Sione Mailau and Feauini Vi, were assigned to work full-time with the

ICFMaP team with the fish transects, and later in Ha'apai with beche-de-mer transects (see below). A minimum target of 40 transects was established prior to arriving in Tongatapu during discussions between ORSTOM and ICFMaP staff.

This target was achieved and exceeded during the trip, and in all 45 transects were made on reefs around Tongatapu. During each transect, the bottom substrate types and water visibility were recorded and all fish species along the transect line identified, counted and the mean length estimated.

The information from the counts can be converted to densities (numbers per m²) and through length-weight conversions to biomass (grams per m²). Besides information on the species targeted for the aquarium trade, the data collected by the ICFMaP team will also provide some details on population densities of shallow-water reef fishes in general, including those species targeted by fishermen for food.

Following the completion of the field work, the ICFMaP team reported their preliminary findings, conclusions and recommendations to the Ministry of Fisheries.

These will be expanded in a report and management plan to be drafted by the team in the near future for consideration by the Ministry.

While in Tonga, the ICFMaP team (minus Mr Mou-Tham) also conducted a follow-up survey of the beche-de-mer resources in the Ha'apai group, following the completion of the aquarium-fish work. The team was augmented by the arrival of Mr Paul Lokani from the

Papua New Guinea National Fisheries Authority, who participated in an earlier joint SPC-Ministry of Fisheries sea cucumber survey in 1990.

The beche-de-mer resources in Ha'apai were relatively unexploited in 1990, but were heavily fished over the next five years and became the centre of beche-de-mer production in Tonga. It was in this island group that the use of hookah gear was particularly extensive, and that most of the accidents and deaths through improper use occurred.

The ICFMaP team transferred to Ha'apai along with the two Ministry of Fisheries staff during the last week of May for a ten-day period. A total of 80 transects were made of the beche-de-mer resources in the central Ha'apai group during this period, and interviews were conducted with beche-de-mer fishermen and buyers to obtain information on fishing pressure and the species being harvested.

Following the survey, a preliminary report giving details of findings, conclusions and recommendations was presented to the Ministry of Fisheries. As with the report on the aquarium trade, this will be expanded and include a management plan for consideration by the Ministry of Fisheries.

Paul Dalzell left the Ha'apai survey during the first week to return to New Caledonia and to prepare for attending a coral reef symposium in Panama (see article on page 4).

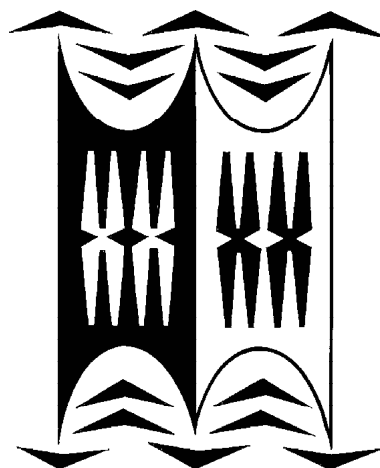
The ICFMaP team, now comprising Messrs Ledua and Matoto, continued on to Fiji during June to undertake a stock assessment survey of the

freshwater clams (**kai**) (*Batissa violacea*) in the Ba River, northern Viti Levu. Fishing for **kai** is the largest domestic single-species fishery in Fiji, and is entirely conducted by women in the rivers of Viti Levu and Vanua Levu.

The stock assessment of the Ba River was part of a three-phase management project on **kai** in Fiji, to be carried out by the Commission and the Fiji Fisheries Division. Phase One on water quality and microbial analysis of **kai** was completed in March this year, and a further study on the socio-economic aspects of the fishery will be undertaken later in the year.

Despite encountering adverse weather conditions during the period spent in Fiji, the ICFMaP team, augmented by Mr Apsai Sesewa and Joe Korovulavula from Fiji Fisheries Division, completed a full survey of most of the Ba River suitable for **kai** fishing.


The team employed UVC techniques, laying transects and conducting quadrat samples (counting all the **kai** within a 50 x 50 cm grid) at eight locations along the transect line, and all **kai** collected were measured and weighed.



During periods of exceptionally heavy rain when diving was impossible, the team conducted interviews with **kai** fishers along the Ba River to estimate the range and average catch per unit of effort by the women harvesting **kai**, and to estimate the

daily frequency of women harvesting **kai** in the river.

As with all ICFMaP field activities designed to collect information for developing management plans, the team reported their preliminary findings, con-

clusions and recommendations to the Fisheries Division. These will be expanded in a report and management plan to be drafted by the team in the near future for consideration by the Division. 

Inshore Fisheries Scientist attends the 8th International Coral Reef Symposium

Inshore Fisheries Scientist Paul Dalzell attended the 8th International Coral Reef Symposium convened in Panama City, Republic of Panama.

The Coral Reef Symposia series was started by the International Society for Reef Studies, with the first being held in India in 1972 and subsequent meetings convened in Brisbane, Miami, Manila, Papeete, Townsville and Guam.

The eighth in the series was the largest to date with over 1,500 registered participants and up to 11 different sessions running concurrently, covering over 50 topics concerned with coral reef biology and ecology.

The symposium agenda listed about 450 presentations, both in the different topic sessions and in the plenary assembly, which was convened three times daily. Besides these spoken presentations there were numerous poster displays (140 listed in the

agenda) and a whole day dedicated to workshops on particular themes.

This is the third Coral Reef Symposium to be attended by a person from the Resource Assessment Section, but the first at which the Section has made a presentation in the meeting.


Paul Dalzell and Tim Adams were asked to contribute two papers to the meeting: one on reef fisheries in the Pacific, as part of a session on status of coral reefs, and the other on sustainability of reef fisheries in the Pacific Islands for a session on sustainable fishing.

The former paper was a synopsis of the various reviews of coastal fisheries in the region conducted by ICFMaP over the past two years.

The latter emphasised the potential of paleo-ichthyological studies conducted mainly by archaeologists and anthropolo-

gists in the South Pacific as a key to understanding long-term effects of subsistence fisheries on coastal reef-fish and shellfish populations (the *Fisheries Newsletter* hopes to publish an article later this year or early in 1997 on this topic).

Many of the sessions were concerned with aspects of reef ecology which have little direct bearing on fisheries management, however, sessions on Fisheries, Fish Biology, Marine Protected Areas, Databases, Fish Dispersal, Rapid Assessment and Sustainable Fishing contained presentations of interest to Pacific Island fisheries scientists.

The *Fisheries Newsletter* will bring these to the attention of readers when the Symposium Proceedings are published in 1997. 

■ CAPTURE SECTION

SPC assists National Fisheries Corporation (FSM) with longline fishing

SPC Masterfisherman Steve Beverly has just returned from his first official assignment with SPC since starting as full-time Masterfisherman in March 1996.

The National Fisheries Corporation, based in Pohnpei, Fed-

erated States of Micronesia, requested assistance from SPC way back in 1994.

NFC's President and CEO, Peter Sitan, has been concerned for the last few years about the poor performance of NFC's two Delta Marine (USA) fibreglass

longline vessels. The Delta boats, *NFC Waab* and *NFC Kosrae* have never done as well as their Japanese or Taiwanese counterparts.

NFC Waab and *NFC Kosrae* are both equipped with American-style monofilament longline

gear manufactured in Florida, USA by Lindgren-Pitman, commonly called 'LP gear'. The concern at NFC was that LP gear was not suitable for FSM waters. *NFC Waab* and *NFC Kosrae* typically had CPUEs (catch per unit of effort) of about half that of other NFC boats, and even less than half the CPUEs of Okinawan boats fishing in FSM waters.

LP gear does well in Hawaii, Fiji, and Tahiti, however, so the problem of the poor performance of the Delta boats needed more investigation. The Masterfisherman set out in late March for a three-month attachment with NFC to try to solve the mystery.

Upon meeting *NFC Waab* at the wharf in Pohnpei and talking with the crew, the Masterfisherman was able to determine that part of the problem with the Delta boats, and probably NFC's other vessels as well, was maintenance.

Without dwelling on all the details, *NFC Waab* was found to be in an unseaworthy condition. In fact, the Masterfisherman spent most of his time while in Pohnpei doing repairs and routine maintenance work on *NFC Waab*.

While the repairs were taking place, the crew of *NFC Waab* made up 1320 new branchlines and added 20 miles of monofilament mainline to the LP reel under the Masterfisherman's supervision.

The new branchlines were composed of five fathoms (10 metres) of tarred 3.0 mm polyester three-strand line with a leaded swivel and one metre of stainless-steel leader wire on the hook end and a swivel snap at the other end. The swivels

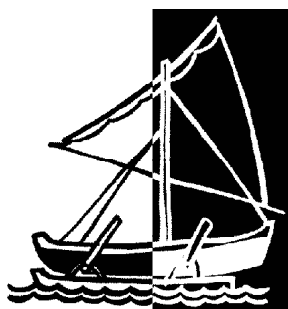
were attached to the line with barrel knots, thus eliminating the need for crimped sleeves, except on the leader wires. This style of branchline is becoming very popular in Hawaii, and is rapidly replacing monofilament branchline gear.

After six weeks of catching up on two or three years' worth of fixing, including replacement of most safety appliances (life raft, fire extinguishers, safety flares, etc.), *NFC Waab* was ready to go to sea again.

The first trip lasted only eight days, however, as *NFC Waab* broke down during the course of the fishing trip and had to return to port early. Three sets were made, and, discounting the first two sets, as the line setter was not working, the catch rate was very good. A total of 18 tuna was caught on 1000 hooks using Japanese muro aji for bait.

In the past, *NFC Waab* had an average CPUE by weight of about 0.18 kg per hook. The CPUE for this first trip, discounting the sets where the line setter wasn't functioning, was close to NFC's target CPUE of 0.50 kg per hook.

Although the yellowfin from this catch did not fare well in the Japanese market (average price 580 yen), the bigeye tuna did quite well (average price 1710 yen).



The second trip took place in June, and the results were similar to the first trip in May: the boat broke down after just three sets and had to return to port, and the catch rate was much better than in the past.

Unfortunately, the Masterfisherman had other duties, and had to leave Pohnpei and NFC before enough data could be amassed to come up with any real conclusions concerning the LP gear, except to say that if used properly, LP gear works fine.

However, several things can be said about longline boats in general, and about NFC's approach to operating a fleet of boats.

There has been some emphasis in the past on government-run fisheries and starting-up private longline ventures acquiring 'mini' longline vessels.

Usually anything 15 m and under (and about 15 to 20 tonnes) is considered a 'mini' longliner. It is now generally agreed by most operators that a 'mini' longliner is not the best choice of vessel for the highly-competitive fresh sashimi tuna industry.

For one thing, most small vessels lack sufficient range to enable them to reach the fishing grounds and stay with the fish long enough to fill the holds and return to port safely.

A longline boat should have the range to allow it to travel for about 10 to 12 days and fish for about 10 to 12 days. In other words, a good boat should be able to operate for nearly one month without refuelling.

Typically, tunas move around a lot, and the hot spot may be as much as four or five days



Setting LP gear (NFC Waab)



Hauling gear (NFC Waab)

from port. Even after finding some fish and having a good catch, there is no guarantee that the fish will stay in one area.

Usually boats have to make some sort of move on a daily basis, and at least one or two major moves during any one trip. *NFC Waab* holds only 1800 gallons of fuel (6.5 t) and her daily consumption is about 200–250 gallons (0.75 t). That gives *NFC Waab* a range of only about eight to ten days steaming, not nearly enough to complete a regular longline fishing trip, and no reserves for safety. This alone rendered *NFC Waab* unsuitable as a viable commercial longline fishing vessel.

If the problem with fuel could somehow be overcome, say with the addition of a fuel bladder as has been done in the past, *NFC Waab* would still not be suitable as a commercial vessel

because of its small fish-hold capacity. *NFC Waab* has two fish-holds: the main hold which has a volume of 25 t and the bait freezer which has a volume of 5 t.

If the bait freezer is used exclusively for bait, then there would only be 25 t of fish-hold capacity for icing fish. *NFC Waab* uses the icing method for chilling and holding fish. It takes about 6 t of fish-hold space to ice 1 t of tuna, so *NFC Waab* can hold only about 4 t of product.

During the project with SPC it was not unusual for some of the Okinawan longline vessels to land 10 t or more from a single trip, and occasionally 15 t were landed. In an export tuna fishery the 'break-even' catch is probably about 5–6 t per trip depending on market conditions in Japan.

While in Pohnpei the Masterfisherman had several opportunities to meet with Mr Gerry Russo, Chief Operating Officer of Micronesian Longline Fishing Company (MLFC). MLFC does not yet have any vessels, although the company has been in existence for over one year.

Russo has spent considerable time and study, along with the team at the Asian Development Bank, to find the right design for a commercial longline vessel for FSM (and presumably elsewhere in the Pacific).

After much consideration, MLFC has decided to alter its original plans and seek designs for 18 to 20 m boats instead of the originally-planned 15 m. MLFC at least is one operation that is willing and capable of learning from the past mistakes of others.



Sirel James, captain of *NFC Waab*, cleaning and bleeding yellowfin tuna

NFC has also realised that the 15 m design is too small, and all of its newer vessels are larger, with greater fuel capacity and bigger fish holds. Any venture that is planning on buying or building a longline boat should investigate the situation in Pohnpei before making a commitment.

Aside from the issues of maintenance and vessel suitability, SPC wanted to answer the questions that arose about LP monofilament gear. MLFC was also anxious to see the results of the fishing trials on *NFC Waab*, as it was still deciding on gear selection for its future vessels.

SPC has had considerable experience with LP gear in the past. In addition to the Masterfisherman's experiences in Hawaii, Fiji, and Guam using LP gear, SPC conducted a long-term longline project in East New Britain (ENB), Papua New Guinea (1992–1994). The ENB project utilised an LP reel installed on an ENB fisheries vessel, and was very successful in terms of CPUE.

It was, therefore, no surprise when LP gear proved to work fine on *NFC Waab* after the vessel's maintenance was brought

up to standard and new branch-lines were fabricated.

The reasons that *NFC Waab* had poor catches in the past were not due to fishing gear, but rather to a lack of routine maintenance which led to too much down time, and also to too small a range of operation, which meant that the boat could not get to the prime fishing grounds or do enough sets to fill the fish hold.

The Masterfisherman found the crew of *NFC Waab* to be hard-working while at sea and knowledgeable about fishing methods and fish handling, if not about boat maintenance.

Management at NFC was very helpful in providing everything necessary for a fairly smooth shore-side operation, including provisioning the vessel, fuelling, procurement of spares and gear, and processing and transshipping the catch at the end of each trip.

However, it needs to become more involved with vessel maintenance and safety issues. In contrast, NFC has a fine fledgling fleet of planes. NFC's Airfreight division acquired another plane while SPC was in Pohnpei.

This brings their fleet of planes to two. The new plane is a refurbished Boeing 727B, the flagship *Micronesia*, capable of flying up to 16 t of export tuna to either Guam or Saipan. NFC's Air Freight Division services NFC's ten vessels, one private vessel in Pohnpei, ten vessels that fish in a joint-venture arrangement with NFC for the Okinawan Tuna Fishermen's Cooperative Association, and a fleet of about 30 Chinese (PRC) longline boats fishing out of Pohnpei.

With two dedicated air cargo planes and processing plants on Yap, Chuuk, and Pohnpei, NFC now has the ability to process and transship a good percentage of the longline-caught tuna from FSM's Exclusive Economic Zone. This is a good step towards domesticating the fishing industry, but more work is still needed on the operation of the local fleet.

SPC is currently seeking funding from the United States to allow the Masterfisherman to spend more time working with the longline fleet in FSM.



New Fisheries Development Adviser joins SPC

Lindsay Chapman was recently appointed Fisheries Development Adviser. Lindsay is well-known by the readers of the *SPC Fisheries Newsletter*, because he was employed by the South Pacific Commission as Masterfisherman from 1982 to 1989.

Lindsay then spent almost a year in the Australian Maritime College, where he obtained a diploma in Fisheries Technology, with courses including

fisheries biology and population dynamics, fisheries economics, fisheries resource management, fisheries technology, and seafood handling and processing.

From 1991 to 1992, he was coordinator on a project entitled 'Development of an albacore fishery off South-eastern Australia', where he organised, amongst other activities, all aspects of the project's fieldwork, including the charter of two

commercial fishing vessels, the collection of scientific and biological data on board the chartered vessels and the selection and placement of observers.

Since 1992 and before joining SPC, Lindsay was working for the Australian Fisheries Management Authority (AFMA) where as Manager of the Southern Bluefin Tuna and Western and Southern Tuna and Billfish fisheries, he was responsible for supervising the development



Lindsay Chapman, the newly-appointed SPC Fisheries Development Adviser

and implementation of a fishery management plan, for participating in the development of

policy directions for AFMA, and for participating on the Australian delegation in do-

mestic and international negotiations. 

■ POST-HARVEST SECTION

Second International Conference on Fish Inspection and Quality Control

The past year has seen a number of *Fisheries Newsletter* articles on the topic of Seafood Quality Assurance with particular reference to Hazard Analysis Critical Control Point (HACCP) (*Fisheries Newsletter* No. 73, April — June 1995, and No. 74 July — September 1995).

Earlier this year, the United States Food and Drug Administration announced details of its new seafood inspection regulations to be implemented on 18 December 1997.

This programme is based on the HACCP system of ensuring product safety for US consumers. The announcement leaves many Pacific Island-based ex-

porters of seafood to the US asking the question: 'will these new regulations affect me'? The simple answer is 'yes'. But to what extent remains unclear.

To help assess the likely impact on the region of the new HACCP-based quality assurance systems planned for the USA next year, and already in place in Canada (QMP—Quality Management Program) and the European Union ('Own check'), the SPC Post-harvest Fisheries Adviser attended the Second International Conference on Fish Inspection and Quality Control held from 19 to 24 May 1996, in the Washington, DC area.

Over 450 industry and government representatives from 65 countries attended the conference. It was sponsored by the National Fisheries Institute, the Food and Agriculture Organization (FAO) of the United Nations, the US Food and Drug Administration, the US National Marine Fisheries Service, the Canadian Department of Fisheries and Oceans, and the Fisheries Council of Canada.

The Conference agenda included 11 sections covering:

- International Trade Considerations;
- Emerging Inspection Systems;

- Special Hazards and their Control;
- Essential Quality and Product Integrity;
- Special Quality Control Considerations in Handling and Processing;
- Inspection and Quality Assurance Monitoring Operations;
- Automated Computer Systems;
- Country Discussions of Progress in Implementing HACCP-based Seafood Inspection Programmes;
- Training of Regulatory and Industry Personnel;
- Equivalency and Inspection Agreements; and
- Conference Recommendations.

The Conference also featured 27 exhibitors of various services and new technology for quality control and inspection.

The exhibitors included those offering assistance in establishing HACCP systems, HACCP plans and training for quality assurance staff; independent assessors of seafood processing facilities and HACCP plans; software to help evaluate processing operations and automate the procedures for writing up HACCP plans; companies selling kits for rapid testing of seafood for histamine, fish toxins (including ciguatera), salmonella, etc.

The Conference was timely in that it allowed the US regulators a platform to inform domestic and overseas processors of how the new health regula-

tions will be applied to all US seafood products. Seafood processors in the US will be checked by the local regulatory authorities.

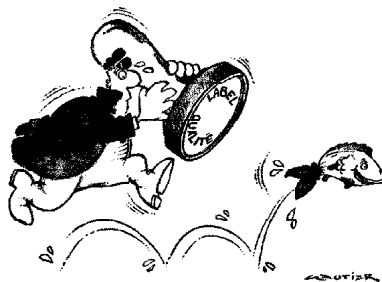
However, overseas producers will need to work closely with their US importer, because it will be the importer who will be responsible for ensuring compliance with the new regulations.

The US importer will need to be able to demonstrate to the US regulatory authority that a HACCP-based system of quality/health assurance is in place. For the seafood exporter in the Pacific Islands, it will mean that in HACCP plan has to be formulated and a copy of this plan will need to be held by the importer.

If the exporter is dealing with more than one US buyer, then each one will need a copy of the HACCP plan for each product (each product requires its own HACCP plan — that is, if there are five products, the company will need five HACCP plans).

Even though the US FDA provided a great deal of valuable advice on the new regulations, they readily admitted that it was unclear how well the new regulations would work.

They would, therefore, be applying the new regulations with a reasonable degree of flexibility, and make modifications to the regulations when these were deemed necessary.



Of the other countries that have made progress towards implementing an HACCP-based QA system, New Zealand, Australia and Thailand are probably the most advanced. Many other countries are making some progress. These include China, India, Indonesia, Japan, Chile, Mexico and Poland.

The driving force behind the rush towards implementing HACCP is the need to be able to meet the health safety requirements of the major seafood importing countries, which include Canada, member countries of the European Union and the USA.

Implementing these new QA systems does confer advantages. It provides exporters from these countries a competitive edge, so that they will be given preferential treatment in accessing important seafood markets, and, because HACCP systems result in products with a much higher degree of certainty that health standards have been met, and that other similar higher-quality standards have been met, they often attract better prices.

The fact is, an HACCP-based quality/health assurance system is not easy to implement for any seafood processor, whether in the US, Europe or overseas.

The difficulties will be more severe in developing countries — a point that a number of delegates made at the Conference. The Pacific Islands face even greater implementation problems. Isolation, small economies, a lack of food sanitation regulations, and a scarcity of technically-qualified staff, are just some of the factors that will need to be overcome during any exercise to upgrade seafood-quality assurance systems.

During the Conference, FAO and the United Nations Industrial Development Organization (UNIDO) outlined their programme of support to developing countries in helping them to establish HACCP-based QA systems.

Discussions were held with FAO Fisheries representatives at the Conference on ways of bringing FAO's expertise to help improve quality inspection and control procedures in the Pacific.

Discussions are continuing, but a proposal along the lines of implementing HACCP QA systems within the Pacific will require national support from within the region.

Some of the more significant recommendations made by the Conference were:

- ☞ The Conference recognised the importance of the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) and the Agreement on Technical Barriers to Trade, and urged governments and industry to facilitate implementation of these agreements and to bring about equivalency, harmonisation and transparency so as to minimise any barriers to international trade.
- ☞ The Conference noted that HACCP-based programmes are in the process of being implemented on a global scale in the seafood industry. Governments and industry were urged to continue their efforts and to give a high priority to full implementation of HACCP-based systems.
- ☞ The Conference strongly recommended that governments and the private sector recognise that HACCP can only be successful if it is built on a sound programme of Good Manufacturing Practices (GMPs).
- ☞ The Conference encouraged governments and industry to explore alternative creative mechanisms to insure industry compliance with HACCP-based programmes. It was suggested that this could include the use of accredited inspection bodies, expert international panels and private laboratories. The use of these alternative mechanisms, however, should not in any way affect transparency and effectiveness of compliance.
- ☞ The proper handling of seafood products by distributors and consumers was emphasised and the Conference urged that appropriate organisations continue their efforts to fully educate consumers, particularly with respect to risk communications and in the handling of high-risk products.
- ☞ New automated systems and rapid detection methods exhibited and discussed at the Conference will play an increasingly important role in implementation of HACCP-based inspection and quality control. The Conference encouraged more applied research and technology development by institutions and industry to improve further the efficiency and effectiveness of inspection and quality control operations.
- ☞ New technology development is encouraged and should be addressed at future meetings.
- ☞ The vital role of training and technical assistance in implementing quality assurance programmes was recognised by the Conference. International bodies are encouraged to maximise the effective use of resources by coordination of their efforts and by recognition of programmes that produce equivalent results.
- ☞ The Conference recognised a number of areas where further work and training are required. In particular, specific consideration should be given to sensory evaluation.
- ☞ It was agreed that the Conference established a basic foundation for increased dialogue on fish inspection and quality control, and the proceedings will certainly contribute to increased global knowledge on this matter. With the aim of facilitating this dialogue, FAO was encouraged to take a leadership role in organisation of the next conference within 4 or 5 years.

For additional information about the Conference, or to obtain a copy of the Conference proceedings, please contact the National Fisheries Institute, 1901 North Fort Myer Drive, Suite 700, Arlington, Virginia 22209, USA, Telephone: 703-5248883, Fax: 703-5244619.

For more information on HACCP and its implementation, please contact Steve Roberts, SPC Post-harvest Fisheries Adviser.



Seafood Information Exchange

For those interested in joining a seafood information exchange site through an e-mail connection, try subscribing to 'list SEAFOOD'. This is a seafood research and extension contact point for facilitating information sharing and exchange among post-harvest fisheries researchers and extension personnel.

Once you have signed on, you will receive information about conferences, publications, training workshops, new innovations in seafood technology, and so on.

The connection can also be used for sending technical and scientific queries on seafood and seafood products, getting up-to-

date information about HACCP, advertising vacancies, etc. At the last count there were over 450 subscribers, which means that an e-mail query should find at least one person with an appropriate, helpful response.

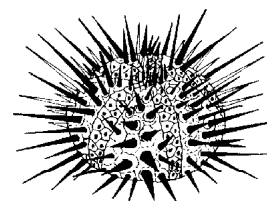
If you would like to subscribe, please follow the following steps exactly:

1. address the e-mail to: **listproc** on e-mail #: listproc@ucdavis.edu
2. **important:** leave subject box empty; in the message area write: SUBSCRIBE SEAFOOD your name e.g. SUBSCRIBE SEAFOOD Fred Bloggs

3. Do not sign at the end, or add any other information. If you have an automatic signature facility, make sure it is switched off.

Within two or three days you should receive an acknowledgement, with instructions on how to use the service.

It also tells you how to obtain a list of all subscribers, or sign off from the list if the service does not meet expectations. 



■ WOMEN'S FISHERIES DEVELOPMENT SECTION

In October 1995, the South Pacific Commission Women's Fisheries Development Section carried out a study on the role that women play in the fisheries sector in the Kingdom of Tonga.

The main objective of the study was to identify and prioritise the training needs of women in fisheries. The findings of the study showed that there was a need for training to improve current practices in seafood handling, processing and marketing.

As a follow up to the study, the Women's Fisheries Development Officer, in collaboration with the Tonga Fisheries Senior Fisheries Extension Officer, drafted a timetable for a workshop on 'Improved Seafood Management Skills for Women of Ha'apai, Vava'u and Tongatapu' which was held from 3 to 7 June 1996.

Sixteen women with varying experiences in fisheries activities attended the workshop.

The criteria for participant selection were based on the women's involvement in fisheries, together with their ability to implement the skills learned at the workshop, and on providing training to others. All of the women were involved in the harvest of marine resources.

However, whereas a number of the women were involved in commercial seafood export activities, others provided seafood for family consumption and sold any surplus at the village market.

The emphasis of training during the five-day workshop was on hands-on learning. Lectures were held in the mornings, with demonstrations and practical sessions in the afternoons. In order to meet the needs of all the

participants, the topics covered a range of subjects, including sustainable resource management, nutrition, hygiene in seafood handling, quality control and assessment, processing and preservation of seafood, marketing, and the establishment of an income-generating venture.


Practical sessions included the preparation of wet fish, dry and wet salting of reef fish, the making of tuna jerky and spicy dried clam, and the constitution of a coconut frond / fibre insulation basket.

At the end of the workshop, the participants, together with the Ministry of Fisheries, identified areas for future development. The workshop is the first form of training which focuses on meeting the needs of women in the fisheries sector.

The Women's Fisheries Development Section is grateful to the

Tonga Ministry of Fisheries for their staff support and provision of facilities, to the local and over-

seas tutors for sharing their expertise and knowledge, to local businesses for the use of materi-

als, and to the New Zealand Government for the overall funding of the workshop. 



Once the reef fish have been soaked in a brine solution, they are arranged on trays ready for drying.



A participant practises preparation skills on a yellowfin tuna

■ TRAINING SECTION

Workshops on the handling and grading of sashimi tuna in French Polynesia

As a follow-up to recent training initiatives in tuna handling and grading (regional workshop in Chuuk in August 1995 and PNG national workshop in December 1995), the Fisheries Training Section coordinated two two-day workshops for the French Polynesia tuna longline industry in Papeete, in the last week of May.

Funded by the European Union, the workshops were jointly organised by the 'Etablissement pour la Valorisation des Activités Aquacoles et Maritimes' (EVAAM) and the Section following an official request from the Government of French Polynesia.

The purpose of this training was to improve the on-board handling and the grading of sashimi-grade tunas in order to meet the requirements of the

exact fresh tuna markets overseas. At present, approximately 70 fishing vessels in Tahiti are equipped with monofilament longline gear, and almost all the catch is still sold and consumed locally; however, the longline fleet is still growing, and the fishing industry predicts the need to start export operations in the near future.

The Fisheries Training Section was again fortunate to secure the participation of Ken Harada, the Sydney Fish Market's Quality Control Officer, as a tutor.

The manager of the Sydney Fish Market, Mr Graham Crouch, also came to Tahiti to inform the workshop participants on the marketing opportunities offered in Sydney. Ken Harada is now well-known in

the region after his participation in similar SPC workshops in Chuuk and Port Moresby. Ken's knowledge of the sashimi tuna markets and his practical experience of the assessment of tuna quality were major assets.

The workshop lectures were hosted by the 'Ecole de Formation et d'Apprentissage Maritime' (EFAM) and included an introduction to the Japanese and Australian sashimi markets, tuna biology and physiology, on-board tuna handling, quality assessment, on-shore handling and packing.

The resource materials used during the lectures included Ken's videos and slides, as well as the SPC video on the on-board handling of sashimi-grade tunas. The recently published SPC manual on the same topic was distributed to the participants.



Ken Harada demonstrating the Tanaguchi method



A trainee practises on-board skills



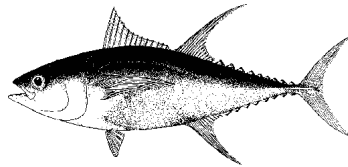
Unloading tuna at Papeete fishing port (two 25 m longliners are in the background)


Practical work was carried out at the auction fish market located at the Papeete fishing port. 'Hands-on' demonstrations of tuna handling and grading were carried out by Ken, who simu-

lated the on-board handling from gaffing to chilling, and compared the quality of several tunas, discussing their colour, fat content, freshness and body shape. A tuna was dissected to

show the position of the brain, spinal cord and main lateral blood vessels. Each participant was then given the opportunity to practice these handling skills on whole tunas.

A total of 23 participants attended the workshops, with two participants from New Caledonia and one from the Cook Islands.



It is expected that, in the future, similar workshops, either regional or national, will be run in support of the development of the region's longline activities. 

Pacific Island Qualified Fishing Deckhand coordinating group holds first meeting

Since 1992, the SPC Fisheries Training Section, the Forum Fisheries Agency, and the Forum Secretariat Maritime Training Division have cooperated in an effort to create a common, regional base for fishing-vessel crew certification.

This effort is now gradually being rewarded with success. On 11 April 1996, a coordinating group for Pacific Island Qualified Fishing Deckhand (PIQFD) training was formed and its first meeting held.

The main objective was to review the first modules (ready in draft form) of the training resource materials being produced for training institutions in the region for use in PIQFD Certificate training. The teaching resource package will contain 22 modules in all, covering all subjects required for certification to international standards and regional legislation for fishing-vessel deckhands.

The meeting was attended by Captain Soko Tuipulotu, Head of the Fiji School of Maritime Studies; Mr Kamaua Bareua, Principal of the Kiribati Fisheries Training Centre; Captain Larry Muller, Principal of the Marshall Islands Fisheries and Nautical Training Center; Mr Pascal Ohoau, Principal Marine Officer (Licensing), Solomon Islands Marine Division; Mr Mosese Fakatou, Acting Secretary for Marine and Ports, Tonga Ministry for Marine and Ports; Mr Ken Barnett, Consultant, Tuvalu Maritime School;

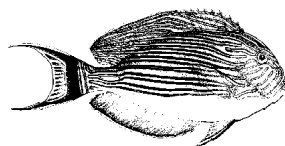
Mr Fatu Lafoai, Acting Principal, Western Samoa Marine Training Centre; Mr Angus Scotland, Regional Maritime Training Coordinator, Maritime Division of the Forum Secretariat; and Mr Michel Blanc, Fisheries Education and Training Adviser, South Pacific Commission, who chaired the meeting.

BACKGROUND INFORMATION ON THE PIQFD PROGRAMME

The necessary background information had been provided to the group through a presentation by the SPC representative at the inaugural meeting of the Association of Maritime Training Institutions and Maritime Authorities (9-12 April).

The group, however, re-emphasised that the PIQFD syllabus was in compliance with International Maritime Organisation standards as outlined in the 1995 amendments to the annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW-F).

It was also noted that most of the items listed in the PIQFD syllabus were of relevance to the training of ratings; thus the resource materials produced by SPC could also be used by the institutions for the training of trading vessel ratings.



COUNTRY STATEMENTS

Fiji:

The School of Maritime Studies would like to be involved in the delivery of fisheries training. At the moment, the School runs courses for trading-vessel crews only. The Fiji legislation has been modified recently so that the School can meet the needs of the fishing industry. The School is considering introducing the PIQFD course in 1997.

Kiribati:

The Fisheries Training Centre runs a similar course (only 8 of the 22 items listed in the PIQFD syllabus are not covered in the FTC course). The FTC course is run in cooperation with and with assistance from the Japan Tuna Association.

However, the FTC Principal predicts an increase in the demand for trained I-Kiribati fishermen, and is keen to introduce the PIQFD course as soon as possible.

Marshall Islands (RMI):

The RMI Fisheries and Nautical Training Centre (FNNTC) would like to introduce the course in September 1996. At present, employment opportunities are limited in the RMI, but the potential growth of the longline fishery makes this training very relevant. FNNTC facilities are adequate, although fire-fighting equipment is not up to IMO standards. One expatriate staff

member of the FNTC has the experience and fisheries background to teach the course, but the School needs a local tutor with similar experience.

Solomon Islands:

The School of Maritime and Fisheries Studies (SMFS) already runs a wide variety of fisheries training courses. It has the staff to teach the PIQFD course, but requires fire-fighting equipment at the IMO standard.

It is hoped that a grant will soon be obtained by the School to upgrade buildings and teaching facilities (fire-fighting, Global Maritime Distress and Safety System). The growing fishing industry in Solomon Islands makes the course very relevant.

Tonga:

The Maritime Polytechnic Institute (MPI) runs courses only for trading-vessel crews, but is keen to introduce the PIQFD programme in the near future. To do so, the MPI will need tutorial assistance, staff training and equipment for the syllabus items specific to fisheries.

Western Samoa:

The introduction of fisheries training courses has been proposed by the Marine Training Centre (MTC). The equipment/facilities at the MTC are suitable, but fisheries instructors are needed. The PIQFD course will be introduced once em-

ployment opportunities for Samoans on foreign fishing vessels are higher.

APPRAISAL OF THE RESOURCE MATERIAL PRESENTED BY SPC

The chairperson explained that each syllabus item will be covered through a separate module containing introductory notes (learning outcome and outline of the module); the learning content to be used as background information for the tutors and hand-outs for trainees; and notes to assist the teacher in planning the lessons, exercises and examinations.

The introduction section of the resource material package, as well as one module in final draft form, were distributed to the group members.

The training methodology was assessed positively by the group, but it was felt that each module should contain a detailed list of competencies to be assessed by the tutors/examiners. The current syllabus should be called 'course syllabus' rather than 'examination syllabus', as it does not contain enough details to be used for examination purposes.

The group strongly felt that two new items, 'Prevention of marine pollution' and 'The rights, responsibilities and duties of fishing-vessel crews', should be included in the syllabus as separate modules.

The module on marine pollution is essential, as it is part of the minimum requirements for the training of fishing deckhands under the 1995 amendments to the IMO convention (STCW-F).

The information contained in the module presented was con-

sidered as being the right amount needed. The group felt that special care should be given to editing, layout and presentation.

The SPC teaching manual *Safety at sea for small-boat operators* should be used as a guide.

The group suggested that the module presented to the meeting (Module 8) be finalised by the consultants and forwarded to the participants in its final form as soon as possible. The participants would send their final assessment of the module to SPC (or the consultants) so that other modules could be finalised accordingly.

DISTRIBUTION OF THE PACKAGE OF RESOURCE MATERIALS

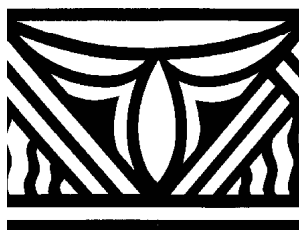
The finalised resource materials will be made available to the training institutions as soon as possible, preferably by August 1996.

FURTHER ASSISTANCE REQUIRED BY TRAINING INSTITUTIONS

The Kiribati and Solomon Islands representatives said that their training institutions could implement the PIQFD course without additional assistance once the resource materials are at hand. Fiji, Western Samoa, Marshall Islands and Tonga would need the assistance of an overseas tutor experienced in teaching Qualified Fishing Deckhand courses.

EXAMINATIONS FOR THE PIQFD COURSE

The group agreed that examinations for the PIQFD course should be competency-based and administered by the tutors and the principal of the training institution. The certificate should be issued by the Marine Department of the country.



PROPOSED CERTIFICATE STRUCTURE FOR FISHING VESSEL DECK CREWS

A proposal for certificate structure had been drafted by the members of the Association of Maritime Training Institutions and Maritime Authorities. This proposal was also discussed by the PIQFD Group. The following issues were highlighted:


- The vessel size category should be changed from 12–24 m to 12–35 m in order to fit most longliners operating in the region into one size category;

- A lower limit of 9 m should be introduced for fishing vessels in near-coastal (12–200 nm) traffic;
- Vessels between 35 m and 80 m should have at least three PIQFD instead of two.

These recommendations were put forward and adopted by the Association of Maritime Training Institutions and Maritime Authorities. The table presents the Association's proposal for deck certificate requirements in a regional certification structure for fishing vessel crews.

DATE OF NEXT MEETING OF THE PIQFD COORDINATING GROUP

The group agreed that the next meeting should be held after the package of resource material has been distributed and some countries have run their initial PIQFD courses, preferably early in 1997.

The purpose of the next meeting will be to review the materials and the initial courses, and to make recommendations on the continued development of standards in a regional structure for certification of fishing vessel crews. 

Vessel size & operation	Skipper	Mate/Watchkeeper	Deckhand
35–80 m, unlimited area ¹	Grade 3 Master ⁴	Grade 4 Master	At least 3 PIQFD ⁵
12–<35 m, unlimited area	Grade 3 Master	Grade 5 Master	At least 2 PIQFD
< 35 m, coastal ²	Grade 5 Master	Grade 5 Mate	At least 2 PIQFD
9–<35 m, near-coastal ³	Grade 5 Master	Grade 5 Mate	At least 2 PIQFD
<9 m, near-coastal	Grade 6		

¹ 'Unlimited area' means fishing outside the 200-mile EEZ.

² 'Coastal' means fishing inside the 200-mile EEZ.

³ 'Near-coastal' means fishing inside the 12-mile limit.

⁴ The syllabus for Grade 3 Master, Grade 4 Master, Grade 5 Master and Grade 5 Mate as laid down shall be amended by deleting all contents not relevant to fishing-vessel activities and by inserting those parts of the syllabus of STCW-F relevant to the grade of the fishing vessel.

⁵ PIQFD: Pacific Island Qualified Fishing Deckhand.

Practical fishing module of the 1996 SPC–Nelson course in Kiribati

The 1996 course was similar in structure to previous programmes, with a 19-week module in Nelson (from 12 February to 21 July), followed by a practical fishing module (from 20 June to 26 July) on the island of Abaiang, in Kiribati.

On Thursday 20 June, after a tiring two-day journey, the eleven trainees and Alastair Robertson, fisheries instructor at the New Zealand School of

Fisheries, were welcomed at Bonriki airport in Tarawa by the SPC Fisheries Training Adviser and staff from the Kiribati Fisheries Division. The next day, the three Fisheries Division vessels that had been made available for the course sailed to Abaiang, the next atoll north of Tarawa.

Abaiang proved to be a perfect venue for the practical module, with good accommodation, ice-making facilities, and, most

importantly, some excellent fishing grounds for deep-bottom and oceanic species.

The three boats used in Abaiang were the Fisheries KIR-4 canoe and 6.5 m skiff, as well as the *Tebenebene*, an 18 m extension vessel recently donated by the Government of Japan to the Fisheries Division.

Although not a fishing vessel, the *Tebenebene* was set up to do

bottom longlining for deep-water snappers using three types of longlines (200-hook tropline, 40-hook bottom longline and 10-hook droppers).

She also was very useful as a mother ship for the other two boats during extended fishing trips in the northern part of Abaiang. The KIR-4 and the skiff were used to demonstrate

bottom fishing with hand-reels, trolling and vertical longlining for tunas.

At the time this article was being written, the course was still on, with two weeks to go. The reported catches of deep-bottom species were excellent, with an average of more than 50 kg per boat per day trip. During the last two weeks, the two

small boats would target deep-swimming tunas with vertical longlines and a short (40 hooks) horizontal longline.

The SPC Fisheries Training Section is grateful to the Kiribati Fisheries Division for making its boats and staff available, and for all the arrangements made prior to and during the course.



Ronald (PNG), Jensen (Niue) and Davis (Palau) displaying a good bottom-fish catch. Don't worry, the fish will be put back on ice in a minute! . . .

■ OCEANIC FISHERIES PROGRAMME

Papua New Guinea's first observer training course

The National Fisheries Authority (NFA) of Papua New Guinea held its first Observer Training Course at the National Fisheries College in Kavieng, New Ireland Province, from 6 to 24 May 1996.

The course was conducted by Kisi Geadeau (Fisheries College), Karl Staisch (FFA) and

Peter Sharples (SPC). Several guest lecturers were also invited to talk on special topics. The course had 29 participants (including three women) invited by NFA from throughout the country. The Solomon Islands Observer Supervisor was also invited to attend and address the course.

The purpose of observer training is to strengthen effective monitoring of fishing activities (including transshipment operations), to facilitate the collection of biological and technical data and to encourage general compliance within Papua New Guinea waters.

The enthusiasm of the instructors was contagious from the first day, and all the participants eagerly absorbed the mass of information given out during the three weeks. Participants bravely weathered the daily tests with similar ardour.

Mr Geadeau taught navigational skills and chart work. This included a field trip on the College's fisheries training vessel, the *F.T.V. Leilani*, to give participants a better understanding of navigational aids used in shipping.

Kenny Leana, the Acting Manager of NFA's surveillance division, talked about PNG legislation and the role of observers in their National Programme.

Andrew Wright, former FFA Deputy Director, spoke on the status of tuna stocks in the region and about the various regional arrangements in place to help manage these stocks. The United States Federal Special Agent attached to FFA as Fisheries Enforcement Adviser, Marc Cline, spoke on compliance and detecting infringements.

Michelle Lam, the Solomon Islands Observer Programme Coordinator, lectured participants on various aspects of marine pollution and its potential dangers, particularly with respect to the tuna industry and transshipment ports. She also shared with participants the experiences of the Solomon Islands observer programme.

Karl and Peter taught the main part of the course. Using videos and anecdotes of experiences from observer programmes in which they had previously been or are currently employed, they introduced participants to observer life at sea. Topics in-

cluded: an introduction to observer programmes under regional arrangements and treaties; data collection from purse seiners and longliners using various standardised regional forms and logsheets; vessel sightings and reporting; scientific report writing; transshipment; biology and taxonomy; and sampling and measuring techniques.

Hands-on experience of port sampling and a guided tour of the electronic instruments used in fishing were given by Peter Sharples on board a Taiwanese

longliner anchored in Kavieng harbour. However, an intended visit aboard Korean purse seiners also held up in Kavieng did not eventuate.

PNG's First Observer Training Course was honoured by the presence at the closing ceremony of the Director of FFA, Victorio Uherbelau, and the executive director of NFA, Dennis Renton, both of whom flew in for the one-day programme.

All 29 participants graduated, with four of them achieving

Trainees practising safety-at-sea exercises

distinction. Lecturers were impressed with the high standard of students and the general willingness of all to learn. The initial selection of students was commended for its quality. Lecturers maintained that it was this thoroughness that led

to the high pass rate and had made their work considerably more easy than is often the case.

A grand seafood reception prepared by the Fisheries College marked the end of the whole programme. The enthusiastic

observers are now looking forward to their first sea trips.

(Source: Michelle Lam, Solomon Islands Observer & Port Sampling Project Supervisor, Fisheries Division)



A tutor showing the trainees how to use flares

■ ORSTOM EXPLORES THE SEABED OF NEW CALEDONIA'S NORTHERN PROVINCE

For more than a year, a team composed of four researchers from ORSTOM (French Research Institute for Development in Cooperation) and several trainees has been studying fish populations in New Caledonia's Northern Province.

The purpose of this programme, carried out as part of the development contract between the French Government and the Province, is to assess fishery resources, i.e. stocks of available, commercially-exploitable fish.

If at the completion of the programme, currently scheduled to end in August 1997, the data presented to decision-makers are considered positive, a complete management system will be implemented (fisheries, reserve, ecotourism).

A systematic approach

All marine biotopes, including the reef, soft bottoms, estuaries and mangroves, from Poya to the Belep Islands in the west and from the Belep Islands to Canala in the east, are being surveyed. This means surveying some 10,000 km² of lagoon and 1,500 km of coastline, by means of both a visual count by divers of all the biotopes and fishing experiments using hand lines on the fringing reefs, nets in the estuaries and mangroves, and longlines on the soft lagoon bottoms.

The study also covers the biology of the various species by determining their reproductive season, food, size-weight ratio and sex ratio (the number of males in comparison to the number of females).

Plenty of fish north of the Belep Islands

The programme, which began 16 months ago, has already covered more than half of the zone to be surveyed. Since March 1996, the ORSTOM team has turned its attention to the northern part of the east coast. All data concerning the west coast, as well as data on the Belep Islands, have been entered and are now being processed. Already certain results attract attention.

In the north, there are large numbers of fish on the Cook and French reefs. Michel Kulbicki, scientific coordinator of the project, pointed out, "... with some unexpected figures which, for certain species, surpass the maximum figures recorded." He then tempered his words by stating, "There is, however, a tendency to count more fish than there are in reality, because they are very curious and are attracted to the divers." Nevertheless, the figures are there and estimates are twice those made in Ouvéa, and four times those for Noumea.

Special attention needed to stock management

Several indicators show that one of the main reasons for these good results in the northern section is the lack of large fishing effort: the presence of very large fish and the absence of medium-sized ones prove that these fish are little exploited and that they are subject to strong competition.

If fishing pressure were to increase, results would be very positive at the outset, with catches comprised of large fish, then yields would drop drasti-

cally, as all the remaining fish would be small. Fishermen would then have to wait for some time before a certain balance was re-established, with a population structure similar to that in Noumea where large fish are rare.

Lagoon populations are as fragile as forest-dwelling species. Thus, it takes at least 30 years for a maori wrasse to reach a metre in length and a weight of 30 or 40 kg. Once it has been caught, it will be replaced by small wrasse and bream which grow more quickly but which attain significantly smaller overall size. For that reason, careful attention must be paid to stock management.

The west coast

Analysis of the results obtained on the west coast is still patchy. In the initial analysis, there were less fish than in the north, their size was smaller and species composition was also different.

Maori wrasse were found along the west coast but in far fewer numbers than in the north. In contrast, mullets were significantly more numerous (probably due to terrigenous deposit ratios and wind).

Half of the programme has already been completed. Some 600 dives and 400 fishing expeditions have been completed of the 1,000 diving hours and 700 expeditions scheduled. The on-site survey continues in the north-east from Balade to Hienghène and will extend as far as Canala before its scheduled completion in February 1997.

(Source: *Les Nouvelles Calédoniennes*) 

■ SEAFDEC-DESIGNED ARTIFICIAL REEFS

South-East Asian Fisheries Development/Aquaculture Department (SEAFDEC/AQD)'s Community Fishery Resource Management (CFRM) Project, a development-oriented research, is focused on Malalison Island, located in western-central Philippines.

CFRM aims to apply community-based techniques of fishery resource management through the collaboration of community organisations, biologists and social scientists. A major stage of the project was the fabrication and deployment of artificial reefs (ARs), which called for engineering expertise.

Engineer Reynaldo A. Tenedero of SEAFDEC/AQD designed the ARs, which were fabricated and deployed by the community. In determining the configuration, form, size and weight, the limitations of the fisherfolk were taken into account.

The fishermen in the area, who were organised into the Fishermen's Association of Malalison Island (FAMI), were consulted on the water currents, underwater topography and substrate. Their information supplemented the data gathered by SEAFDEC/AQD staff, who made a hydrographic survey, and actual dives to determine the AR site.

AR designs

The main considerations in choosing materials for the ARs were availability, cost, and ease of installation. Concrete and stone were used for AR construction because of their density, durability, and low cost. The ARs were made of steel-reinforced concrete, fabricated

in segments of at least 1.47 kilo Newton (KN) per block to avoid the use of heavy lifting and transport equipment.

When concrete was poured, the sides in contact with the formwork were left as is to produce a smooth-to-rough finish, but the exposed sides were deliberately made rough to provide a varied surface texture which might allow a diversity of organisms to settle.

Three types of unit reef were fabricated. Unit reef I was a building-block type consisting of ten 150 x 200 x 2,000 mm long concrete blocks, arranged two blocks per layer with a unit size of 2 x 2 x 1.6 m high (see figure).

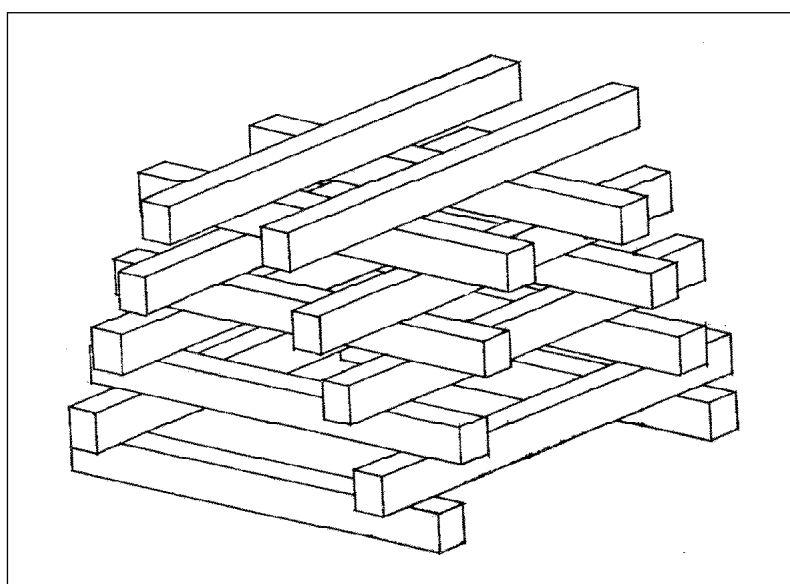
Unit reef II consisted of fifteen 300 (ID) x 200 mm concrete pipe culvert blocks arranged in pyramidal configuration of 5, 3, 2 and 1 layers to a unit reef size estimated at 1.2 x 2.5 x 2 m high. However, the height depended on the spaces in between each block when the unit reef was set.

Unit reef III consisted of thirty 499 (ID) x 500 mm modified concrete pipe culverts with three 250 x 250 mm openings on the sides. The unit reef size was estimated at 2.5 x 2.5 x 1.5 m arranged at random.

Unit reef I was fabricated on the island using locally-available materials. Manpower was provided by fishermen and FAMI members, who were not really skilled construction workers. Skilled labour was not necessary since the units were of rough finish.

Ready-made concrete pipe culverts for unit reef II were fabricated by a concrete product dealer in Culasi, 20 minutes by motorised banca from the island. Unit reef III culverts were also made to order at Culasi, but modified to provide three openings on the sides. The costs of fabrication and deployment of ARs appear in the table on page 24.

To instil a sense of responsibility for the project, FAMI gave a



Unit reef I, building block

AR fabrication and deployment costs (conversion rate: 1 US\$ = 26.0 pesos, include direct labor and material costs)

Unit reef	Description	Block/unit	Cost (Pesos)	
			Fabrication	Deployment
I	Building block	16	4624 ¹	995 ³
II	Concrete pipe culvert	15	4060 ²	995 ³
III	Modified Concrete pipe culvert	30	3600 ²	995 ³

¹ Based on estimates.

² Actual cost.

³ With community counterpart.

counterpart contribution of P 5,000.00 (US\$190) to cover part of the deployment cost. The amount was taken from the barangay (village) internal revenue allotment fund.

Deployment site

In May 1994, prototype prefabricated AR reef units I and II were deployed to determine transport and deployment problems. Guib-ob Reef was identified as an appropriate site through a consultative process among the fisherfolk, biologists, and engineer. Prior to deployment, fishermen and AQD staff surveyed the sea bottom and identified the exact location.

Following the criteria for site selection, FAMI and the local government of Culasi approved the AR site as a fish sanctuary where fishing is prohibited. Enforcement of fishery laws were to be implemented by both FAMI and the local (village) government unit.

Deployment procedure

The final deployment was done in April and May 1995. Three reef groups, each consisting of 9 reef units for each type have

been deployed at Gui-ob Reef, covering an area of less than 1 ha.

The three types of AR unit basically followed the same method of deployment. Unit reef III was easiest to deploy because of its lesser weight. Although unit reef II had the heaviest reef blocks (1.47 kN), it was easy to manoeuvre because the blocks could be rolled. Small-sized blocks of unit reef I were difficult to manoeuvre during transport and deployment because of their cornered forms.

After attaining their concrete strength in 28 days, the reef blocks were manually hauled from the fabrication site near the seashore to a bamboo raft and towed by motorised banca to the deployment site.

The 3.5 x 7 m bamboo raft had a rectangular opening of 0.7 x 2.5 m in the middle into which the reef blocks were manually lowered one at a time. The raft was buoyed by 30 empty sealed plastic drums (0.15 m³).

During the deployment, four motorised bancas were used to haul the units, tow the bamboo raft, and transport the divers to

the site. The biggest banca could load one set of unit reef. Upon reaching the deployment site, the bancas were anchored to previously-installed surface buoys, which also served as markers for the exact location of ARs.

Each block was tied with ropes, then lowered manually into the water. FAMI divers using surface-supplied air compressors assembled the modules in pre-designated areas.

When AR units were lowered into the bottom they sometimes dispersed far from the designated area. The divers then hauled each block manually underwater, and assembled them in the exact position and location. The clear water transparency from the banca to the sea bottom was advantageous during the deployment, as the units could be seen while being lowered. In this situation, the units could be lowered directly to the exact site.

However, when the loading raft or bancas were anchored far away from the site, the mooring ropes were adjusted for the raft or banca to be directly above or near the designated sites.

The fisherfolk grouped themselves into two teams. Each team was composed of 6–8 persons.

The team loaded unit reefs II and III in less than 1 hr, with 2 hrs for unit reef I. Transporting ARs from the shore to the deployment site took 45 minutes for the towed raft and 10 minutes for the motorised bancas. The team completely set up unit

reefs II and III in an average of 3 hrs, with an average of 4 hrs for unit reef I. Each team could set up at least 2 to 3 reef units per day. The 25 reef units were deployed in 10 days.

The experience of deploying ARs in 1994 made the following deployment more efficient. Less time was involved, and the techniques of transporting, hauling, deployment, and as-

sembling the unit reef were improved. A year afterwards, prototype ARs are still completely intact and stable. The people, the local government unit, and the concerned agencies handling the project were the social agents that contributed to the success of setting up the ARs.

(Source: *SEAFDEC Asian Aquaculture*, vol XVII, No. 2) 

■ GIANT CLAMS PROMISE TO REVITALISE PACIFIC ISLAND ECONOMY

Finding sustainable sources of income is a major challenge for the Pacific Islands. Tuna continues to be the major marine industry in the area, but giant clams (*Tridacna* spp.) promise to capture an increasing portion of the export markets in the future.

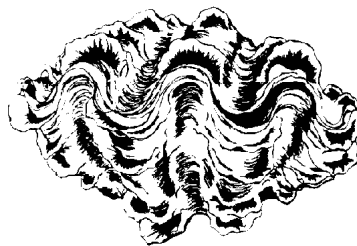
A collaboration of federal and local agencies—including the University of Hawaii Sea Grant College Program, the Center for Tropical and Subtropical Aquaculture, Salton Stahl-Kennedy Grant Program, and the College of Micronesia are working together to develop and organise a giant clam industry.

The giant clam industry could give the Pacific the export income needed to sustain islanders' current standard of living. Farming giant clams will also help to save the remaining wild stocks, which are being depleted because of over-harvesting and illegal fishing.

Hopefully, the farmed clams will take the place of the former illegal trade of giant clams, thus giving the wild stock a chance to replenish.

Anne Orcutt, coordinator for the Pacific Aquaculture Development Programme (PADP), says, 'The giant clam industry has unrealised economic poten-

tial.' She also states that this is just the beginning stage. 'We are still working on developing new markets for the giant clam. The farmed clams are mostly sold in the local food-markets, since they are an important part of the cuisine in the Pacific. The future, though, lies in the growing export trade.



The giant clam industry can lead to the development of several kinds of businesses: larval rearing, growout, and transportation operations, as well as companies focusing on turning the shells into different products.

The clam industry eventually could be expanded to a level that augments the whole region economically.

'There is room for everyone in the marketplace. We are exploring more avenues for development as we go along,' Orcutt pointed out.

In the beginning, the programme focused on the United States mainland market, with clams for aquariums as the primary trade. This market has grown into a profitable nationwide e-mail and mail-order industry, led by Reef Science International. Colourful giant clams can be ordered through the Internet for between US\$20 and US\$90 each.

John Teichman, a business development specialist with the Pacific Business Center at the University of Hawaii, says that the aquarium market is the most profitable market for the giant clams. 'You do not have to deal with USDA and other United States regulations that concern food items when exporting to the US, and the price you get is a lot higher than in other markets,' Teichman said.

John Gourley, owner of the Micronesia Clam Company, believes the giant clam has a bright future in the food market. He has developed the restaurant market on Saipan, where his company is located. Gourley sells live giant clams to Japanese restaurants, where they are prepared as sashimi. Gourley estimates the giant clam market in the restaurant industry in Saipan was worth about US\$45,000 during 1995.

Gourley is also researching the possibilities of marketing the giant clam as a food item in Japan, Hong Kong, and Taiwan. 'The giant clam is a unique product,' Gourley said. 'I market the clam as a high-end product that can be selected, live, from an aquarium.'

Gourley also gets additional income from the shells. He picks them up at restaurants and converts them into souvenirs that are sold in a local gift store.

Currently, there are no hatcheries or farms on Saipan, so Gourley imports the clams from producers in Palau. He hopes Saipan will have its own hatchery and local 'clam farmers' in the future, because shipping is costly.

Several countries in the Pacific region have a government-sponsored giant clam hatchery supplying local farmers. The hatchery provides farmers with approximately two-inch giant clams that are placed in cages on the bottom of the ocean or lagoon. The farmers 'nurture' their clams for two to three years until the giant clams are

ready for harvesting. The harvested giant clam is normally about six inches across the shell. Robert Reimer's Enterprises in the Marshall Islands is an example of a successful family-owned and operated hatchery.

Orcutt says that farming clams is not difficult, but it requires training. Currently, training is provided by a cooperatively-funded regional aquaculture extension agent who is based at the College of Micronesia in Pohnpei. Extension services also provide clam farmers continued support throughout the development of their clam business.


'Clam farming requires lots of support in the initial stage, since the farmer cannot yield any income from these clams until they have grown, which typically takes a couple of years,' Orcutt says.

Right now most of the clam farms are owned and controlled by the local governments, but the goal for the future is greater private sector involvement in cooperation with local regulatory agencies.

The main obstacle to mass production is the lack of developed markets in the area, which limits the export of the clams. Another constraint to overcome is CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora).

CITES monitors the trade of rare animal and plant species. All shipments of giant clams must be accompanied by CITES documents that show that the clams are farm-raised and not illegally harvested from the wild stock, because the clams are listed as a 'threatened' species.

The key to developing the clam farms into a large-scale industry is to find and develop a good, stable market and provide constant supplies. If that is possible, giant clams could become a natural resource that creates sustainable economic development in the Pacific and expands in harmony with the environment and local culture.

(Source: *Makai*, Feb. 1996, Vol. 18, No. 2) 

■ DEVELOPMENT OF SMALL-SCALE FISHERIES IN YAP

The Secretary of the Department of External Affairs, Asterio Takesy, and the Chargé d'Affaires of the Embassy of Japan in the Federated States of Micronesia, Kiyoshi Nishikawa, recently signed the necessary documents for the development of small-scale fisheries in the State of Yap. The project is said to be worth 216,000,000 yen (US\$2,000,000).

In his remarks, Mr Nishikawa reaffirmed his Government's support of artisanal and subsistence fisheries activities which

will promote consumption of fish caught by local fishermen and substitute for food imported into Yap State. The three components of the project include increased ice production capacity at Colonia, and setting up a support station building with ice-making capability in Falalop Island in Ulithi Atoll for the outer islands.

Nishikawa expressed hope that such a project will lead to further development of the local fishery industry and increase the self-sufficiency of the people

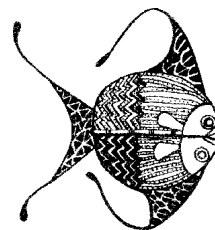
of Yap State. Takesy called the occasion 'special' because it has reached new heights in small-scale fisheries grant schemes with the figure over two hundred million Japanese yen, an amount that is twice that of 1995.

'Furthermore, there is more than one component to the project. Artisanal fishing is an indispensable part of our every day living,' Takesy stated, 'but has become a vital source of income in today's cash economy.'

'This project, while it is labeled small-scale, will contribute immensely to our efforts in our quest for economic self-sufficiency,' Takesy declared. Takesy reiterated and affirmed the Government's strong and

undivided commitment to nurture and expand relations with Japan.

(Source: *Marianas Variety News and Views*, April 1996)



■ VCS SAMOA PROCESSES TUNA 'UNDER FEDERAL INSPECTION'

Van Camp Seafood Company Inc. is the first tuna processor to launch a Hazard Analysis Critical Control Points (HACCP) quality assurance system with the Voluntary Fishery Products Inspection Program, the National Marine Fisheries Service recently announced.

'Van Camp's processing plant in American Samoa, which processes Chicken of the Sea tuna, has adopted the voluntary HACCP programme offered by the Fisheries Service,' said Richard V. Cano, chief of the voluntary programme.

'This programme includes control over all aspects of safety, wholesomeness, quality and proper labelling of the seafood produced at the facility,' Cano continued. 'It also goes beyond the Food and Drug Administration programme, which focuses only on safety and will not be implemented for at least another year.'

'By incorporating this inspection programme into its tuna processing facility, Van Camp Seafood is demonstrating its

commitment to food safety and product quality,' Cano said.

The HACCP concept was originally developed for the NASA space programme during the early 1970s to ensure food safety for astronauts. The Fisheries Service's HACCP inspection programme identifies hazards associated with the safety, wholesomeness and economic integrity of seafood products.

Control points are established for these hazards and constantly monitored by the participant, with corrective action taken if problems occur. Participants must demonstrate control of processing, handling and storing operations through close monitoring and record-keeping activities audited by NMFS inspectors.

According to Dan Sullivan, Van Camp Seafood senior Vice-President of production operations, Chicken of the Sea's programme monitors quality and safety at eight critical move points, beginning at dockside when the fish are brought off the boats and continuing

through the canning process from cleaning to labelling and casing.

'HACCP represents the most significant change toward food safety in the past 50 years,' said Steven Otwell, Ph.D., University of Florida scientist and member of the Seafood Alliance that established the HACCP training protocol. 'It is an inspection model for food safety in the future. Van Camp is ahead of the curve not only for seafood but all foods,' said Otwell. 'They should be commended for their leadership in the seafood industry.'

Van Camp Seafood becomes the only tuna processor approved by the federal government to produce canned tuna for the United States market bearing the 'processed under federal inspection' seal. Consumers and restaurant operators will begin seeing this seal on Chicken of the Sea cans in 1996.

(Source: *Samoa News*, March 1996)



■ UNITED NATIONS DECLARES 1998 AS OCEAN YEAR

The United Nations General Assembly, in December 1994 at its 40th Session, proclaimed 1998 the 'International Year of the Ocean'. This was in response to an initiative launched in 1993 by the IOC Assembly,

at the proposal of Portugal, and subsequently supported by the UNESCO General Conference and by the UN Economic and Social Council. The UN resolution was co-sponsored by 102 member states.

The objective of the International Year of the Ocean is to stimulate public action and to provide a general framework for decentralised initiatives at all levels for worldwide public information efforts, emphasis-

ing the growing importance of the oceans and coastal zones in national and international affairs. As a culture event, the Year is also expected to improve general public awareness and to further influence decision makers as to the need for a

sustainable development of marine resources and environment that is based on scientific knowledge and social goals.

The programme of the Year has not yet been formalised. The Inter-secretariat Committee on

Scientific Programmes Relating to Oceanography (ICSORI) will play an active role in UN system-wide coordination

(Source: NAGA, July 1995)



■ TREASURES LOST IN REEF MADNESS

Almost 200,000 species that live on coral reefs could die out in the next 40 years, according to a zoologist from the University of Maryland. Reefs are shrinking faster than ever as development accelerates around tropical coastlines.

Marjorie Reaka-Kudla calculates that there are probably around 950,000 species on the world's reefs, and concludes that in 40 years' time, when a predicted 70 per cent of reefs will have been lost, 175,796 species will have gone with them. 'These are the first estimates and are based on the best information we have.'

Reaka-Kudla borrowed equations from biogeographers who have worked out the relationship between the area of an island and the number of species it is likely to support.

She knew that reefs cover 0.1 per cent of the planet and how many species are known to live in the oceans, as well as what proportion are likely to live in the tropics and inhabit reefs. From this she calculates that the world's reefs contain 93,000 known species. These probably represent less than 10 per cent of the true number that live there, Reaka-Kudla estimates.

Ten per cent of reefs have already been lost. If the destruction continues, another 60 per cent will disappear in 20 to 40 years. Reaka-Kudla estimates

that 2,400 known species have already died out. In 40 years' time another 17,203 will have joined them, she says. Extrapolating from her figures to include the species that have yet to be discovered gives her the total of 175,796.

Although the most obvious species on reefs are the corals themselves and the multitude of brightly coloured fish, most reef-dwellers are tiny worms, sponges and other well-hidden animals that live in holes and crevices created by burrowing animals such as molluscs and sea urchins.

Most of the organisms that die out will be small species such as these. In general, says Reaka-Kudla, the smaller the organism, the fewer eggs it lays and the shorter the distance its larvae travel before settling on the reef. 'Everyone assumes that small species have mobile larvae that are spread widely but this is not so,' she says. 'As a result small species are especially in danger of extinction.'

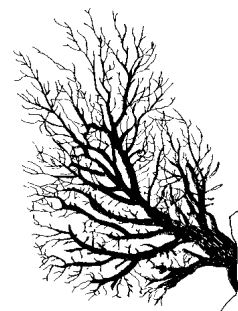
The main threats to reefs are overfishing, being buried under a blanket of sediment washed from coastal lands, and an overdose of nutrients from agricultural fertilizer and sewage. Deforestation of coastal hillsides and road cutting leads to a massive influx of sediment into coastal waters which smothers the coral. 'Sediment is the number one enemy of coral

reefs,' says Christopher D'Elia, a colleague of Reaka-Kudla's at the University of Maryland. 'Added nutrients cause fleshy algae to grow over the corals and trigger blooms of plankton that blot out the corals' light. They also upset the balance between the coral polyps and the symbiotic algae that live in their tissues,' says D'Elia.

Although human development in Asia and Oceania poses the biggest threat, global warming and the extra ultraviolet radiation that reaches the ground through the thinning ozone layer may be an added stress. Already there has been an increase in outbreaks of 'coral bleaching', in which coral's algae desert their host when the sea temperature rises about a degree above its usual summer value.

'These estimates are the first to give some sort of prediction of how much we might lose very soon. They clearly place us within the range of the mass extinctions seen in the fossil record,' says Reaka-Kudla.

(Source: *New Scientist*, 17/2/96)



■ MARINE STUDIES AT THE UNIVERSITY OF THE SOUTH PACIFIC

INTRODUCTION

Countries served by the University of the South Pacific (USP) have a rich traditional and modern involvement in maritime activities, which, for many, offer the best hope for future economic development.

Because of its regional importance, USP has made the Marine Studies Programme (MSP) an area of high priority.

The mission of the MSP is :

- to provide the necessary opportunities for Pacific Islanders to understand, conserve, develop, manage and utilise their living resources in a rapidly changing world;
- to give Pacific Islanders the widest possible range of opportunities for research, education, training and employment in the marine sector; and
- to provide for collaboration between USP, island nations, regional and international bodies in their common goals in the maritime sector.

Sustainable development of marine resources will be of crucial importance to the Pacific Island countries in the years to come.

One of the most important aims of the MSP is to develop Pacific Island human resource capabilities and research projects which are appropriate to the sustainable development of regional marine resources.

To help achieve these aims, the MSP also administers the following:

- Ocean Resources Management Programme (Fiji);
- Institute of Marine Resources (Solomons);
- Atoll Research Programme (Kiribati);
- Dravuni Island Field Station (Fiji);
- Marine Public Education Programme (Fiji);
- Pacific Islands Marine Resources Information System (PIMRIS) (Fiji); and
- International Ocean Institute, South Pacific Regional Operational Centre (Fiji).

MSP PROGRAMMES

Pre-degree

The MSP offers pre-degree certificates and diplomas, which require shorter periods of study than full bachelor degree programmes.

Certificate and diploma courses can be accredited towards any subsequent bachelor degree study.

Certificates are offered in:

- Earth Sciences and Marine Geology,
- Tropical Fisheries, and
- Ocean Resources Management.

Diplomas are offered in:

- Tropical Fisheries,
- Ocean Resources Management and Policy, and
- Fisheries Economics and Management.

These short pre-degree courses are ideal for in-job training of staff whose posts cannot be vacated for longer study periods. Some courses can also be taken in-country through the University Extension Service.

Degree

The MSP now offers two new degree programmes:

- Bachelor of Science (B.Sc.) in Marine Science, and
- Bachelor of Arts (B.A.) in Marine Affairs.

Graduates with these degrees will strengthen the capacity of government departments to:

- enforce regulations,
- enforce environmental controls,
- collect and analyse data for management,
- carry out marine technical projects,
- carry out marine development projects,
- formulate policy, and
- give good advice to political leaders.

Post-graduate

These degrees also lead on to post-graduate studies for a:

- Master of Science (M.Sc.),
- Master of Arts (M.A.), and
- Doctorate (Ph.D.).

B.Sc. (Marine Science)

The degree is offered as a Single Major in Marine Science. The degree requires three years of full-time study at USP's Laucala Bay Campus in Suva, Fiji.

Study areas

These are:

- Planet earth—the 'water planet',
- life in the sea,
- properties of seawater—marine chemistry,

- South Pacific tropical marine environments,
- important marine ecosystems—mangroves, seagrass beds, coral reefs,
- marine invertebrates—especially economically-important species,
- fish biology and identification,
- fisheries management and development,
- aquaculture—sea ranching,
- fisheries enhancement,
- marine pollution—training in water-quality analysis,
- marine geology and sedimentology—reef-building processes,
- ocean currents and weather patterns—physical oceanography,
- statistics, computing, and social survey methods,
- coastal zone management—threats from land use, and competing coastal uses, and
- ocean resource management—high seas resources, international conventions.

Graduate careers

The B.Sc.(Marine Science) is for people who will provide fisheries managers with technical and scientific support in the fields of:

- marine geology,
- physical oceanography,
- marine chemistry,
- marine physics,
- marine biology,
- aquaculture development,
- post-harvest fisheries,
- fisheries surveillance and enforcement,
- marine conservation,
- endangered species,
- environmental impact,
- resource development.

It is also for educationalists who will work in:

- secondary schools,
- tertiary institutions,

- curriculum development,
- marine public education,
- non-government organisations.

Job types include:

- extension workers,
- technicians,
- research scientists,
- planners,
- environmental consultants,
- conservationists,
- environmental monitoring officers,
- enforcement officers,
- coastal resource managers,
- coastal resource legislators,
- fisheries managers, and
- fish-stock assessors.

B.A. (Marine Affairs)

The degree is offered either as a Double Major (with one major in Marine Affairs and one in another discipline) or as a Minor in Marine Affairs (with the major in another discipline).

The B.A.(Marine Affairs) is coordinated by the Ocean Resources Management Program of the Marine Studies Program.

Study areas

These are:

- reasons for ocean resources management,
- the physical processes of the ocean,
- the ecology of important marine ecosystems,
- human interactions with marine ecosystems,
- major forces affecting non-living marine resource development,
- international, regional and national institutions and policies on ocean use,
- the law of the sea,
- fisheries resource economics,
- fisheries development planning and policy,

- coastal area management—the land / sea interface,
- fisheries management—conservation, regulations and enforcement,
- maritime shipping and transportation, and
- maritime surveillance.

Graduate careers

The B.A. (Marine Affairs) is mainly for people who will be involved in policy formulation, decision-making, or lobbying about marine resources, at a political, government departmental or international level. Graduates could work in the following areas:

- Ministries of Foreign Affairs,
- economic planning,
- fisheries departments,
- mineral resources,
- energy,
- tourism,
- environment,
- regional institutions (SPC, FFA, USP and South Pacific Regional Environment Programme),
- non-governmental organisations (South Pacific Action Committee on Human Ecology and the Environment, Greenpeace and World Wide Fund for Nature),
- private sector industries.

Job types include:

- extension workers,
- teachers at secondary or tertiary level,
- environmental / fisheries surveillance and enforcement officers,
- environmental consultants,
- industry environmental lobbyists,
- lobbyists for non-government or conservation organisations,
- government policy-makers, planners, legislators and managers,

- coastal managers and developers,
- fisheries managers.

For information about enrolment in the Marine Studies Program write to:

Coordinator, Marine Studies Program, University of the South Pacific, P.O. Box 1168, Suva, Fiji. Tel: (679) 305272; Fax: (679) 301490.

(Source: Tony Chamberlain, Marine Studies Programme, University of the South Pacific, Suva, Fiji)



■ 1995: A YEAR IN REVIEW

Weather patterns in the tropical western North Pacific during the first half of 1995 were characteristic of the transition from an El Niño 'warm event' to a La Niña 'cold event', with a cooling of equatorial sea surface temperatures (SSTs) from 160°E to the South American coast, a rising of the Southern Oscillation Index (SOI), a delay in summertime tropical cyclone activity, and generally very dry conditions over the western North Pacific, well into summer.

Weather patterns in late 1995 were largely characteristic of a mature La Niña, with colder equatorial SSTs and abnormally strong easterly trade winds dominating the region from June through December.

Strong easterly winds delayed the normal eastward advance of westerly monsoonal winds, and during the early summer, the monsoon was forced into a south-south-west to north-north-east orientation, from the South China Sea to southern Japan.

This caused drier-than-normal conditions across Micronesia and into the Philippines. By September, the trade winds had finally weakened, but only two brief episodes of westerly monsoonal winds advanced as far east as 150°E (near Chuuk).

In October, the trade winds again strengthened, preventing further advance of near-equatorial westerly winds that nor-

mally extend to the Marshall Islands in October and November, as the Southern Hemisphere (SH) monsoon develops and strengthens over Australia. Westerly winds in the Northern Hemisphere (NH) were constrained to the extreme western part of the Philippine Sea.

Equatorial SSTs from 150°W to the coast of South America experienced a significant cooling trend during spring and early summer, typical of a transition from El Niño to La Niña conditions. However, equatorial SSTs from 160°E–150°W cooled to levels only slightly below normal, indicating a La Niña event of only moderate strength.

In the atmosphere, La Niña conditions became apparent in 1995, with reduced cloudiness over the colder-than-normal equatorial regions (and increased cloudiness in the west), stronger-than-normal easterly winds, and a rising Southern Oscillation Index (SOI), or difference in surface atmospheric pressure between Tahiti and Darwin, Australia, and an important indicator of El Niño Southern Oscillation activity.

Consistent with the trend toward La Niña conditions, the SOI increased in value during most of 1995. A positive value of the SOI is generally associated with La Niña conditions. Though SOI values followed a rising trend throughout most of the year, they did not rise much above the long-term average

value of zero. However, a rapidly-rising SOI (e.g. a change greater than 1.0 over about 6 months) has been shown to lead to significantly drier-than-normal conditions in Micronesia, whether or not the SOI actually becomes positive.

Such a rapid change would be consistent with a strong La Niña event. Since this did not occur in 1995, this again indicates La Niña conditions of only moderate strength.

Despite lower-than-normal monsoon and typhoon activity, rainfall in the latter half of 1995 was above-average in most Micronesian locations west of the Marshall Islands. Heavier-than normal rainfall occurred primarily from tropical disturbances and developing tropical storms in these areas. Localised thunderstorms also made a major contribution to the total rainfall of the mountainous islands.

In eastern regions, including parts of the Marshall Islands, Hawaii, and American Samoa, drier-than-average conditions persisted through the end of the year.

These island areas lie closest to the central tropical Pacific, which has been most greatly influenced by the development of La Niña conditions, including colder-than-normal SSTs pushing westward along the equator from South America, reduced cloudiness and rainfall,

and stronger-than-normal easterly winds throughout the region.

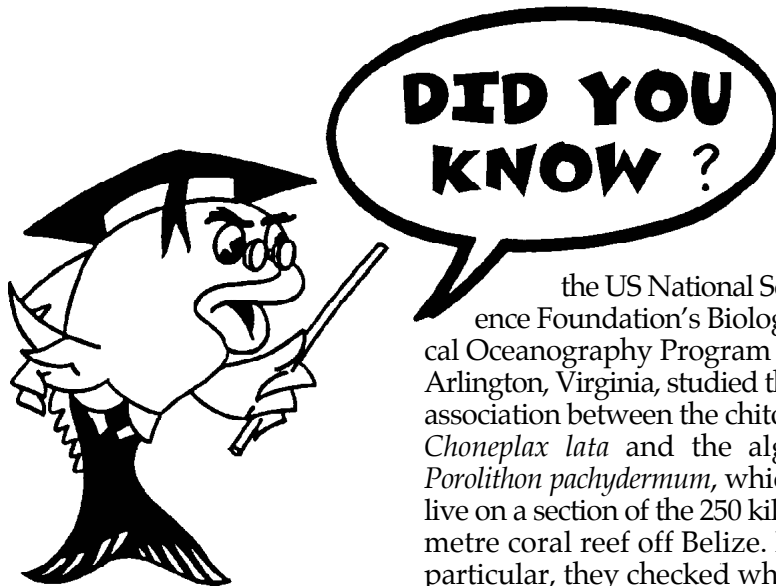
Hawaii's 1995 hurricane season was the quietest since 1979. During the season, only one decaying tropical storm (remnant of Tropical Storm Barbara) entered the region west of 140°W longitude. In the South-

ern Hemisphere, only five named storms occurred in the Pacific during the 1994/95 cyclone season, well below the yearly average of about ten.

In Hawaii, a rainfall gauge maintained since 1958 on the grounds of the UH-Manoa campus recorded its second-lowest annual rainfall in 1995:

20.98 inches (532 mm), compared to lowest rainfall of 19.77 (502 mm) inches in 1983. Both years are similar in that they followed ENSO warm events.

(Source: *Pacific ENSO Update*, 1st quarter 1996) 



PERFECT DINNER PARTNERS ON A CARIBBEAN REEF

When one living thing eats another, it is usually just the consumer who benefits. But there are a few exceptions: herbivorous mammals stimulate and maintain the grasslands on which they depend, for example. And now two American researchers have found that a coral-like alga grows better when it is grazed on by a tiny mollusc on the Belize Barrier Reef.

Mark and Diane Littler of the Smithsonian Institution, Washington DC, and Phillip Taylor of


the US National Science Foundation's Biological Oceanography Program in Arlington, Virginia, studied the association between the chiton *Choneplax lata* and the alga *Porolithon pachydermum*, which live on a section of the 250 kilometre coral reef off Belize. In particular, they checked what happened when they removed *Choneplax* from its burrows in certain areas.

When the researchers returned up to two and a half years later, they found that the alga had grown better where the molluscs were present. The grazing seemed to have stimulated the growth of the alga, but also removed any minute new plants of other algae that tried to settle on it. This not only eliminated competition for light and space, but discouraged the attentions of parrotfish, which damage the underlying *Porolithon* when feeding on these algae (*Ecology*, vol. 76, p. 1666).

Choneplax definitely feed on *Porolithon*, as the researchers found that the alga makes up over half of the mollusc's gut contents. Scanning electron microscope pictures also revealed a close match between the rasping teeth on the chiton's radula, or tongue, and scars on the surface of the alga.

However, these scars are only some 10 micrometres deep, while the really important tissues of the alga, concerned with its growth, photosynthesis and reproduction, are more than 20 micrometres below the surface, safe from damage.

The steady growth of the Belize Barrier Reef is a tribute to the success of this partnership, which provides the mollusc with a reliable source of food and a safe place to make its burrows. The same researchers have now also noted similar associations in reefs in the Pacific, off Fiji and Papua New Guinea, suggesting that this harmony between eater and eaten has a widespread ecological significance.

(Source: *New Scientist*, September 1995) 

■ REEF FISHERIES

Reef Fisheries, edited by Nicholas V. C. Polunin and Callum M. Roberts, is reviewed by Paul Dalzell, SPC Inshore Fisheries Scientist

Chapman & Hall have just published the 20th volume in their review series 'Fish and Fisheries'. Entitled *Reef Fisheries*, this collection of reviews by various authors, edited by Drs Nicholas Polunin & Callum Roberts, covers various aspects of fisheries ecology and biology, fisheries dynamics, socio-economics and management of coral reef fisheries.

Altogether there are 14 chapters that include the following topics: the scope of tropical reef fisheries and their management; reproduction of reef fishery species; larval dispersement and survival in tropical reef fishes; population and community structure of reef fisheries; trophodynamics of reef fisheries productivity; geography and human ecology of reef fisheries; catch rates, selectivity and yields of reef fishing; population and ecosystem effects of reef fishing; model and method in reef fishery assessment; social and economic aspects of reef fisheries and their management; maintenance and recovery of reef fishery productivity;

traditional management of reef fishing; modern institutional framework for reef fisheries management; and developments in tropical reef fisheries science and management.

The editors have generally succeeded in maintaining a reasonable balance between reef fish biology and ecology, on the one hand, and on the other, the more practical aspects of the characteristics of reef fisheries and how can they be managed.


The opening chapter by John Munro sets the scene for reef fisheries in a global context. Most of the world's coral reefs are in the coastal regions of developing countries, where population growth rates are high and poverty forces people to seek a livelihood from fishing.

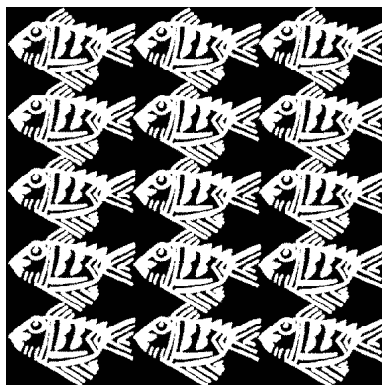
Munro notes that most attempts to manage reef fisheries have been a dismal failure, and in areas where population pressure and poverty are acute, reef fisheries resources have been depleted to extraordinarily low

levels. Marine protected areas (MPAs) are now seen as a prime solution to the problems of managing reef fisheries, but as Munro points out, there are still insufficient data on which to base optimal size of MPAs or on how effective they are in maintaining fisheries productivity.

In the final chapter, co-authored by the editors and Daniel Pauly, a review and synthesis is made of the progress in reef fisheries research and management over the past 30 years.

The authors also note that successful reef fisheries management will by necessity require local community involvement. This appears to be a growing trend in fisheries management in developing countries, where the governments cannot offer scientific expertise for local fisheries management and not all fishing communities are committed to sustainable resource utilisation.

Reef Fisheries, published by Chapman & Hall, London. 1996. ISBN 0 412 60110 9 



THE DEVELOPMENT OF SMALL-SCALE FISHERIES FOR BOTTOMFISH IN AMERICAN SAMOA (1961–1987) — PART 2

The first part of this article was published in SPC Fisheries Newsletter #76

by David G. Itano,
Hawaii Institute of Marine
Biology
Kaneohe, Hawaii

SECOND-GENERATION FISHERY DEVELOPMENT

Introduction

The 1978 visit by Paul Mead of the SPC Deep Sea Fisheries Development Project brought new gear and techniques to an aging dory fleet. These were to revolutionise domestic fisheries and offer an alternative to fishing on the already heavily-exploited, shallow-water bottomfish grounds adjacent to Tutuila. The gear used by Mead, including grapnel anchors, inexpensive polypropylene anchor line and depth sounders, became standard on boats engaged in the fishery during the early 1980s.

However, it was the introduction of the simple, wooden handreel which was most responsible for increasing the catching power of the boats and making the deep-water snapper resources of the Territory available to local fishermen. Until then, this resource had been unexploited on the outer reef slopes of Tutuila and on the offshore submarine banks and seamounts of the Territory.

This year also saw the addition of two 12.2 m, diesel-powered vessels to a fishery that had previously been exploited solely by 7.3 m dories. The new boats carried crews of four to five fishermen and made fish-

ing trips of up to four days or more (Wass, 1978). The increased catching power and autonomy of these vessels make comparisons of catch rates with the dory programme invalid or subject to careful adjustments. The longer range of the larger craft allowed the first bottomfish exploitation of the offshore banks, seamounts and outer reef slopes of the remote islands of American Samoa, i.e. Swain's Island and Rose Atoll.

Fleet composition

At the close of the 1970s, the last remaining dories were operating alongside the two larger, diesel-powered craft described

above. The 1980s signalled the end of the dory fleet and a rapid growth in the quantity and variety of small commercial/artisanal craft in the Territory.

Figure 3 shows this dramatic increase in different fishing-vessel types that peaked in 1985, with 49 boats engaged in the bottom and troll fisheries. The sharp decline in the number of vessels shown in 1987 was partly due to hurricane Tusi, which damaged or destroyed all nine vessels of the Manu'a Islands fleet (Itano, 1987a).

The most popular fishing craft used in Samoan fisheries is the FAO-designed alia catamaran, and plywood, aluminum or fibreglass alia were used during bottomfishing operations. The majority were 8.5 m aluminium alia constructed in Apia, and powered by a single 25–40 hp outboard motor.

These vessels, fully equipped with fishing gear, were made available for purchase by Pago Pago-based fishermen through the OMR at relatively low, government-subsidised rates. In 1981, an American boat-builder

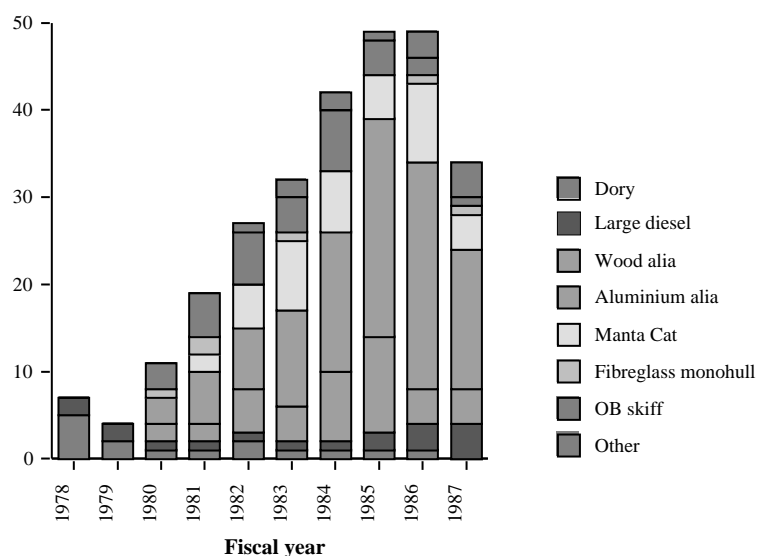


Figure 3: Composition of the artisanal fishing fleet engaged in bottomfish exploitation

established a workshop on Tutuila, and began turning out plywood and fibreglass catamarans for the local fishing industry.

These vessels, called Manta Cats, quickly became the boat of choice for the more dedicated, full-time commercial fishermen. They were 6.7–9 m in length and generally powered by two 40 hp outboard motors. They were easily capable of exploiting the offshore banks and seamounts, and were used for multiple-day bottomfishing trips. Increasing availability of US- or New Zealand-built aluminum skiffs and fibreglass craft in the mid-1980s added variety to the artisanal fleet.

Deep-water snapper fishing grounds

The Dory Project vessels concentrated effort on the broad shelf areas around Tutuila Island near Cape Taputapu and Aunu'u Island or between Ta'u and Olosega in the Manu'a group. Larger boats and better fishing gear and techniques meant that fishing operations

expanded to include seamounts and pinnacles over 70 km from Pago Pago. Figure 4 shows all of the areas that produced significant quantities of deep-water snappers and groupers during the 1980s. These areas were well known during the early 1980s, except for 2% Bank which was first exploited for deep-water snappers in 1986 (Crook, pers. comm.).

Bottomfish marketing and export

Shallow-water species

During the early years of the dory project, the ex-vessel price of bottomfish in American Samoa was around US\$ 0.23–0.27/kg. By 1980, the price received for bottomfish had risen to an average of US\$ 0.57/kg (Wass, 1974, 1980b).

In December 1980, a fish market opened in Pago Pago (Fagatogo) This allowed the fishermen to market their own catch at a centralised, relatively sanitary location and improved the quality of OMR fishery data collection. Dory fishermen ex-

perienced difficulty in marketing their fresh fish at a profitable price due to stiff competition with inexpensive sales of 'miscellaneous' fish from the canneries. This consisted of bycatch and discards from the large tuna canneries based in Pago Pago Harbor.

There are three sources of miscellaneous fish that compete with the local sale of fresh fish in American Samoa: direct sale by canneries of longline bycatch (wahoo, swordfish, etc.); longline by-catch illegally bartered to Samoans by crews (wahoo, tuna, mahi mahi, sharks, billfish, etc.); and purse-seine bycatch that is sorted from the tuna catch by unloading crews (rainbow runner, mahi mahi, wahoo, triggerfish, undersized tuna, etc.).

These sources of frozen fish (mostly wahoo) account for a tremendous amount of the local fish consumption in American Samoa and dominate sales to local restaurants and some markets. Fishermen found it increasingly difficult to compete and an increasing amount of

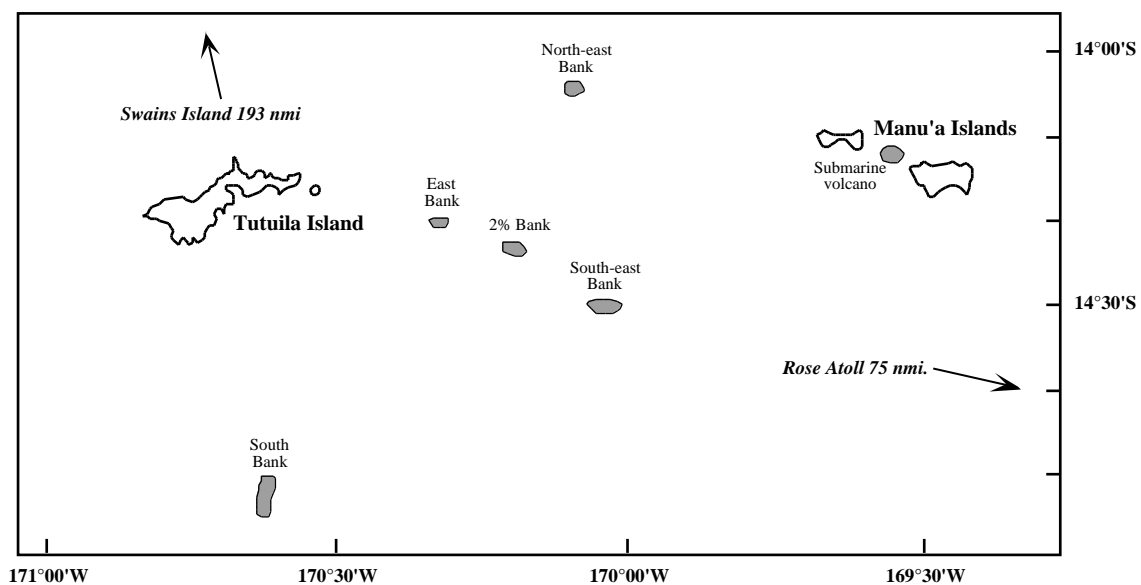


Figure 4: Deep-water snapper fishing grounds in American Samoa

their time was required to market their own catch. This situation turned them into fish peddlers, when their time could have been better spent on fishing or vessel maintenance.

Competition problems with cannery 'miscellaneous' fish and purse-seine by-catch were compounded by the Polynesian preference for eating whole, small fish in the 0.5–2 kg range.

Fishermen were now landing high-value *Etelis* spp. of 5–10 kg, and having great difficulty marketing them in Samoa outside the limited European restaurant trade that had already been inundated with cannery fish.

In order to maximise the potential economic benefit of the deep-water snappers that were now within the range of the local fishery, the OMR pursued various options to train local fishermen in handling and storage techniques that would allow them to export their catch to high-value markets outside of Samoa.

Fish handling, processing and marketing

In April 1982, the Pacific Tuna Development Foundation (PTDF), which was later to become the Pacific Fisheries Development Foundation (PFDF), contracted Richard Howell to administer and conduct the American Samoa Fish Handling and Marketing Training Project.

The objectives of the project were to increase income and maximise benefits to local fishermen through improved handling of catches that would allow a diversification to better markets (Howell, 1983).

Fishermen were trained in proven techniques of brain spiking, bleeding, ice-slush brining and icing of deep-water snappers.

Demonstrations were given on how to pack and ship to fresh-fish markets by air with a minimum of packing materials (which add weight and shipping costs). Manuals on exporting fish were prepared and translated into Samoan.

During the first four months of the project, high-quality fish from a single, highly skilled fisherman were sent to one Hawaii-based buyer at a fixed price of US\$ 0.82/kg. The buyer assisted in the start-up of the project by providing current price information and boxes, paying freight and making contacts with the Hawaiian fish marketing industry.

When fishermen were landing export-quality fish in adequate quantities, catches were sent directly to the United Fishing Agency, which represented the catch at auction, kept track of transactions and remitted the money back to Samoa minus a 10 per cent commission fee.

The fish were shipped in a chilled but dry state in fish-shipping cartons and kept cold in flight, as they were stored in the unheated cargo compartments.

Tare weights were approximately 5–7 per cent of the total and air freight charges at the start of the project were US\$ 0.14/kg. Waxed boxes were available to the fishermen at US\$ 5.00 per box. The OMR assisted by providing current auction prices to the fishermen and handling the importation, storage and sale of boxes (Howell, 1982).

An increase in bottomfish effort, landings and trip length was noted during 1983 as a result of this project (Wass & Aitaoto, 1983). During the first nine months of shipping to the auction, over 2,727 kg of high-quality bottomfish were sent to Hawaii and marketed at an average price of US\$ 1.64/kg (Howell, 1983). Over 55 per cent of the exports during this time period were *Etelis* spp., 14 per cent *Aphareus rutilans* and 17 per cent *Aprion virescens*.

Other fish regularly exported included *Pristipomoides filamentosus*, *P. flavipinnis*, *P. multidentis* and *P. zonatus*, groupers, jacks (*Caranx lugubris* and *C. ignobilis*), wahoo and mahi mahi.

Fresh fish exporting

The American Samoa Fresh Fish Exporting Programme contracted Jim McGuire from December 1983 to May 1984 to continue the work begun by Howell under PTDF funding. The project provided assistance to fishermen by funding phone calls to the Honolulu auction block to obtain current price information, importing and selling shipping boxes, transporting fish to the airport, assisting with packing and helping to fill out the various shipping documents.

The shipping of groupers and jacks was discontinued after 1985, and the programme manager emphasised shipping eteline snappers and *Pristipomoides* spp. (Aitaoto, 1987). This phase of the project concentrated on maximising the value of high-priced bottomfish by sending selected species to Hawaii only when the prices and profit margins were highest. This strategy was designed to leave valuable bottomfish species stored 'in the water' around

Samoa until the prices were right and the fishermen could expect to obtain the highest possible return on their efforts (McGuire, 1985).

THIRD-GENERATION FISHERY DEVELOPMENT

General

The export of high-priced bottomfish began to decline in American Samoa by the mid-1980s, and only three fishermen exported fish to Honolulu in 1986 and 1987. This was partially due to the depletion of the deep-water bottomfish stocks around American Samoa and the general decline of the artisanal fishery.

The major emphasis of work conducted by OMR shifted away from fisheries development and towards resource assessment, monitoring and management. Most of the fisheries development work concentrated on FAD-related fisheries and attempts to develop completely new fisheries on unexploited resources.

PVC bottom longline trials

In 1985, a consultant from Hawaii visited American Samoa to implement trial fishing and the demonstration of a multiple-hook, longline system for bottomfish. The project was funded by the PFDF and chartered local fishing vessels and fishermen.

The system used two-metre PVC pipes, each rigged with six hooks and weighted at one end with steel reinforcing rod. Each pipe was clipped to a polypropylene mainline, and set on the bottom in depths of 80 to 200 m.

A typical set of the gear consisted of approximately 20 to 30

PVC pipes, each with six baited leaders. The extremely rugged bottom topography and steep slopes of the offshore banks in American Samoa caused severe fouling of the gear on most attempts. The method was unsuccessful for these reasons and was never adopted for use by the local fishermen.

Hydrographic surveys

In August 1985, the Western Pacific Regional Fishery Management Council met in Hawaii, and the Bottomfish Advisory Panel to the Council passed a resolution that stressed the need for better charts of the offshore banks and seamount areas of American Samoa.

In early 1986, the NMFS/NOAA research vessel *Townsend Cromwell* visited Pago Pago en route to albacore surveys in the southern convergence zone. Five days were spent performing hydrographic soundings. This resulted in the generation of five charts by NMFS staff in Honolulu that were later circulated to American Samoa fishermen (Ralston & Goolsby, 1986; Itano, 1987a).

The surveys did not discover any new bottomfishing grounds, but charted the exact location and bottom profiles of the known banks and seamounts that had been exploited for deep-water snappers since the late 1970s. The survey of the East Bank area came very close to locating what was later known as 2% Bank; this was discovered by a local fishermen and exploited for deep-water snappers later in 1986.

The surveys did confirm that the area of deep-water bottomfish habitat in American Samoa is extremely limited, with most of it existing only on the steep

outer slopes of the offshore seamounts and high islands.

The *Townsend Cromwell* visited American Samoa again in March 1987 on the final leg of an extensive South Pacific cruise that included stops in Tahiti, Rarotonga and Niue. Pyramid-style shrimp traps and deep-water fish traps were tested on South-east Bank, East Bank and 2% Bank.

Eight species of *Heterocarpus* shrimp were taken, but catch rates were below commercial quantities. The fish traps produced very little, but the cephalopod *Nautilus pompilius* was found to be very common at depths of 250 to 375 m. During the cruise, the exact position of 2% Bank was charted. A small amount of bottom lining was conducted on the three banks but catch rates generally were very poor (Itano, 1987b), and the catch rates of eteline snappers were very low.

SPC Deep Sea Fisheries Development Project—second visit, 1988

A second visit of the SPC Deep Sea Fisheries Development Project (DSFDP) was made between 3 February and 13 June 1988. Masterfisherman Archie Moana spent most of his visit training local fishermen in the use of vertical longline gear on FADs to target large, deep-swimming tunas. Five bottomfishing trips were made, four to offshore banks and one to Cape Taputapu (Tutuila). The bulk of the catch consisted of shallow-water snappers, emperors and barracuda, as more time was spent fishing in depths of less than 80 m.

Deep-water snappers (*Etelis coruscans*) made up only 9.4 per cent of the catch by weight. The

dominant species in order of weight were barracudas, *Lutjanus bohar*, *Elagatis bipinnulata*, *Aprion virescens* and *Lethrinus amboinensis*. The blue-lined snapper, *Lutjanus kasmira*, was numerically dominant in the catch (Moana, 1988).

CATCH-AND-EFFORT RESULTS

Fishing area summary

Bottomfishing during the expanding years of the Dory Project was basically restricted to the shallow shelf areas around Tutuila and the Manu'a Islands.

A limited amount of deep-water snapper fishing was conducted on the steep outer reef slopes around Tutuila, particularly on the south coast during rare northerly wind conditions (Pedro, pers. comm.).

After 1978, with the introduction of handreels and larger vessels, the offshore banks came under exploitation and the outer reef slopes of Tutuila and Manu'a were fished down.

The order of discovery and intensive fishing of the outer reefs and seamounts was probably East Bank, followed by South Bank, Southeast Bank, Northeast Bank and 2 % Bank.

The bottomfish stocks of Swain's Island and Rose Atoll have also come under sporadic exploitation by the larger diesel-powered vessels in the fleet and a 15.5 m multi-purpose research/training vessel operated by the Department of Marine and Wildlife Resources (DMWR¹). The chartlets produced by the *Townsend Cromwell* hydrographic surveys

were used with a linear tracking device to yield an estimate of the 100-fathom isobath around the seven islands and offshore banks of American Samoa of 109.8 and 33.5 nmi respectively.

Fishing effort summary

The start of the Dory Project in 1972 signalled the first serious exploitation of bottomfish in American Samoa. During this period, an average of 3.4 to 4.7 men took part in the fishing trips, and most trips engaged in bottomfishing with handlines (Wass, 1973).

Each dory was of a similar size and catching power during the early project, so each dory could be equated to one unit of catching power, i.e. three or four men each fishing with one handline for one evening per trip. The size of the dory fleet expanded rapidly during the first three years of the boat-building programme, and the local fishery experienced a strong growth pattern from 1972 to 1975.

After this boom period, the number of vessels actively engaged in the fishery declined steadily through disrepair, sinking, sale to Western Samoa or general disinterest in commercial fishing.

The two 12.2 m diesel-powered monohull vessels joined the fleet in 1978, with crews of four to five men making multiple-day trips. The FAO handreels and depth sounders were also quickly adopted by American Samoan fishermen after 1978, which greatly increased fishing efficiency. The 1980s brought a rapid expansion of fishing-vessel types, including alias,

aluminum skiffs and Boston Whaler fibreglass skiffs (Wass, 1980b).

However, it was the alia, or catamaran-style vessels, that quickly became the favoured fishing vessel in American Samoa (see Figure 3).

The years 1980–1985 could be considered the second boom period in local fishing effort, as virgin deep-water snapper grounds came under initial exploitation, and the bottomfish export programmes were active.

Wass credited these programmes with increasing bottomfishing effort, landings and average trip length. Most of the fishermen stopped exporting fish after 1985, after which time only three of the most successful fishermen continued to send deep-water snappers to Hawaii.

Apparently, the majority of fishermen abandoned shipping their catches to Hawaii for procedural or cultural reasons, as well as due to a decline in ready availability of deep-bottomfish stocks near Tutuila.

These reasons included: inexperience in catching deep-bottom stocks already culled by exploitation; the volatility of the auction market, with some low prices; a general lack in trust of others handling their catch and fairly representing it at auction; a general prejudice against non-Hawaiian fish by some Honolulu fish buyers, resulting in unfairly low purchase prices offered; dissatisfaction with waiting to be paid for the catch as opposed to the preferred 'cash in hand' transaction; and

¹ The Office of Marine Resources (OMR) became the Office of Marine and Wildlife Resources (OMWR) in 1987 and the Department of Marine and Wildlife Resources (DMWR) in 1988.

a decrease in OMR assistance and free services to fishermen.

Bottomfishing effort for the deep-water snappers dropped away sharply after 1985 and an increasing amount of shallow-water reef and bottomfish was supplied by imported catch from Western Samoa. A further decrease in effort was caused by the destruction of the floating docks and alia fleet of the Manu'a Islands by hurricane Tusi in 1987.

Bottomfish landings in American Samoa dropped to the lowest on record during 1987 and exports of deep-water snappers had virtually ceased by 1989.

Landings and CPUE summary

General

The direct comparison of CPUE over the time-span covered in this paper (1961–1987) is difficult, as a common unit of effort was not recorded during this period and completely different stocks of bottomfish are involved. To further complicate matters, a great deal of the information on the early period is no longer available. This analysis will examine CPUE and landing trends for the separate

periods that have been outlined in previous sections.

Dory Project years

Table 1 lists the catch rates in kg per trip for the *Tautai A'e* surveys, the Dory Project vessels and the first SPC DSFDP visit to American Samoa, covering the years 1967 to 1978

The table also summarises the number of dories existing in American Samoa, the number of dories fishing regularly around Tutuila, and the number of fishing trips and total catch of the Tutuila fleet per year. The *Tautai A'e* surveys and Dory Project vessels fished shallow-water grounds around Tutuila and most trips were of only one night's duration.

The data indicate that the dories experienced a catch rate similar to the *Tautai A'e* surveys during the first year, after which CPUE dropped to around 60 to 90 kg/trip between 1972 and 1977. Anecdotal information indicated that catch rates on local bottomfish grounds declined during this period.

However, the slight increase in CPUE evident in the data may have been due to the exploita-

tion of new fishing grounds combined with increasing fishing skill of the fishermen and a decrease in fishing effort (Wass, 1976; 1977).

The first visit of the SPC DSFDP recorded a similar catch rate (average of 83.9 kg per trip). The masterfisherman during this visit used dories for his fishing surveys; he averaged 9.5 hours of bottomfishing and 3.2 fishermen per trip, which is quite similar to average dory effort.

Significantly higher catch rates might have been expected, as Mead was a highly experienced fisherman using wooden handreels, but his fishing concentrated on much deeper fishing grounds which typically produce lower catch rates.

Figure 5 page 40 plots the CPUE of vessels listed in Table 1 against the number of artisanal vessels operating in the fishery for each year. This figure indicates what appears to be a dramatic drop in catch rates in response to the sharp rise in fishing effort (fleet size) during 1973–1974.

Catch rates then indicate a gradual increase as the number of vessels began to decline after

Table 1: Shallow-water bottomfish catch rates in American Samoa (1967–1978)

Date	No. of dories	No. fishing Tutuila	No. of trips	Total (kg)	Catch per trip (kg)	Comments	Information source
July 67/March 69	N/A	1	104	14,456	139.0	<i>Tautai A'e</i> surveys	Ralston, 1978
Feb. 72/June 72	5	5	42	6,670	158.8	Dories–handlines	Wass, 1972
July 72/June 73	13	13	?	?	95.5	Dories–handlines	Wass, 1973
July 73/June 74	21	14	673	42,892	63.7	Dories–handlines	Wass, 1974
July 74/June 75	23	11	312	19,650	63.0	Dories–handlines	Wass, 1975
July 75/June 76	23	13	305	22,119	72.5	Dories–handlines	Wass, 1976
July 76/June 77	18	9	?	?	82.3	Dories–handlines	Wass, 1977
April 78/June 78	4	2	36	3,022	83.9	SPC/DSFDP handreels	Mead, 1978

1975, possibly due to the explanation of lowered effort and increased fishing experience put forth by Wass.

Ralston also noted that catch rates in line-hours dropped over the course of the Dory Project, but reported that fishing was thought to improve in the later years, as fewer boats meant decreased effort on the stocks (Ralston, 1978). The sharp increase in CPUE in 1978 was caused by the entry of the two large, diesel vessels and the introduction of the FAO handreel by Paul Mead.

Deep-water snapper exploitation

Table 2 lists catch rates for Tutuila-based fishing vessels from 1978 to 1983, which was a transition period between the end of the Dory Project and the start of deep-water snapper exploitation. It is difficult to interpret these data, as a large variety of fishing vessel types was engaged in the fishery (see Figure 3). However, there is some indication of high initial catch rates that may have been

a result of the use of handreels, followed by a decline to CPUE levels similar to those of the late Dory Project.

Table 3 summarises the amount (kg) and species of all bottomfish exported from American Samoa to the Honolulu Wholesale Auction between September 1982 and December 1987. The export of groupers and jacks ('Others' in the table) was discontinued after 1985 and exports concentrated on sending only high-value, deep-water snappers. The catch rates of eteline snappers declined as virgin stocks were fished, and fishermen extended operations to more remote banks and islands (Crook, Kitiona, pers. comm.).

The total catch of eteline snappers rose sharply in 1986, while the number of fishermen had dropped from ten in 1985 to only three in 1986. This increase in catch rate can be partially explained by the improved skills of the few remaining fishermen and the better fishing experienced due to a drop in fishing pressure.

However, the main reason for increased landings in 1986 was the discovery and exploitation of virgin deep-water snapper stocks on an isolated seamount, named 2% Bank (Crook, pers. comm.). A depletion study of the eteline snappers taken from 2% Bank between 23 February and 21 May 1986 has been conducted through the examination of Honolulu Wholesale Auction data and interviews with the fishermen involved (Moffitt, 1989).

This analysis estimated a 78 per cent removal of the eteline snappers during the three-month period. The removals of *Etelis coruscans* and *E. carbunculus* during this period, according to the Moffitt report, amounted to 2,203 kg, which is 69 per cent of the total amount of eteline snappers exported from American Samoa for the entire year.

The conclusion of this report, which supports anecdotal sources in American Samoa, is that deep-water snappers in American Samoa can be quickly depleted from the very

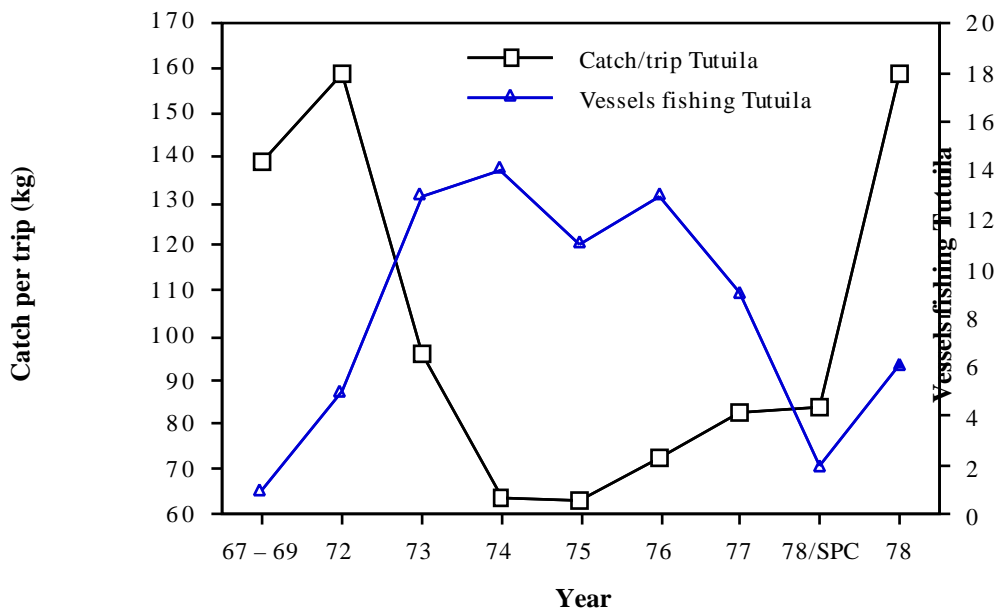


Figure 5: Catch per trip (kg) vs the number of vessels engaged in the bottomfishery of American Samoa (1967-1978)

Table 2: Catch rates of Tutuila bottomfish vessels (1977–1983)

Date	No. of dories fishing	Other vessels	No. of trips	Total (kg)	Catch per trip (kg)	Comments	Information source
July 77/June 78	4	2	13	2,067	159.0	Dories + 2 large diesel boats with handreels	Wass, 1978
July 78/June 79	2	2	?	?	103.2	Dories + 2 diesels	Wass, 1979
July 79/June 80	1	12	162	?	115.0	Alias, skiffs	Wass, 1980
July 80/June 81	1	18	209	12,137	58.1	Alias, skiffs, Manta cats	Wass, 1981
July 81/June 82	2	25	?	?	50.0	Some deep snappers	Wass, 1982
July 82/June 83	1	31	?	?	81.4	Fish export begun	Wass & Aitaoto, 1983

Table 3: American Samoa bottomfish exports to Hawaii (1982–1987)

	Sept. 82/May 83	1984	1985	1986	1987	Total
<i>Etelis coruscans</i>	868.6	1,393.0	548.2	1,940.2	466.6	5,216.6
<i>Etelis carbunculus</i>	639.9	1,021.4	443.2	1,250.9	16.1	3,371.5
<i>Etelis radiosus</i>	0.0	0.0	19.3	6.8	0.0	26.1
<i>Pristipomoides</i> spp.	145.9	722.3	278.2	369.1	339.3	1,854.8
<i>Aphareus rutilans</i>	386.6	265.4	205.4	258.4	5.9	1,121.7
<i>Aprion virescens</i>	459.8	101.1	29.8	36.4	15.2	642.3
<i>Paracaesio kusakarii</i>	0.0	0.0	13.6	300.9	15.0	329.5
Others	145.7	286.4	79.5	0.0	0.0	511.6
Total	2,646.5	3,789.6	1,617.2	4,162.7	858.1	13,074.1
No. of fishermen	?	18	10	3	3	N/A

Source: Howell, 1983; Aitaoto, 1984; DMWR/NMFS data from United Fishing Agency, 1984–1987

limited habitat available. Exports of *E. coruscans* and *E. carbunculus* dropped to only 467 and 16 kg respectively in 1987.

CONCLUSIONS

The development of artisanal bottomfisheries in American Samoa can be grouped roughly within two ‘boom and bust’ cycles corresponding to (1) the Dory Project and (2) the export of high-value deep-water snappers. This type of fisheries development, in the long term, is no good for the fishermen or for the resource, and runs counter to the development of sound,

sustainable fisheries. At the same time, a number of positive developments and benefits were derived from both programmes.

The Dory Project spent a great deal of time and energy on a vessel type that was not suited to conditions in American Samoa.

A great deal of time was also spent on experimentation with various engine types and drive systems, resulting in the most appropriate combination of the outboard-driven alia using wooden handreels.

When aid projects involve low-interest or government-subsidised equipment, cultural and societal influences often spoil the intent of programmes.

Some of the positive aspects of the Dory Project were not maximised. Some of the dories were given to persons of high social standing (who did not use them for earning a living), instead of to young, enthusiastic fishermen with a higher incentive for profit-making and full-time operation.

Another aspect of aid-subsidised development is that fishermen become accustomed to

receiving free training, assistance, gear and easy charter fees, and their expectations of profit are unrealistic. This situation led to the abandonment of the fishery by several part-time fishermen when the 'freebies' were no longer available.

In addition, employment with the American Samoa Government provides a steady salary without the hardships involved in making a living with a small commercial fishing vessel. This is especially true given the low price of locally-sold fresh fish caused by the availability of frozen wahoo and by-catch from the canneries.

Some restaurants and markets in Pago Pago prefer this source of fish as it can provide delivery of large quantities of fish at a low price on a fixed schedule. Landings from the artisanal fleet are often curtailed by rough weather or seasonal availability of particular species.

The sudden appearance of 23 dories was a good example of over-capitalisation on a limited resource and a poorly-developed market structure. The rapid expansion of the fleet was also not regulated by normal economic constraints, as low-interest loans made the dories easily available to fishermen.

In addition, full-time commercial fishing is basically incompatible with traditional Samoan cultural norms. Providing fresh fish for their families and other social obligations will always be a primary concern to the local fishermen, and serves to preserve strong cultural values.

Most, if not all of the fishermen in American Samoa have other sources of income, and fish for a variety of reasons beside profit: i.e. subsistence, barter,

recreation and to fulfil social obligations.

The export snapper programmes were extremely successful in promoting the exploitation of deep-water snapper resources in the Territory. Unfortunately, the limited extent of the resource was not known during the initial years of the programme, and stocks were quickly depleted.

In summary, the advice and cautions made in the Marr report of 1961 were quite sound, and a number of the recommendations have been fulfilled (see *Fisheries Newsletter* #76).

The OMR became a full department of the American Samoa Government in 1988 and has legislated a full set of conservation, fishery and wildlife regulations for the Territory. A suitable artisanal fishing craft is now in use and an appropriate harvesting technology has been adopted.

However, cannery fish and industrial fisheries by-catch, as well as cultural aspects, will always inhibit domestic fisheries development. The main aspect of rational fisheries development that was not stressed in Marr's report was the need for assessment and management of the resource from the beginning of the fishery.

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