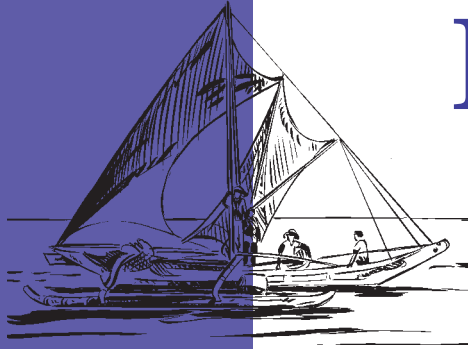


FISHERIES

Newsletter



NUMBER 85
APRIL-JUNE 1998

IN THIS ISSUE

- | | |
|---|---------|
| SPC ACTIVITIES | Page 2 |
| NEWS FROM IN AND AROUND THE REGION | Page 17 |
| ASSESSMENT OF COMMERCIAL FISH RESOURCES
IN THE LAGOON OF THE NORTHERN PROVINCE,
NEW CALEDONIA
<i>by Pierre Labrosse, Yves Letourneur and Michel Kulbicki</i> | Page 22 |
| SPC MASTERFISHERMAN VISITS TWO SKIPPERS
WORKING FOR SOLOMON TAIYO'S POLE AND LINE
FISHING FLEET
<i>by Peter Watt</i> | Page 32 |
| TUNA LONGLINE FISHING TAKES A DIFFERENT TURN
IN FRENCH POLYNESIA
<i>by Steve Beverly</i> | Page 36 |



Masterfisherman Steve Beverly spent two weeks in April fishing aboard the 26 m longline vessel, F/V Arevamanu.



■ CAPTURE SECTION

Following the successful completion of the first regional course on vessel operation management and electronic aids for Pacific Island skippers, held at the Nelson School of Fisheries during February 1998, the Section's two Masterfishermen, Steve Beverly and Peter Watt, continued their in-country follow-up work with each course participant.

The aim of this work is for the Masterfishermen to assist each participant in the operation of their fishing vessel under their local conditions, and to assess their abilities in managing the operation of their vessel.

Steve Beverly spent two weeks during April in Tahiti fishing with Fa'arei Leboucher (a course participant) and his father, Gilles Leboucher, who are owner and operators of a 26 m longliner, F/V *Arevamanu*. The fishing trip on F/V *Arevamanu* (see article on page 36) was very productive.

Eight days were spent at sea, and fishing took place over six days. A total of over six tonnes of fish were caught. Gilles' operation needed little improvement, but Steve was able to show Fa'arei and Gilles a few tricks in fish handling and making up gear.

In May, Steve fished with Kiniviliame (Kini) Kiliraki, captain of a pole-and-line vessel, F/V *Trapper*. Paiau Pirake, from Cook Islands, came along on the fishing trip in Fiji as the longline vessel back in Rarotonga was up on the hard.

The fishing trip on F/V *Trapper* in Fiji was much shorter than the trip in Tahiti. Steve and Paiau spent only four days on F/V *Trapper*, with two days spent baiting and fishing for skipjack tuna. During that time,

about two tonnes of skipjack tuna were landed.

This was actually a learning experience for both Paiau and Steve, and they had a good teacher: Kini is a real master and is actually the last of his kind in Fiji. F/V *Trapper* is the only vessel presently pole-and-line fishing for skipjack tuna in Fiji waters.

During the remaining time in Fiji, Steve took Paiau on a tour of most of the commercial fishing operations in Fiji, including Fiji Fish, Ocean Traders, and Celtrack Holdings Ltd (formerly Feeders Seafoods). Paiau observed a shipment of tuna being graded and packed for shipment to Japan and Hawaii, and he met most of the players in the fish business in Fiji.

Peter Watt was in Pohnpei and Chuuk during April, completing his work with the participant from the Federated States of Micronesia, Miko Mikey. Peter undertook a 10-day trip with Miko, however, the trip was cut short due to a very good catch of yellowfin tuna on the fourth set, with over 200 fish ranging from 15–25 kg, and one 40 kg bigeye tuna.

This catch, along with the fish from the previous three sets, filled the fish holds. The vessel, F/V *Captain Honda*, had to return to Chuuk to unload.

Peter travelled to Noro in the Solomon Islands in May to work with the two participants, Timothy Sosimo and Samuel Sautei, who are Fishing Masters on pole-and-line vessels for the Solomon Taiyo Company.

Peter undertook a trip with each Fishing Master (see article on page 32) which included catching bait at night and then

steaming to offshore fish aggregating devices (FADs) to pole skipjack tuna.

The catches were good, with 29 t of skipjack on one trip and 18 t on the other. Peter's time resulted in a valuable exchange of knowledge, with Peter gaining first-hand experience in pole-and-line fishing and the Fishing Masters getting pointers on ways they could improve the management of their vessels at sea.

In June, Peter headed off to the National Fisheries College in Kavieng, PNG, to commence an in-country assignment following an official request for assistance. Peter will be stationed in Kavieng for at least 4 months, lecturing the students about different fishing gears and techniques, and taking them to sea on board the college's training vessel for practical instruction and demonstration.

Steve also commenced a new assignment in June. He worked with the SPC Training Section in conducting the practical module of the SPC–Nelson Polytechnic Fisheries Officers Course, which was held in New Caledonia for 5 weeks during June and July.

In Noumea, Fisheries Development Adviser Lindsay Chapman supervised the recruitment of the Section's first Trainee Associate. Following the recruitment process, Mr Marsh Uele from American Samoa was offered, and accepted, a 12-month contract.

Marsh has worked for the Department of Marine and Wildlife Resources (DMWR) for two-and-a-half years, first as an Americorp volunteer (two years) and then as a Fisheries Technician (last six months). Marsh's work at DMWR included:



Marsh Uele was recently appointed Trainee Associate (Capture Section).

- assisting with inshore fisheries surveys; assisting in the collection of fish samples (parrotfish and mullet) and their dissection;



- liaising between DMWR and local fishermen; collecting catch and effort data from fishermen and entering the information into a database;
- and assisting with deep-water snapper fishing trials for research purposes. Marsh started with the Capture Section in mid-July.

Progress was also made on reports, with one published report ready for printing and several unpublished reports progressed ready for country comment and clearance. The FAD Volume III manual is also being finalised in both English and French, and will soon enter the final editing phase before publication.



■ TRAINING SECTION

Safety Aboard Fishing Vessels — The booklet

As a follow-up to the Section's safety-at-sea awareness campaign, a small booklet has been produced to complement the resource materials developed for the SPC Pre-sea Safety and Fishing course.

This booklet will be distributed to commercial fishing companies in the region, and the target group will be the deckhands working onboard fishing vessels, especially new recruits.

This booklet is very handy, with an A5 format and waterproof, hard-to-tear glossy paper. Its production was co-ordinated by Alastair Robertson, ex-SPC Fisheries Training Adviser and now tutor at the New Zealand School of Fisheries.

In 24 pages, the booklet shows the safety and survival equipment found on commercial fishing vessels and demonstrates its use. It also highlights the main

causes of accidents on board or at port, from fire hazards to HIV/AIDS risks.



Intended to be used by Pacific Islanders on both domestic and foreign fishing vessels, the booklet also contains a list of English terms commonly used

at sea and their phonetic equivalents in Taiwanese and in Japanese. Initially distributed in English, it will soon be translated into French.

It is hoped that this booklet will become the inseparable shipmate of all deckhands in the Pacific.



More management training for fishing enterprises

Pacific island commercial fisheries enterprises need management training. The Training Section has clearly identified this need through correspondence, country visits and regional fora.

Starting in March 1996, with funding assistance from UNDP, the Fisheries Training Section has launched a series of regional training courses and workshops for enterprise managers.

The first regional workshop (Santo, Vanuatu, March 1996) targeted the trainers of small-scale fishers and was followed by national workshops in the

Solomon Islands, Papua New Guinea, Niue, the Federated States of Micronesia, Vanuatu and Tuvalu.

The workshops focussed on the financial management of small fishing businesses and the use of a fishing vessel logbook as a tool to improve the profitability of these businesses.

Subsequently, in March 1997, a two-week regional course was run for managers of larger fisheries enterprises. The Nelson Polytechnic in New Zealand implemented the course, beginning a close partnership between

the School of Fisheries and the Section in the delivery of enterprise management training.

The course was a success, and participants identified a need to run similar programmes in future, as well as a tailor-made course for their skippers. This recommendation led to the implementation of a regional course on vessel operation management and electronic aids. The programme was run in February this year, and was completed by 12 commercial fishing skippers.

A second regional course was organised from August 10 to 21,

again at the New Zealand School of Fisheries. A comprehensive report on that course will be included the next issue of the *Fisheries Newsletter*.

The Section wishes to continue assisting with the emergence of an industrial fisheries sector in the Pacific. To that effect, it is

felt that more management training is needed, and Section staff are actively seeking funds for additional courses in 1999.

If funding can be secured, the Section will organise a five-week course on seafood business operations and management for Pacific island women.

Funding proposals have been sent to the Commonwealth Secretariat and to New Zealand Official Development Assistance (NZODA). Depending on the outcome of these proposals, the course might be run in November 1998.



Sashimi tuna workshops in Tahiti

After workshops in Papua New Guinea (January 1998) and Tonga (March 1998), the fishing industry in French Polynesia has now received training in the handling and grading of sashimi tunas.

From 30 March to 3 April, the SPC Fisheries Education and Training Adviser ran a series of short workshops targeting either crew of tuna longliners, fish retailers, or exporters. In five workshop sessions, a total of 53 persons were instructed in the correct on-handling procedures for export sashimi tunas. Fish retailers and exporters received additional training in

tuna grading. Several staff from the Service de la Mer et de l'Aquaculture (SMA) attended the workshops.

The workshop venue was the Fare Tautai, located at the fishing port, next to the fish auction floor where all the practical exercises (tuna handling and grading) were carried out. In Tahiti, the SPC Fisheries Education and Training Adviser received assistance from Stephen Yen (SMA) on the administrative side of the workshop.

Stephen organised the selection of participants, and looked after the supply of tunas for the prac-

tical exercises. The Papeete Fishing Port made its facilities available to the workshop participants, and doing so greatly assisted with the successful outcome of the workshops.

Similar training programmes are planned in the Marquesas Islands where the government of French Polynesia is supporting the emergence of tuna fishing activities.

Countries which have training needs in sashimi tuna handling/grading should contact the SPC Fisheries Training Section for the implementation of similar workshops.



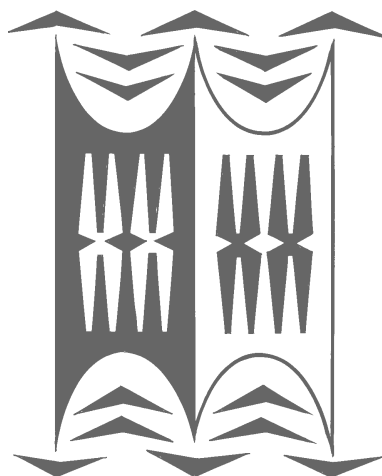
Attachment training activities

As part of the Marine Resources Division's mandate to implement strategic training activities, the Fisheries Training Section has undertaken 'one-off' training programmes that will enable nominated individuals to receive subject-specific training through attachments and short courses.

During the first half of 1998, the Section organised and funded a range of successful attachments, as follows:

- a Fiji aquaculture technician observed the pearl oyster wild spat collections developed by ICLARM at the ICLARM Coastal Aquacul-

ture Centre in the Solomon Islands;



- a Guam biologist from the Guam Aquaculture Development and Training Centre (GADTC) and a Fiji Aquaculture Technician studied hatchery techniques for shrimp at IFREMER in New Caledonia;
- the Manager of the Santo Training Centre (Vanuatu) studied at the AIT/Continuing Education Centre in Thailand to upgrade skills in Management of Training Centres;
- a PNG Skipper completed a New Zealand Coastal Master (NZCM) qualification at the New Zealand School of Fisheries.



Two Pacific Islanders participate in Aquaculture training sessions in New Caledonia

Two Pacific Islanders, Mr Anand, a technician with the Fiji Fisheries Department and Mr Camacho, a biologist from the Guam Aquacultural Training and Development Center, recently took part in a three-week training attachment in the Territory of New Caledonia arranged by the SPC. The training session, supervised by SPC, was made possible through the support of IFREMER and the GIE RA (Aquacultural Research

Economic Interest Group). The trainees' travel costs were funded by SPC and FAO/SPADP.

The trainees were based at the Saint Vincent Aquaculture Station, where they were able to hone their skills in Penaeid hatchery techniques. At the end of the session, they expressed their satisfaction with the training, and praised the high quality of the instructors.

It is interesting to note that the SPC was instrumental in the creation of the Saint Vincent Aquaculture Station, which began operations in 1972 as part of an SPC-FAO-UNDP experimental aquaculture project.

The SPC would like to express its warm appreciation to IFREMER and the GIE RA for accepting the proposal for this training session.



Mr Anand (Fiji) and Mr Camacho (Guam) spent three weeks at the Saint Vincent Aquaculture Station in New Caledonia.

■ POST-HARVEST SECTION

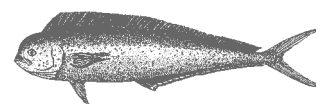
Hazard Analysis and Critical Control Point (HACCP) support to seafood exporters

Background

The US Seafood HACCP Rule finally came into being on 18 December 1997. The SPC Post-harvest Fisheries Section in col-

laboration with the Fishery Industries Division at FAO, undertook and completed a range of activities leading up to the implementation of the rule to help member states of the

two organisations and seafood exporters in the region.



These activities included:


1. Technical Cooperation Project executed jointly by SPC and FAO in the second half of 1997 had the following outputs:

- *review of the establishment of HACCP in selected Pacific Island countries (the report¹ will shortly be published);*
- *assess seafood HACCP legislation reviews of importing countries and legislative requirements of member states (the report² will shortly be published);*
- *drafting of generic HACCP plans for seafood-processing procedures relevant to the region;*
- *a regional workshop in Pacific Harbour, Fiji (October 1997), the culmination of the project, that was designed to help plan*

future activities and directions for regional bodies, national regulators and the commercial sector.

2. Five-day national seafood HACCP workshops were held in Samoa, Fiji and Tonga in October and November 1997 with qualified HACCP tutors provided by SPC and FAO. The workshop participants were taught the US Seafood HACCP Alliance course that met the training requirements of the US Seafood HACCP rule. These HACCP workshops are a valuable first step for seafood exporters in that trained employees can play an active role in developing HACCP plans, etc. Over 60 people were certified in the three countries.
3. With funding assistance from UNDP, SPC hired a HACCP specialist to advise and assist

seafood exporters with their HACCP documentation and procedures. Over a three-month period (October through to December 1997) the consultant provided assistance to over 15 exporters in Samoa, Fiji and Tonga. This assistance made sure that fish trade with the USA could continue without interruption.

4. The same HACCP specialist visited the Federated States of Micronesia (FSM) and Marshall Islands in December 1997 to help plan HACCP activities for seafood exporters in these two countries (UNDP funded). Recommendations were made to support HACCP workshops similar to those conducted in Samoa, Fiji and Tonga and for providing direct assistance to seafood exporters. These activities were approved by SPC and included in the work programme for 1998. 

HACCP assistance to the Federated States of Micronesia – June 1998


To follow up on the earlier mission to FSM to evaluate the national needs of seafood exporters, a programme of activities was completed in June that helped put seafood exporters in FSM on the road to meeting US import regulations in this area. Activities were jointly planned and executed by the FSM Department of Economic Affairs and SPC. With funding assistance from UNDP to cover SPC's input, the following activities were completed during the June/July assignment:

- National Seafood HACCP Workshop was held in Moen, Chuuck State from 1 to 4 June 1998. SPC provided HACCP

tutors (Dr John Sumner – HACCP Consultant and Steve Roberts, SPC's Post-harvest Fisheries Adviser). Eighteen participants from the public and private sectors were certified;

- Direct technical support was given to seafood exporters to help draft HACCP plans and work out appropriate HACCP procedures, as follows:
 - Chuuk State: 1 to 5 June
 - Kosrae State: 6 to 9 June
 - Yap State: 7 to 10 June
 - Pohnpei State: 9 to 13 June

Dr John Sumner, HACCP consultant, participated in the assignment wrap-up meeting held with Fisheries Unit staff, FSM Department of Economic Affairs prior to departure from Pohnpei. The HACCP consultant remained in contact with exporters through fax and electronic mail to provide ongoing assistance to further develop and fine-tune their written HACCP plans and procedures.

Over 15 seafood-exporting enterprises were assisted during the assignment. 

¹ Gillett, R. 1997. 'Hazard Analysis and Critical Control Point (HACCP) for Seafood Exports: The Situation in Selected Pacific Island Countries'. FAO Technical Cooperation Programme (TCP/RAS/6713, Technical Report 1). FAO, Rome. SPC, Noumea.

² McDorman, T. 1997. 'Seafood Safety Standards (With Special Reference to HACCP): Review of the Import Regulations of the U.S. and E.U. and the Relevant Laws of the South Pacific Region'. FAO Technical Cooperation Programme (TCP/RAS/6713, Technical Report 3). FAO, Rome. SPC, Noumea.



HACCP workshop participants assessing a tuna exporting facility in Chuuk State, FSM

Technical review of the fish-market project and proposed fish-export facility in Nauru

With an eye on expanding fisheries activities on the island, the Nauru Fisheries and Marine Resources Authority (NFMRA) has made plans to improve the marketing of seafood by establishing a modern fish-marketing facility.

No facility where fish caught by local fishers can be sold to local consumers in a clean hygienic setting is currently available in Nauru.

The current practice for selling fish is informal, and ranges from selling fish directly from boats to selling from the fishers' home.

As part of the overall fisheries development plan, NFMRA hopes that the fish market will encourage improved handling and marketing of fish on Nauru.

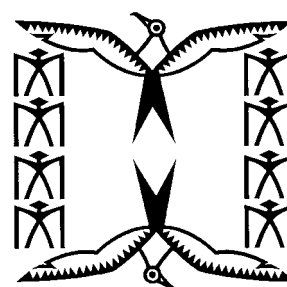
As catches are expected to grow it is likely that an appropriately designed market facility could benefit the fishing community by supplying ice and storing chilled fish, and benefit local consumers by providing safer, better quality fish.

In previous years SPC was asked to provide NFMRA with advice on setting up a fish-market facility in Nauru. Layout plans were drafted and technical specifications on the construction of the building and details of most suitable equipment had been provided.

In advancing the project to the next phase, NFMRA's concern was to select the best available. SPC's Post-harvest fisheries Adviser visited Nauru in February 1998 to assist with the task of

site selection and provide a technical evaluation of the market facility, including the possibility of expanding the facility sometime in the future for export purposes.

A draft report of the study including recommendations on selection of site was completed during the assignment.



■ WOMEN'S FISHERIES DEVELOPMENT SECTION

Nauru Women's Workshop on Alternative Harvesting and Processing Techniques

In November 1997, the SPC Women's Fisheries Development Adviser visited Nauru to carry out a study on the participation of women in the fisheries sector. During her visit, requests were made for a workshop to teach women methods of sustainable harvesting, and alternative processing techniques.

The *Nauru Women's Workshop on Alternative Harvesting and Processing Techniques* was held from 20 to 24 April 1998. Twenty-five women attended the workshop (Nauruan, I-Kiribati, and Tuvaluan participants). All of the women were involved in the harvesting of resources, with a few involved in the marketing of seafood.

As with other WFDS workshops, the emphasis was on practical hands-on learning by participants. Lectures were kept to a minimum, with demonstrations and practical sessions taking up most of each day. Participants were required to participate during demonstrations and practicals.

Topics included sustainable harvesting practices, alternative fishing methods, basic gear technology, the processing of non-traditional seafood (sea cucumber, and sea egg), milkfish filleting, deboning, smoking and recipes, and the making of value-added products (such as tuna jerky and fish burgers).

Instruction was held at the Arts and Craft Centre, on the reef, and at the Nauru Secondary School's cooking room. At the end of the workshop, all of the participants stated that they could teach the skills learned to others in the community.



Pamela Scriven, President of the National Council of Women, tries her hand at making fish burgers.

Requests were made for training in catching and processing octopus, and milkfish farming.

This workshop was the first to be held in Nauru for women involved in fisheries activities. It is hoped that other workshops will be held in the future.

At the closing ceremony, the participants requested that a

Women in Fisheries Officer be employed within the Fisheries and Marine Resources Authority to develop programmes of support to women in the fisheries sector.

The participants were, therefore, happy when told by the Honourable Bernard Dowiyogo (the Minister responsible for fisheries) in his closing ceremo-



The fish smoker proved so popular with workshop participants that they continued to smoke fish for their weekend meals after the workshop closing ceremony.



Sea cucumber strips and tuna jerky slices dry in the sun.

ny speech, that Cabinet had approved such a position. He anticipated that the Officer would be in place in June 1998.

The Women's Fisheries Development Section is grateful to the Director of the Culture and Tourism Unit, Ms Julie Olsson,

for her logistical support as local counterpart; the Nauru Fisheries Authority for constructing the fish smoker; and the overseas tutors for sharing their expertise and knowledge.

The workshop was funded by the Women's Fisheries Develop-

ment Project funds provided by New Zealand Official Development Assistance (NZODA) and the Australian Agency for International Development (AusAID).



■ OCEANIC FISHERIES PROGRAMME

Billfish research, conservation and management — a new project

A new project is starting within the Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC) to begin looking at billfish resource issues throughout the Pacific. The tuna stocks of the western and central Pacific Ocean are the region's most valuable renewable resource. Catches of the main market species—skipjack, yellowfin, bigeye and albacore tuna—

exceed 1.5 million tonnes annually, and have a landed value of approximately US \$1.7 billion.

While tuna are the principal targets of the purse seine, pole-and-line and longline fleets in the region, other highly migratory species are also caught. The most important of these are the billfish, predominantly the blue marlin (*Makaira mazara*), black marlin (*Makaira indica*), striped

marlin (*Tetrapturus audax*), sailfish (*Istiophorus platypterus*) and broadbill swordfish (*Xiphias gladius*). These species occur widely throughout the Pacific Ocean and are commonly caught by longline (Figure 1).

Blue marlin and black marlin are also caught (though in small numbers) by purse seiners in log-associated sets. The total annual longline catch of billfish

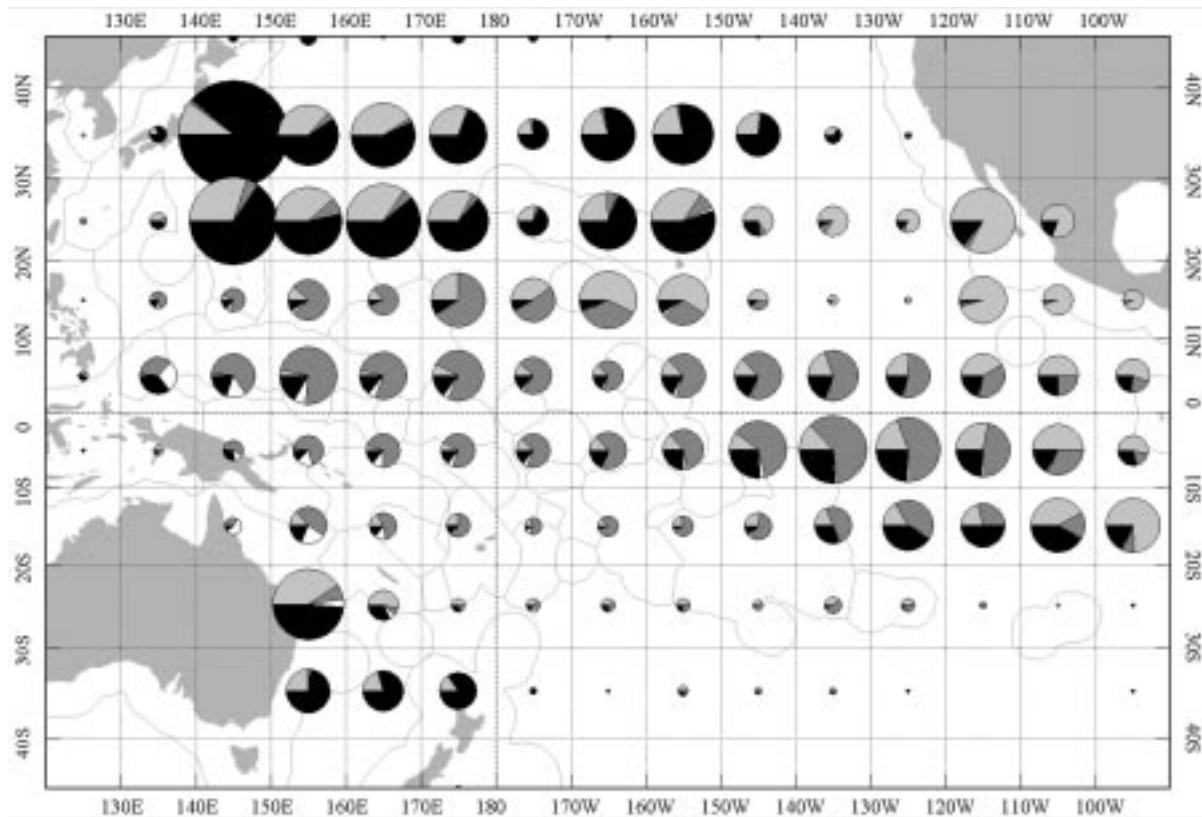


Figure 1: Distribution of longline billfish catch 1962–1995
(Broadbill swordfish: black, black marlin: white, striped marlin: lighter shade, blue marlin: darker shade)

in the western and central Pacific (east to 150°W), in 1994, was estimated at approximately 23 000 tonnes.

While billfish have commercial value and are generally retained for sale, these catches of billfish are usually considered by-catch. Targeting of swordfish, and to a lesser extent striped marlin, does occur in some locations. It is possible that this practice will increase in the future, due to high prices and a demand for these fish on the Japanese and US markets.

Recent increase in longline effort, particularly by small-scale commercial fleets, and a growing interest by many Pacific Island countries in developing locally-based game-fishing industries, has further increased the need for ongoing billfish data collection and research.

Consequently the OFP of SPC, funded by AusAID, has commenced a three-year project to provide scientific support for the conservation and management of billfish in the western and central Pacific Ocean.

Specifically, the project will provide information on the impact of regional tuna fisheries on billfish stocks, and help provide the biological information necessary for the sustainable development of the billfish fisheries, particularly island-based sports fisheries.

Project goals and objectives

The main goal of the project is to increase scientific understanding of billfish stocks in the western and central Pacific Ocean in order to:

- ☞ Estimate the impacts of regional tuna fisheries on these stocks, and thereby assist in their rational management and,

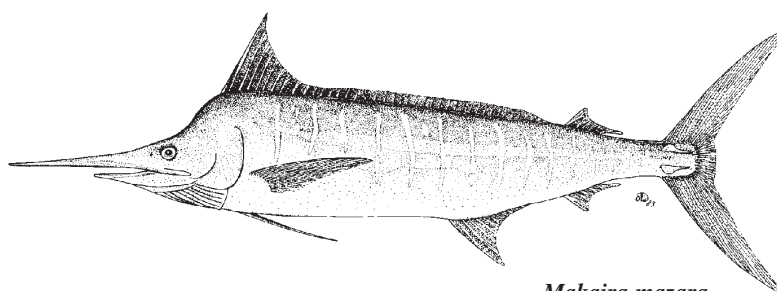
- ☞ Assist the development of sustainable fisheries for billfish (particularly island-based sports fisheries).

The specific operational objectives of the three-year project are:

- ☞ To produce a review of billfish biology and exploitation in the western and central Pacific region. The review will compile available biological information (distribution, stock structure, migration, reproduction, feeding, mortality, age and growth and environmental influences), for the main five species. Important gaps in our understanding that could hinder future assessment of stocks will be identified. The review will compile existing data on catch and catch-per-unit-effort for the major fisheries (predominantly longline), including seasonal, inter-annual and geographical distribution. Size composition data will be included, where available.
- ☞ To assemble information on potential billfish availability, at the national level, for provision to member countries. The project will assemble and interpret information on potential billfish availability on a country-by-country basis. This will involve collecting and collating commercial longline and recreational catch data, as well as environmental data, bathymetric data and information from a basin-scale produc-

tivity simulation model developed by the OFP.

- ☞ To investigate alternative methods for regional assessment of billfish stocks, and, where possible, produce preliminary reports on status of stocks. Possible methods, that would be assessed, include abundance indices based on longline catch and effort data, biomass dynamics models and length-based age-structured models.
- ☞ To initiate and continue billfish data collection programmes from both large-scale industrial fisheries of the region as well as island-based sports fisheries. To date, there has been little systematic collection of data from island-based sports fishing clubs in a consistent format. Systematic data collection from cooperating island-based sports fishing clubs around the region will be initiated and the existing data collection systems from the industrial fisheries fine tuned. Biological sampling of sports fishery catches during peak seasons or tournaments may also be carried out. The feasibility of introducing and/or co-ordinating tag-and-release programmes at a regional level will also be investigated and implemented if appropriate. Annual data summaries will be compiled and distributed to fisheries departments, sports fishing clubs and other interested parties.



Makaira mazara

- To develop a medium- to long-term plan for future billfish research. This will involve extensive collaboration with scientists of the Standing Committee on Tuna and Billfish, in particular with members of the working group on billfish and by-catch research.

Project implementation

This work can only be carried out successfully with full cooperation and collaboration between all involved parties.

This includes all users of this valuable resource, including commercial and recreational fishermen, all nations involved in the fisheries, as well as scientific and management bodies.

The work will involve extensive collaboration with participating

scientists from other agencies, including Australia (CSIRO, AIMS and BRS), Japan (National Research Institute of Far Seas Fisheries), Taiwan (National Taiwan University and Overseas Fisheries Development Council), Korea (National Fisheries Research and Development Institute) and the United States (National Marine Fisheries Service).

Most importantly it will also need to involve the Cupertino and collaboration of all the sport fishing organisations, individuals and government bodies of the member nations. It is intended that the Standing Committee on Tuna and Billfish will be the main facilitator for this collaboration.

To further the aims of this project, SPC have appointed a fisheries scientist, Wade Whitelaw, who has many years experience

with pelagic species and sport fishing.

Wade is now based in Noumea, and starting to determine the extent of billfish data holdings throughout the Pacific.

If anyone has any information, data, advice or offers of assistance in trying to obtain a better understanding of the billfish resources of the region, please contact him at:

Tel.: +687 262000,
Fax: +687 263818 or
E-mail: wadew@spc.org.nc

He is especially interested in hearing from any sport fishermen, clubs or charter operators who may be interested in participating in the project. Wade also intends to visit various members to assess the potential for development of island-based sport fishing.



Eleventh meeting on the Standing Committee on Tuna and Billfish

The Eleventh Meeting of the Standing Committee on Tuna and Billfish (SCTB) was held from 28 May to 6 June 1998, in Honolulu, Hawaii, at the invitation of the Western Pacific Regional Fisheries Management Council of the United States of America.

SCTB #11 was attended by participants from American Samoa, Australia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Japan, Kiribati, Korea, Marshall Islands, New Caledonia, New Zealand, Northern Mariana Islands, Palau, Samoa, Solomon Islands, Taiwan, Tonga, the United States of America and Vanuatu.

Participants from the Food and Agriculture Organization of the United Nations (FAO), the Forum Fisheries Agency (FFA), the Inter-American Tropical

Tuna Commission and the Secretariat of the Pacific Community (SPC) also attended.

The first two days of SCTB #11 were taken up by the Workshop on Precautionary Limit Reference Points for Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

The Workshop was the result of a request to SCTB made by the Inter-sessional Technical Consultation on Issues Relating to Fisheries Management of the Multilateral High-Level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (the MHLC), which met in Honiara, Solomon Islands, in December 1997.

The agenda for the Workshop included an overview of the precautionary approach and its

application to fisheries science and management; a review of precautionary reference points; setting limit reference points and definitions of overfishing; stock assessment using precautionary reference points; the



impact of environmental variability on highly migratory fish stocks; the current status of stock assessment for target tuna species in the western and central Pacific and options for the application of precautionary reference points; and the application of precautionary reference points in 'data poor' situations.

The Chairman of SCTB #11, the Honourable 'Akau'ola presented a report of the Workshop to the Third MHLC, which was held in Tokyo, Japan, from 22 to 26 June 1998.

SCTB #11 was the first meeting since modifications to the Standing Committee's Terms of Reference were endorsed by the Thirty-Seventh South Pacific Conference, held in Canberra, Australia, in October 1997. The new Terms of Reference are as follows:

- ☞ *Co-ordinate fisheries data collection, compilation and dissemination according to agreed principles and procedures;*
- ☞ *Review research on the biology, ecology, environment and fisheries for tunas and associated species in the western and central Pacific Ocean;*

- ☞ *Identify research needs and provide a means of co-ordination, including the fostering of collaborative research, to most efficiently and effectively meet those needs;*
- ☞ *Review information pertaining to the status of stocks of tunas and associated species in the western and central Pacific Ocean, and produce statements on stock status where appropriate;*
- ☞ *Provide opinions on various scientific issues related to data, research and stock assessment of western and central Pacific Ocean tuna fisheries.*

The previous Terms of Reference were to advise the SPC Regional Technical Meeting on Fisheries (RTMF) concerning biological research on stocks which support oceanic fisheries for tuna and billfish in the SPC region. A notable feature of the new Terms of Reference is the absence of the requirement to advise RTMF. As a consequence, SCTB is no longer formally related to the Pacific Community.

This modification was proposed in order to ensure equal participation in SCTB by participants from SPC member countries

and territories, and non-SPC members alike.

In conjunction with the revision of the Terms of Reference, six SCTB working groups were created. These include the Statistics Working Group and Research Groups for albacore, bigeye, skipjack, yellowfin, and billfish and by-catch.

The Research Groups have taken over the activities that were previously conducted by the South Pacific Albacore Research Group and the Western Pacific Yellowfin Research Group. The agenda for SCTB #11 included an overview of the western and central Pacific tuna fisheries, and sessions for each of the working groups.

During the overview of the western and central Pacific Ocean (WCPO) tuna fisheries, it was noted that the total catch during 1997 has been estimated to be 1 439 000 mt, which is a slight increase from the 1996 catch, but lower than the peak which occurred in 1991 (Figure 1).

Purse seiners accounted for an estimated 859 000 mt of the total catch, while pole-and-line vessels accounted for 239 000 mt,

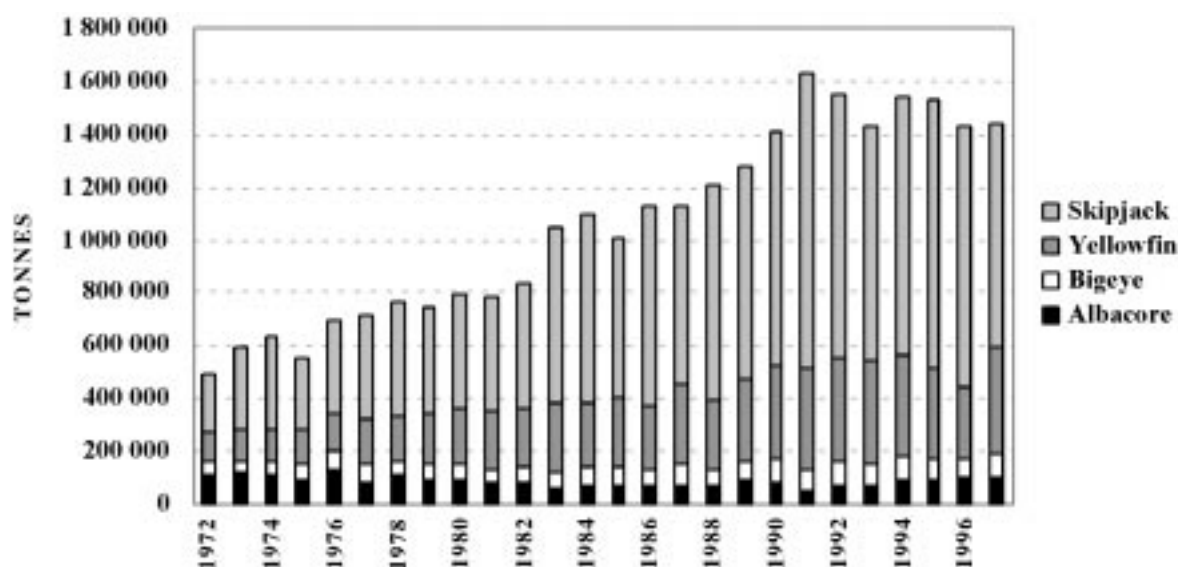


Figure 1: Catch (mt) of albacore, bigeye, skipjack and yellowfin in the central and western Pacific Ocean

and longliners, an estimated 187 000 mt (Figure 2). The catch in the WCPO represented 73 per cent of the total Pacific Ocean catch of 1 965 000 mt in 1997, and 46 per cent of the world catch of 3 120 000 mt.

Following national tuna fishery reports from many of the participants, the first meeting of the Statistics Working Group was held. The objective of the Statistics Working Group is to co-ordinate the collection, compilation and dissemination of data by the SCTB.

The participants considered various proposals and agreed on procedures for data collection, compilation and dissemination. An extensive series of tables of annual catch statistics for the western and central Pacific Ocean, and for other ocean areas, were presented,

and the format and content of the tables were discussed.

The Research Groups each considered regional fishery developments; biological and ecological research; stock assessment; and research co-ordination and planning. The sessions were largely taken up by presentations of recent research, and consensus statements concerning the status of the stocks were not considered.

The formulation of such statements may be considered at the future meetings of the SCTB. It was, however, agreed that the status of bigeye was highly uncertain, and the following consensus statement to that effect was formulated and presented to MHLC3:

The 11th SCTB noted with concern the large and continu-

ing increase in the catch of small-medium sized bigeye in both the eastern Pacific and the western and central Pacific, and the steady decline in long-line catches in some areas. However, because of the varying interpretation of observed CPUE trends and the present inability of stock assessments to produce unequivocal results due to poor estimates of some key parameters, the Group considered that the present condition of the Pacific bigeye stock was uncertain. It recommended that directed research efforts to reduce this uncertainty be urgently undertaken, and noted in particular the need for better estimates of the bigeye tuna catch by surface fleets, mixing rates and movements of fish across the range of the stock, and estimates of biological parameters such as size-specific natural mortality rates.

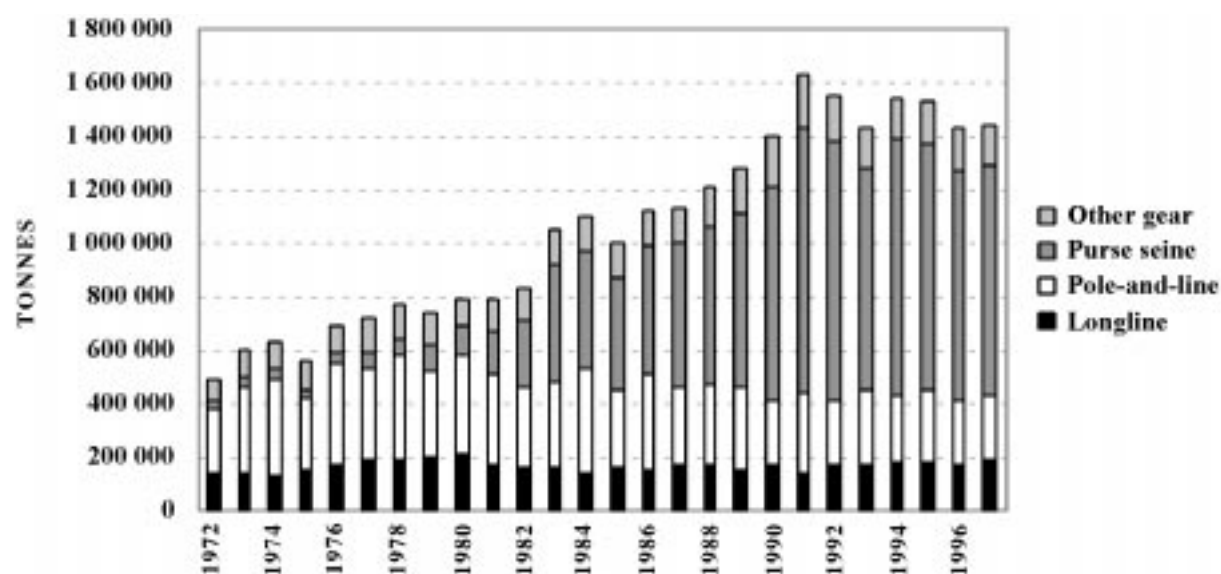


Figure 2: Catch (mt) of albacore, bigeye, skipjack and yellowfin in the central and western Pacific Ocean, by longline (LL), pole-and-line (PL), purse seine (PS) and other (OTH) gear types

Third Multilateral High-Level Conference held in Tokyo

The 3rd Multilateral High-Level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the

Western and Central Pacific Ocean (MHLC) was held in Tokyo, Japan from 22 to 26 June 1998. This followed previous

conference sessions in Honiara (December 1994) and Majuro (June 1997), which set a timetable for establishing a new interna-

tional management arrangement for tuna and other highly migratory species in the western and central Pacific by mid-2000.

The Tokyo session was attended by representatives from all major distant-water fishing nations operating in the region, most Pacific Island countries and territories, as well as the Philippines and Indonesia. The main task of the meeting was to consider a draft set of articles for a Convention, prepared by the chairman of the conference, Mr Satya Nandan. The draft prompted vigorous discussion on a range of important issues. Some of the issues upon which general agreement seems to be emerging include:

- ☞ The Convention will be a legally-binding agreement to conserve and manage the highly migratory fish stocks of the western and central Pacific region throughout their range.
- ☞ The focus of management measures will be the four species targeted by the tuna fisheries of the region – skip-

jack, yellowfin, bigeye and South Pacific albacore. However, the convention will also have the flexibility to consider any other species that may be affected by the fisheries.

- ☞ The convention shall establish a Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. The Commission would be supported by Scientific and Compliance Committees and a small Secretariat, but would, as far as possible, draw on existing regional institutions for the provision of technical services. In particular, the Oceanic Fisheries Programme of SPC is seen as a logical provider of scientific information to the new Commission.

Of course, many difficult issues remain to be resolved in future MHLC sessions. Some of the issues yet to be resolved include:

- ☞ How would fishing opportunities be defined (e.g. in units of catch or fishing

effort) and how would they be allocated amongst the participants?

- ☞ How would management measures adopted by the Commission and those adopted by coastal states within their Exclusive Economic Zones (EEZs) be made compatible?
- ☞ What would be the formula for financing the Commission?
- ☞ What would be the nature and objectives of compliance measures to be adopted by the Commission?

These and other matters will be the subject of further negotiation at future MHLC sessions. Two sessions are planned for 1999, the fourth session in January/February and the fifth session towards the end of that year. The United States is expected to host MHLC 4 in Honolulu, Hawaii.



■ US TUNA SEINERS TO FISH WEST AND CENTRAL PACIFIC

Up to 50 American purse seine vessels will be permitted to fish for tuna in the Western and Central Pacific Oceans for the next five years following the signing of a fisheries treaty in April 1998 in Tonga between the Forum Fisheries Agency (FFA) and the Government of the United States of America.

The signing was the culmination of three days of talks between the 16 countries that make up the FFA (Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu) and the American industry and government representatives.

According to Ian Cartwright, deputy director of the FFA, the treaty is a model of international co-operation, providing substantial benefits to both Pacific Island countries and the US tuna industry. FFA members

will receive US\$ 18 million in access fees from the United States. The first treaty came into being in 1988 and ran for five years. It was renegotiated in 1993 for a further 10 years, and the recent talks in Vava'u, Tonga, undertook a mid-term review.

'Tuna fishing under treaty terms is carried out under carefully controlled conditions that place a high priority on conservation and management provision, including the use of on-board observers and the submission of comprehensive catch and other data for scientific purposes from the vessel', said Mr Cartwright.

Boosted by relatively firm tuna prices over the last 12 months, the United States tuna industry representatives expressed confidence in the future of their operations in the Western and Central Pacific.

'The purse seiner operators present in Tonga indicated that

they were not contemplating shifting their operations back to the Eastern Pacific despite the recent agreement on the tuna/dolphin interaction issue. The US tuna fleet in the region has developed a strong, mutually beneficial relationship with the Pacific Islands, and a number of the vessels are partly crewed with island nationals.'

Mr Cartwright said island parties would like to see an increasing level of US involvement in the region's tuna industry beyond the receipt of access fees.

'The US has been encouraged to seek viable onshore investment opportunities within the islands. While progress on this issue has not been as great as we envisaged, plans are advanced for a number of such investments by the US', said Mr Cartwright.

(Source: *Professional Fisherman*, May 1998)



■ CORAL REEFS: MINES OF PRECIOUS SUBSTANCES

There are numerous species of organisms in tropical waters, particularly in coral reefs. The diversity of species in coral reefs is comparable to or even greater than that in a rainforest. Many bottom-dwelling invertebrates such as sponges, soft corals and tunicates have no value as food and, hence, have not been considered as economically-important resources.

However, chemical and pharmaceutical studies in the past three decades have revealed that these unpalatable organisms are important sources of biologically active (bioactive) substances which have potential for development into new drugs and other useful products.

Because of high diversity of species and hence high competition for survival, coral reef organisms, particularly lower invertebrates which lack the physical means of defence, have evolved a variety of unique toxic compounds as their defence strategy.

Many of these compounds have no terrestrial counterparts in their chemical structures as well as biological activities. These facts, together with a high incidence of bioactive compounds, have made coral reef organisms especially attractive targets of research.

Cytotoxicity (the degree of poisoning of cells) screening using animal or human cell lines is

often carried out as a first convenient step in the search of new anti-tumour drugs. When the author's research team screened the extracts prepared from several hundred species of invertebrates collected in the Okinawan waters, the incidence of cytotoxicity observed was more than 50 per cent.

Likewise, incidences of other activities such as anti-viral activity are also high with coral reef organisms, indicating that they are good sources of bioactive compounds. Indeed, we have discovered a variety of bioactive compounds from Okinawan marine organisms. Some of them are now under further evaluation as anti-tumour drugs.

Currently, several marine-derived compounds are under clinical trials as anti-cancer drugs in the world, especially in the United States. The most notable example is bryostatin-1, a minor constituent of the cosmopolitan bryozoan *Bugula neritina*, which was discovered by Professor Pettit of Arizona State University. In order to conduct clinical trials, several tens of grams of bryostatin-1 were obtained from more than 12 tons of the material collected in California.

Since the compound has a complex chemical structure, chemical synthesis may not be a practical way to supply the drug when it is approved. A possible solution to meet the future demand is aquaculture of the bryozoan. Research is now under way at a venture company in San Diego.

In our collaboration with the Pharmaceutical Research Laboratory of Kirin Brewery, Co., Okinawa, Kirin scientists discovered a new compound (agelasphin) showing anti-tumour and immuno-stimulatory activity (activates immunity to disease) from a sponge collected at a coral reef in Okinawa.

Chemical analysis revealed that agelasphin belongs to a class of compounds called cerebrosides which are constituents of the brain cells of humans and other animals. The relatively simple chemical structure agelasphin allowed the Kirin scientist to synthesise a number of compounds having related structures for the evaluation of drug efficacy.

One of them has now been selected for human clinical trials which were scheduled to occur

in the United States during 1997. In tests with mice which were injected with colon cancer cells into their spleen, 100% of the mice died of liver cancer after 40 days, while all of those administered the drug were still alive after 100 days.

It was proved to be highly effective in preventing translocation of colon cancer to the liver. When approved, annual sales of the drug are estimated to total more than 10 billion yen (US\$ 88 million).

Other than human medicines, a number of marine compounds are now used as important research reagents in biochemistry and related areas of bio-science.

For example, tetrodotoxin, which is a potent neurotoxin extracted from puffer fish, has been an important tool in the physiological study of nerve cells. Okadaic acid, a toxic compound discovered from a sponge in 1980, has become an extremely valuable reagent in the study of cell biology, and is a highly expensive commercial

product. To illustrate what are available and how expensive they are, some of the marine-derived reagents listed in the 1997 Sigma catalogue (a large chemical-supply company) are shown in Table 1.

Most of these reagents are far more expensive than diamond itself. It should also be noted that most of them are products of coral reef organisms.

As shown in these examples, tropical marine organisms are rich sources of bioactive compounds. Although the majority of them have no commercial value today, some of them may contain compounds that are much more precious than diamond.

In the light of the necessity of developing highly effective drugs to combat modern health crises such as cancer and AIDS, coral reef organisms are becoming increasingly important as the sources of such drugs.

(Source: *Tropical Coasts*, July 1997)



Table 1: Marine-derived biochemical reagents listed in the Sigma Catalogue, 1997

Reagent	Quantity	Price (Yen)	Source
Kainic acid	100 mg	4 900	Alga
Holothurin	10 mg	4 800	Sea cucumber
Domoic acid	1 mg	15 300	Alga
Tetrodotoxin	1 mg	20 000	Puffer fish
Brevetoxin	10 µg	13 500	Dinoflagellate
Saxitoxin	10 µg	9 800	Dinoflagellate
Palytoxin	10 µg	16 500	Soft coral
Okadaic acid	10 µg	10 800	Sponge
Manoalide	10 µg	12 000	Sponge
Calyculin A	10 µg	12 200	Sponge



■ EXPLORING THE OCEAN FOR ANTIBIOTICS

Mankind's discovery of antibiotics ushered in a new age of medicine, an age when many predicted an end to diseases that have plagued us for centuries. But the recent emergence of antibiotic-resistant bacteria threatens the idea that science can eradicate disease.

As scientists scour the globe for new antibiotics, Sea Grant researcher Sophia Kathariou is exploring Earth's last frontier—the ocean. While fungi, algae and plants are possible sources of antibiotics, Kathariou is limiting her research to bacteria.

Found everywhere in large quantities, bacteria reproduce quickly, are easy to maintain, and are relatively straightforward and easy to manipulate genetically.

Kathariou and her team of students first isolate bacteria from sand or other marine samples and breed them. Not all the bacterial species obtained from the natural environment are cultivable in laboratories due to the deviation from the natural conditions in a laboratory setting. Once single-species isolates are obtained by repeated dilutions and platings, they are subjected to anti-bacterial activity tests.

The simplest test for anti-bacterial activity is the disc diffusion method. A circular piece of filter paper disc, 7 mm in diameter, is impregnated with bacterial extract from the natural isolates and then laid down on a lawn of bacteria, such as *Staphylococcus aureus*, to see if killing occurs. Killing is indicated by a clear zone around the disc. Kathariou then selects the most promising isolates and works toward increasing their efficiency in anti-bacterial substance production through carefully monitored mutations.

The key to this project is the idea of a novel antibiotic. When an old standard like penicillin is overprescribed and misused, infectious bacteria like staph or strep can mutate and adapt, making penicillin an ineffective cure.

Antibiotic-resistant bacteria pose a severe threat, especially in hospitals where pathogens are an everyday occurrence. One solution is to constantly find new antibiotics never before seen by human or bacterium alike. For this, Kathariou looks to the undisturbed depths of the ocean.

'In general, if one looks at the earth, the marine habitats have the greatest biodiversity, so the potential for organism diversity is very, very high', Kathariou said. 'If you look both in the soils and in the deep sea, we would have many more species [in the ocean] than anywhere else.'

While coastal collections can be carried out with little effort, the chances of finding new strains of bacteria are lower because of increased human disturbance. 'We rely on other people to do expeditions for the deep sea material,' Kathariou said. 'Oceanography has ongoing programmes where basically they can do remote-controlled collections or manned submersible collections; there's one going on now at Loihi.'

Thomas Truong, a graduate student in Kathariou's lab, said one gramme of sample is usually enough to obtain a good number of isolates for anti-bacterial activity testing.

Such diversity, especially with bringing unknown bacteria to the surface, can also mean risk, Kathariou said, but laboratory safety protocols have worked well so far. 'Bacteria are handled

in a contained area,' Kathariou said. 'It is basically a hood that has a recirculating air system. The hood traps airborne bacteria in the filter and restricts possible spills to one area for clean-up.'

She said a campus safety officer inspects the lab every year, but the biggest threat is not the bacteria from the ocean, but the bacteria from the earth.

'To test for antibiotic producers, we test [oceanic bacteria] against organisms that are potential pathogens,' Kathariou said. 'Because our goal is to find a new antibiotic that would work against those that have become resistant to current antibiotics.' Lab workers also take standard precautions—gloves, glass, coats, hand washing—and so far, Kathariou said, no one has been sick from working in the lab.

'We have isolated some bacteria from different areas: soil; the deep sea area near Loihi, and have found good anti-microbial activity,' Truong said. 'Now we need to see if they are really novel and if they are some kind of proteins or just some chemicals.'

'From Tom's data, it looks like he has some strains from all the different habitats we've looked at,' Kathariou said. 'Some look better than others, some look very promising, but we don't yet know whether the antibiotics we're seeing are novel in terms of what other people have seen.' Kathariou said antibiotics research is also very active in other countries, especially Japan and Russia.

Ultimately the fate of antibiotics research depends on the pharmaceutical and chemical companies that pick up, develop

and market new drugs, Kathariou said. She added that in the event of a crisis the pharmaceutical industry often can be unprepared.

'The pharmaceutical companies don't want to invest money unless they really see a reason,'

Kathariou said. 'So as long as they have some antibiotics that work, they don't stop to think that they may not work in five or six years'.

'I think a more rational approach is to maintain a steady pace of discovery of these

organisms,' Kathariou said. 'Characterise organisms that are promising, and those that are promising can be taken further now or a few years down the road.'

(Source: *Makai*, Vol. 19, No.11, Nov. 97)



■ SEAFDEC DEVELOPS TECHNOLOGY FOR MUD CRAB CULTURE

Researchers of the SEAFDEC AQD Department in the Philippines have successfully spawned the mud crab in captivity and raised crab larvae to megalopa in the hatchery. The researchers have also reared the megalopa to crablets in nursery ponds, the first successful attempt in the history of mud crab culture.

Crabs are commercially important, commanding high prices in local and international markets. Of several crab species, the mud crab (*Scylla* sp.) holds the prime position in the market in terms of price because of its excellent meat quality and large size.

Mudcrab culture is an important source of income for coastal fisherfolk. Wild stocks are becoming scarce due to loss of brackishwater habitat from pollution and conversion of mangroves to fishponds.

Mudcrab research and development (R&D) efforts at SEAFDEC Aquaculture Department (AQD) date back to the late 1970s but took a back seat to tiger shrimp during the 1980s. Crab megalopa, a critical stage marked by the onset of cannibalism and sharp decline in survival, were produced in the AQD hatchery.

Research efforts were intensified in 1996 under a 3-year collaborative project partly funded by the Australian Centre for Interna-

tional Agricultural Research (ACIAR). This project focuses on all phases of mudcrab culture—broodstock, hatchery, nursery and pond grow-out.

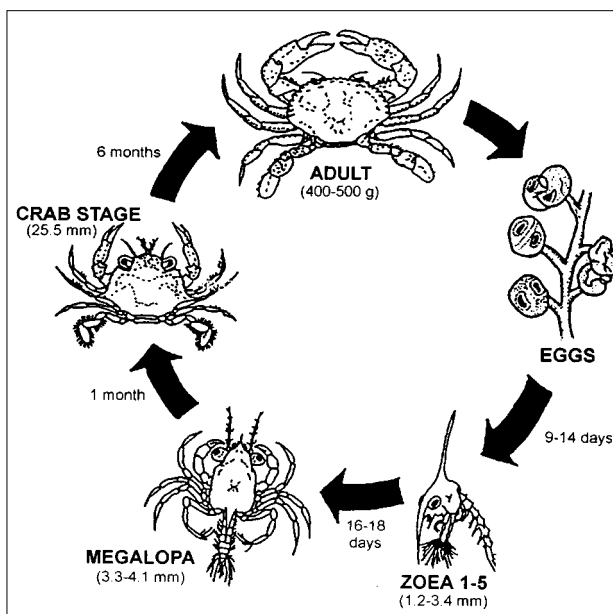
Significant progress has been achieved in all areas: **First**, The Aquaculture Department (AQD) has developed a suitable but inexpensive broodstock holding system and broodstock diet that promotes consistent spawning and production of good quality larvae. Female mudcrab can remature and spawn 2 to 3 times under this management scheme.

Second, mudcrab megalopa are now produced at the AQD hatchery using a SEAFDEC-for-

mulated micro-particulate diet combined with natural food and a water management scheme that involves water conditioning and salinity manipulation.

Third, AQD successfully reared megalopa in hapa nets in nursery ponds, with survival rates of 50 to 60 per cent and final weights of 4 to 5 grams in 30 days. Growth rates of megalopa were 100 times faster in ponds than in tanks. This experiment was carried out by AQD researchers at the Department of Agriculture's demonstration fish farm in Molo, Iloilo City.

Fourth, grow-out experiments conducted by AQD at the Molo



Life cycle of the mud crab *Scylla serrata*

farm confirmed the tremendous potential of mudcrab in aquaculture. Mudcrab, 5 to 10 grams, stocked at 0.5 to 1.5/m², with seaweed *Gracilaria* as shelter, reached weights of 440 grams (males) and 330 grams (females) in four months with a survival of 57 to 89 per cent.



Culture of all-male mudcrab gave higher profits and return on investment and lower production cost than culture of all-females. Mudcrab are now being cultured in net pens in mangrove areas in Banate, Iloilo; Buswant, Aklan and Palawan, Puerto Princesa to demonstrate the viability of environmentally-friendly farming systems.

Fifth, the completion of the mudcrab life cycle in capacity was achieved when pond-grown

females spawned in the hatchery and produced crablets that themselves matured and spawned after 6 months in ponds.

These achievements in mudcrab R & D contribute significantly to the development of mudcrab culture technology in Southeast Asia and provide benchmark information to interest crab farmers and entrepreneurs.

(Source: *SEAFDEC Newsletter* Vol. 21, No. 1, January–March 1998)



■ NEW RESEARCH FACILITY AT USP

The former site of an old aircraft hangar left over from the Second World War has been turned into a world-class marine research facility, thanks to Japan. A US\$ 15 million grant from the Japanese Government is transforming part of the old New Zealand Air Force base at Laucala Bay near Suva into a top-notch facility.

Expected to be in use by mid-March this year, the facility will turn the University of the South Pacific's current Marine Studies programme into one claimed to be unmatched by any other tropical developing country.

Programme co-ordinator and Director of the International Ocean Institute's Operational Centre Robin South says students and senior researchers from all over the world are already queuing to be part of the programme.

'... I received requests two or three times a week, every week of the year, from people who want to come here. A unique environment is being created, where Pacific Islands students can study the most important topic in the region', says South.

'The oceans are where their future lies. To my mind, it is the

most important thing the University is doing.'

The research centre is expected to stem the brain-drain from the region. 'A large percentage of the region's top students leave to study overseas and fail to return,' says South, who is also Professor of Marine Studies at the University.

'... We want them to do their research in their home country, so that they are not only doing their advanced training, they are also contributing to the needs of their own country,' says South. '[We'll] create a very talented cadre of well-trained people in our country who will be the leaders of the future in the marine area.' The new facility will not be used for undergraduate teaching alone. The inclusion of about US\$ 3.5 million worth of equipment means it will also be equipped to address the needs of marine research in the Pacific.

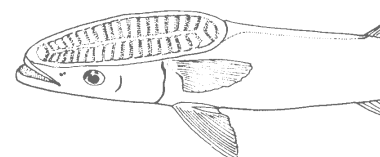
'You can't continuously rely on aid. The regional organisations are not that well endowed, or capable of responding to all the research needs of the region.'

The marine facility will include an administrative and teaching block; teaching; research and

preparation laboratories; a resource centre and library; motel-style accommodation for up to five visiting scientists; a recreational centre, restaurant and cafeteria; a dive shop; a workshop for servicing research vessels and boats; a large lecture theatre; and an elaborate communications network, including Internet satellite and state-of-the-art audio-visual systems.

Negotiations are also underway for an additional US\$ 5 million grant from Japan. South is optimistic about the outcome, which, if successful, will result in the building of a research vessel.

(Source: *Fiji's Business Magazine*, March 1998)



ASSESSMENT OF COMMERCIAL FISH RESOURCES IN THE LAGOON OF THE NORTHERN PROVINCE, NEW CALEDONIA

Background

The Northern Province of New Caledonia has in recent years been concerned with implementing rational and sustainable management of lagoon fish resources. In addition, the Province needs to be in a position to respond to various questions raised by fishermen.

These questions mainly concern exploitation levels for certain species or fishing areas, fisheries development and the use of new techniques. Available information and knowledge were, until now, too inadequate and incomplete for the Province to be able to respond.

This situation justified the implementation of an assessment of commercial lagoon fish resources. This study was carried out by ORSTOM (French Research Institute for Development in co-operation) at the request of the Northern Province, as part of the French Government/Northern Province Development Contract. It was completed in August 1997 after two-and-a-half years of work.

A major sampling operation was mounted by the team of four ORSTOM researchers and technicians from the Provincial Government. The work covered almost 300 species, which are, or are likely to become, of commercial interest. Of the 10 000 km² of lagoon in the Northern Province,

by Pierre Labrosse, Yves Letourneur and Michel Kulbicki
ORSTOM,
Noumea, New Caledonia

7 000 km² were surveyed. For practical reasons, the area was divided into three zones (see Figure 1): the Belep Islands (northern zone), the West Coast (west zone) and the East Coast (east zone). All biotopes were sampled with complementary techniques (reefs, lagoon bottoms, mangroves).

Over the 270 days of work, more than 1,800 underwater visual censuses (dives on the reef), 400 experimental fishing trips with hand-held lines on the reef edges, 210 longline deployments on the lagoon bottoms and 100 net deployments in the estuaries and mangroves were carried out.

From this point of view, this programme is a world-wide first. No sampling effort had ever previously been undertaken on a so great geographical scale and with different techniques in the tropical world.

It has made it possible to collect a very large amount of information concerning the structures of fish populations (diversity, abundance, biomass); species; individuals; and preferred locations, depending on their size and biology (reproduction periods, feeding habits, habitat, etc.).

A large proportion of these data can be consulted through the FISHEYE database accessible by Internet*.

Sampling techniques

Underwater visual census (UVC)

The underwater visual censuses were spread in such a way as to cover all reef geomorphologic types with a minimum sampling frequency of 6 dives for every 4 miles of reef (fringing and barrier reefs) and surveys on both the windward and leeward sides of the middle reefs. UVC's were mainly carried out on inner coral-reef slopes.

The populations were studied by the so-called 'line-transect' method (Buckland et al. 1993). At each site, a 50 m transect was laid out with a 50 m-long measuring tape. Two divers, one on either side of the transect, carried out visual surveys (Figure 2).

They noted all commercial fish seen. For each observation, they identified the species concerned, estimated the number of specimens (n), the size and the perpendicular distance (d) of the fish(es) from the transect.

Along each transect, the special characteristics of the surroundings were noted. In 10 m sections, each of the two divers estimated the relative percentage of each of the different kinds of substrate: i.e. mud, fine sand, coarse sand, debris, blocks, rock, coral heads (Table 1).

In the same way, the observer noted the cover rate of the substrate by living organisms (stringy algae, brown algae, green algae, alcyonarians, coral).

* <http://noumea.orstom.nc/BASE/FISHEYE/presentation.html> or 'presentation_en.html' (for the English language version)



Figure 1: Northern, western and eastern zones of the Northern Province of New Caledonia

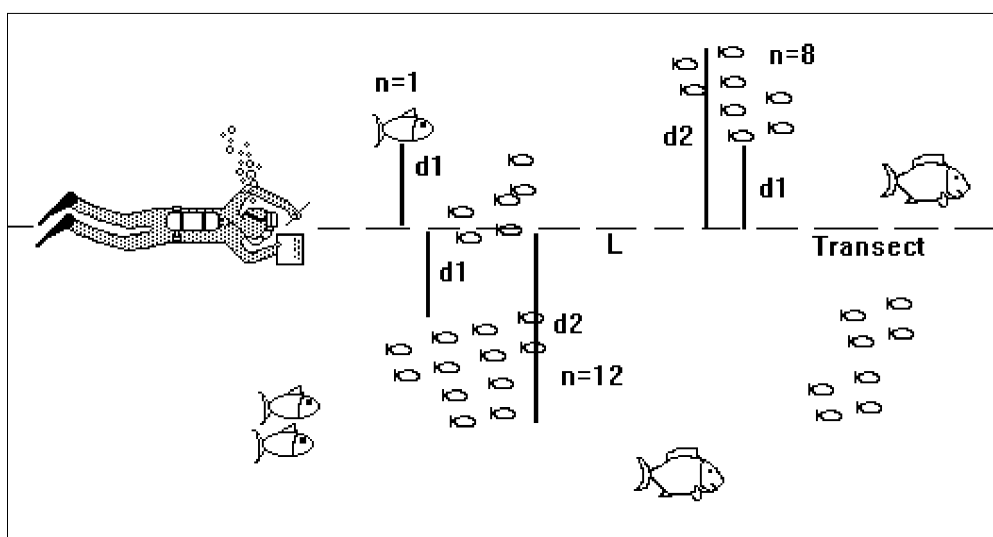


Figure 2: UVC (L = length of transect, d1 = distance from the fish to the transect, n = number of fish)

Fishing experiments using handlines

Handline fishing experiments were spread over the sea-floor, at depths of 3 to 20 m, near the barrier, fringing and middle reefs. Wherever possible, these fishing experiments took place on sites

next to those sampled by diving, in order to be able to reveal any possible correlation between fishing and diving. In general, fishing experiments were carried out every 2 to 3 nautical miles.

At each site, there was a boat with two fishermen. Each of

them had a hand-line rigged as shown in Figure 3; the line was baited with squid. Fishing began half an hour after the official sunset time and lasted two hours. Every half an hour, the boat was moved about 100 m around the station marker. This procedure made it possible to

Table 1: Granulometric scale used during surveys

Name	Description
Mud	Particles < 0.063 mm in size
Fine sand	Particles 0.063 to 0.25 mm in size
Coarse sand	Particles 0.25 mm to 2 mm in size
Gravel	Particles 2 mm to 1 cm in diameter
Debris	1 to 5 cm in diameter
Small blocks	5 to 30 cm in diameter
Big blocks	30 to 100 cm in diameter
Rock	Rock of organic or non-organic origin
Coral head	Coral head more than 1 m in diameter
Slab	Hardened horizontal layer

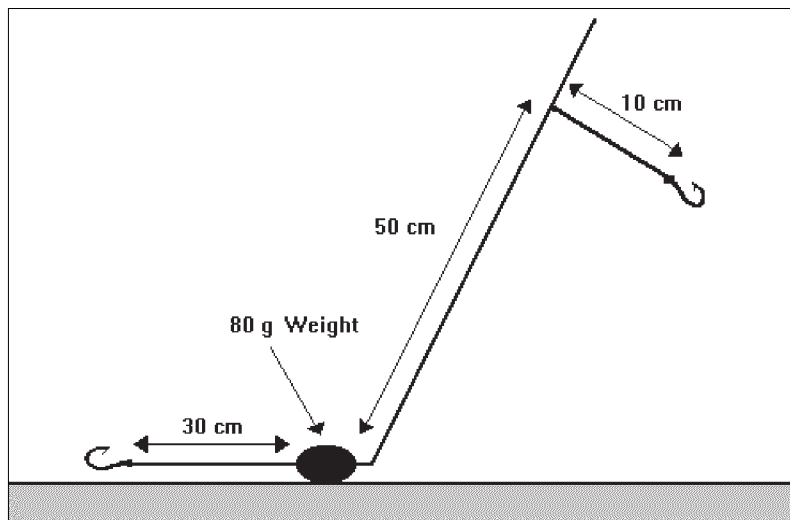


Figure 3: Handline rig for fishing experiments

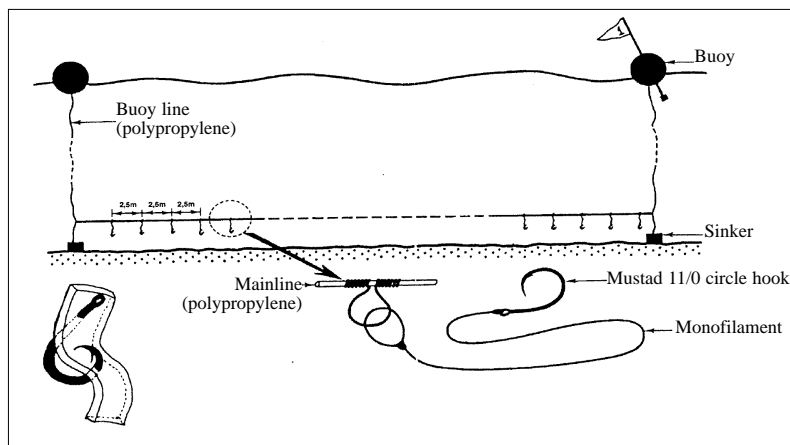


Figure 4: Longline rig for fishing experiments

limit the variability of results caused by the very heterogeneous nature of the surroundings.

Longline fishing experiments

These were spread over the lagoon floor using a sampling grid with a spacing of 3 nautical miles. About 30 visual censuses were carried out using longlines (transect length 250 m) according to the method described above, with only the carnivorous species being recorded.

A longline consists of a mainline made of polypropylene 250 m long. On this line, 100 snoods were spaced 2.5 m apart and equipped with a Mustad 11/0 circle hook baited with squid. Either end of the cord was weighted with ballast and attached to the surface buoy by a rope (Figure 4).

At each site, two longlines were set parallel (i.e. 200 hooks) with a spacing between the two longlines of about 80–100 m. Fishing lasted about two hours (not including setting and reeling in).

Fishing trials with gillnets

Gillnet fishing was carried out at the edges of the mangroves and estuary regions. Each site was sampled with two types of net (large and small mesh).

Each net was 50 m long and 1.5 m high. Mesh sizes were 47 mm (small) and 57 mm (large). At each site, 4 nets (a total of 200 linear metres) were set perpendicular to the edge of the mangrove or the coastline.

They were spaced every 100 m approximately, alternating small and large mesh sizes. They were set at high tide and caught fish at low tide for about four to six hours.

Population structure

The average density figures for fish from the coral reefs of the East Coast lagoon and the Belep Islands were equivalent and slightly higher than those from the West Coast (Table 2).

On the other hand, biomasses in the Belep area were among the highest recorded in the Indo-Pacific region. They were twice those on the East Coast and a third higher than those on

the West Coast. This means that average specimen weights for fish in the East and West Coast lagoons were less than those in the Belep Islands, especially for long-lived species. In general, the biomass figures obtained were relatively high in comparison to data and literature (Table 2).

Study of the demographic structure shows that long-lived species accounted for a large proportion of total biomass,

particularly in the Belep area. Analysis of size structures confirms the differences observed between the northern, eastern and western areas for these fish.

Given population characteristics, and negligible fishing pressure, stocks of bottom fish of commercial interest in the Belep zone could be considered untouched. By contrast, those in the East and West Coast lagoons show the characteristics of stocks under exploitation.

Table 2: Assessment of densities (spec/m²) and biomass (g/m²) for fish in some Indo-Pacific reefs. The figures concern all species, unless otherwise stated.

Location	Surroundings	Density	Biomass	Source
East Coast lagoon, Northern Province, New Caledonia	Barrier + fringing +middle	0.48 ⁽¹⁾	158 ⁽¹⁾	Letourneur et al., 1997
West Coast lagoon, Northern Province, New Caledonia	Barrier + fringing +middle	0.62 ⁽¹⁾	258 ⁽¹⁾	Labrosse et al., 1997
Northern lagoon, Northern Province, New Caledonia	Fringing +middle	0.54 ⁽¹⁾	339 ⁽¹⁾	Labrosse et al., 1996
Hawaii	Fringing	3.1	106	Brock et al., 1979
Hawaii	Coral heads	2.6	102	Wass, 1967
Chesterfield, New Caledonia	Fringing	2.0–3.2	37–43	Kulbicki et al., 1990
Australia	Fringing	7.0	92	Williams and Hatcher, 1983
Australia	Outer reef	3.2	156	Williams and Hatcher, 1983
Mayotte	Barrierreef	3.7	202 ⁽¹⁾	Letourneur, 1996
La Réunion Island	Coral slope	3.0	161	Letourneur, in prep.
La Réunion Island	Isolated coral	1.1	34	Letourneur, in prep.
New Caledonia	Barrier	3.4	244	Kulbicki et al., 1991
New Caledonia	Middle	3.4	301	Kulbicki et al., 1991
Aboré (Noumea), New Caledonia	Barrier	7.9	253	Kulbicki et al., 1995
Aboré (Noumea), New Caledonia	Barrier	0.7 ⁽¹⁾	182 ⁽¹⁾	Kulbicki et al., 1995
Ouvea, New Caledonia	Barrier	3.70	260	Kulbicki et al., 1994
Ouvea, New Caledonia	Barrier	0.5 ⁽¹⁾	187 ⁽¹⁾	Kulbicki et al., 1994

⁽¹⁾ commercial species only

Yields for the fishing trials carried out on other biotopes corroborate these results (Tables 3 and 4). In the Belep Islands, the figures observed for handline fishing were among the highest in the Indo-Pacific region, while those from East and West Coast lagoons were comparable with those from areas under exploitation.

Status of total stock

Total stock was estimated at 138 000 tonnes of commercial bottom-dwelling fish over all the biotopes studied, except for the estuaries and mangroves for which an estimate was not possible. It is interesting to note that half of this total stock is

located in the Belep Islands region (Figure 5).

The rest is divided between the East and West Coasts. In general, a little less than half of the total stock is located on the reefs (principally on the barrier reefs), with the other half on the lagoon floor (Figure 5). This latter part is difficult to exploit and can be considered as a biomass reserve for the resource, especially for lethriniidae (emperors and breams).

More than two-thirds of the total stock (about 70 per cent) is formed of six families of fish which can be classified into two groups.

'Line-caught fish' included the Serranidae (cod and trout), Lutjanidae (snapper) and the Lethrinidae (emperor and bream) which made up slightly less than 50 per cent of the total stock. About half of this group was located on the lagoon floor.

Where 'browsing fish' are concerned, the Acanthuridae (clown fish), Scaridae (parrot fish) and the Siganidae (rabbit fish) make up about 25 per cent of the total stock.

They were almost always concentrated on the coral reef where they made up 75 per cent of the commercial fish resource.

Table 3: Yields observed for handline fishing in the tropical reef setting (yields are shown in kg/hour/fishermen)

Location	Yields	Source
East Coast lagoon, Northern Province	1.70	Letourneur et al., 1997
West Coast lagoon, Northern Province	1.55	Labrosse et al., 1996
Northern lagoon, Northern Province	6.80	Labrosse et al., 1996
Ouvea	6.90	Kulbicki et al., 1994
South West lagoon, New Caledonia	10.00	Loubens, 1978
South West lagoon, New Caledonia	2.60	Kulbicki et al., 1987
Chuuk	2.30	Diplock and Dalzell, 1991
Guam (lagoon)	0.90	Hosmer and Kami, 1980
Guam (lagoon)	1.50	Molina, 1982
Nauru	5.80	Dalzell, unpublished
Norfolk	13.60	Grant, 1981
Palau (reef)	3.49	Anon, 1990, 1991
PNG (exploited lagoon)	1.20	Wright & Richard, 1985
PNG (untouched lagoon)	3.90	Wright & Richard, 1985
PNG (Port Moresby)	2.50	Lock, 1986
Samoa (lagoon)	0.90	Wass, 1982
Yap	1.70	Anon., 1987
North West Australia	15.60	Stehouwer, 1981
American Samoa	0.54	Sauceman, 1994
Tuvalu (Funafuti)	2.35	Patiale and Dalzell, 1990
Wallis	1.30	Taumaia and Cusack, 1988
Tonga	0.44	Munro, 1990
Guam	0.55	Katnick, 1982
Caribbean (10 to 20 m)	1.70	Munro, 1983
Caribbean (20 to 30 m)	1.60	Munro, 1983
Caribbean (30 to 40 m)	2.60	Munro, 1983
Caribbean (40 to 60 m)	1.10	Munro, 1983

Table 4: Yields observed from longline fishing in tropical areas. Yields are shown in kg/100 hooks.

Location	Depth and type of zone	Average weight (kg)	Yield (kg/100 hooks)	Source
East Coast lagoon, Northern Province	20–50 m, lagoon floor	1.6	9.80	Letourneur et al., 1997
West Coast lagoon, Northern Province	20–40 m, lagoon floor	2.1	8.80	Labrosse et al., 1997
South West lagoon, New Caledonia	5–70 m, lagoon floor	1.6	7.50	Kulbicki et al., 1987
Maldives, Shaviyani Atoll	Atoll	–	16.70	Anderson et al., 1991
Maldives, Alifu Atoll	Atoll	–	24.00	Anderson et al., 1991
Maldives, Laamu Atoll	Atoll	–	9.80	Anderson et al., 1991
Maldives, N. Malé	Atoll	–	20.00	Anderson et al., 1991
Sri Lanka	10–180 m, reef flat	2.6	5.90	Anon., 1982
Vanuatu	120–440 m, outer reef slope	3.9	39.50	Brouard and Grandperrin, 1984
Kenya	200 m, continental shelf	–	23.00	Anon., 1979
Caribbean	32–450 m, fringing reefs	2.2	8.30	Kawaguchi, 1974
Caribbean (commercial trial)	30–300 m, fringing reefs	–	3.00	Kawaguchi, 1974
Guyana and Surinam	160–400 m, continental shelf	6.0	22.70	Wolf and Ratjen, 1974
Gulf of Mexico	50–550 m, continental reef flat	–	15.00	Nelson and Carpentier, 1968
New Caledonia	100–500 m, outer reef slope	–	24.00	Grandperrin, pers. Comm.
Hawaii	200–500 m, seamounts	4.5	30.30	Anon., 1984

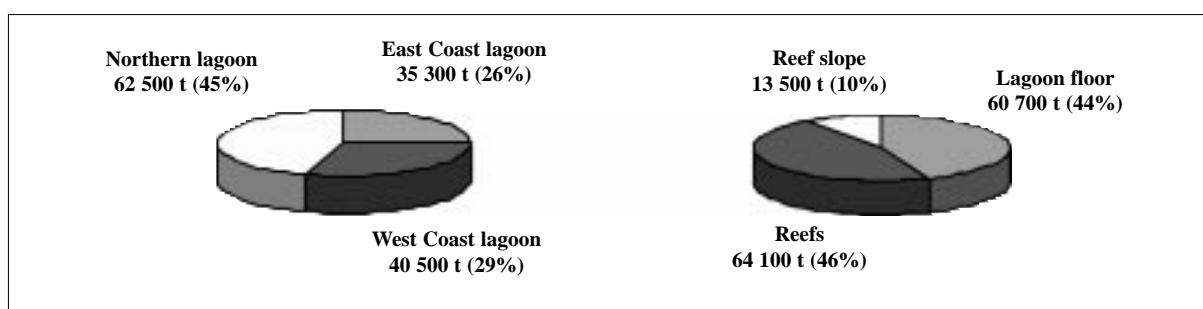


Figure 5: Distribution of total stocks by geographical area and biotope.
Stock figures are given in metric tonnes.

Fishing pressure and exploitable stocks

Assessment of the quantity of fish which can be exploited without danger to the resources and the lagoons of the East and West Coast must include fishing mortality, in contrast with the Belep Islands where the stocks are considered untouched. At the beginning of the study, the only data about lagoon fishing related solely to the activities of a few commercial fishermen. Subsistence fishing catches had never been calculated.

On the basis of statements by commercial fishermen, and subsistence quantities estimated from a study of household con-

sumption budgets carried out by the ITSEE (Institute of Statistics and Economic Research) in 1991 (28.6 kg/inhabitant in the Northern Province), fishing pressure was assessed in the various areas and geographical sectors studied (Labrosse et al., 1996).

In 1996, catch amounts in the Northern Province were estimated at 1 330 t. It is important to note that subsistence fishing accounts for 90% of this total (Figure 6), i.e. almost all catches. It is higher on the East Coast. The foreseeable growth of the amount of fish caught seems, for the moment, to be mainly determined by subsistence fishing, and consequently, by the demography of the fish populations.

Catches in the Belep Islands represent 0.003% of the total estimated stock in this area. The same calculations made for the West and East Coasts yield figures of 0.3 and 0.1% respectively, that is to say 100 and 300 times higher than in the Northern area. These exploitation percentages for the resource remain low overall.

A significant relationship between total stocks and fishing pressure, as estimated in the various Northern Province locations, shows that catches are higher in certain habitats and for certain species.

Therefore, on the East and West Coasts, handlined fish are sub-

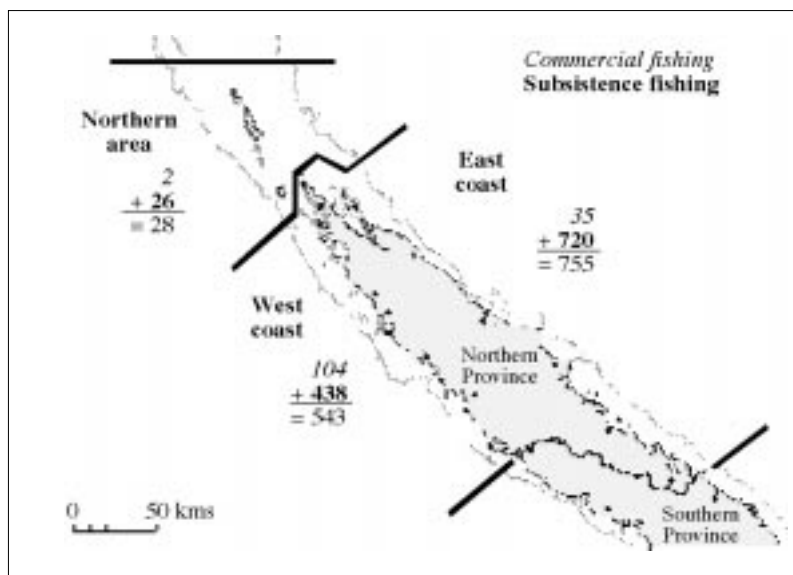


Figure 6: Distribution of commercial and subsistence fishing catches in the Northern Province in the various zones studied in 1996. Catch figures are given in metric tonnes.

ject to higher fishing pressure which mainly occurs on and around the reefs.

All of these results confirm that fishing has an effect on the populations of the West and East Coasts.

Fishing pressure and the biological characteristics of each species (e.g. growth, mortality) have made it possible to estimate than 13 000 t per annum could currently be caught without endangering the resources in all of the lagoons in the

Northern Province, i.e. about 10% of the total stock. These resources mainly consist of, in order of importance, Lethrinidae (emperors and breams), Acanthuridae (clown fish), Scaridae (parrot fish), Serranidae (cods), Lutjanidae (snappers), and Siganidae (rabbit fish). For each one of these families, the maximum sustained catch also represents about 10% of the estimated total stock.

When considering overall fishing pressure, stocks seem far from being threatened, and it is possible to significantly increase fishing effort. However, it must be considered that, on a smaller geographical scale, some specific reef habitats and geographical locations (Figure 7) already sustain a significant amount of fishing activity.

In some cases, the exploitation limit seems to have already been reached, and even exceeded, as in Koné (Figure 5). However, it must be understood that fishing pressure takes into

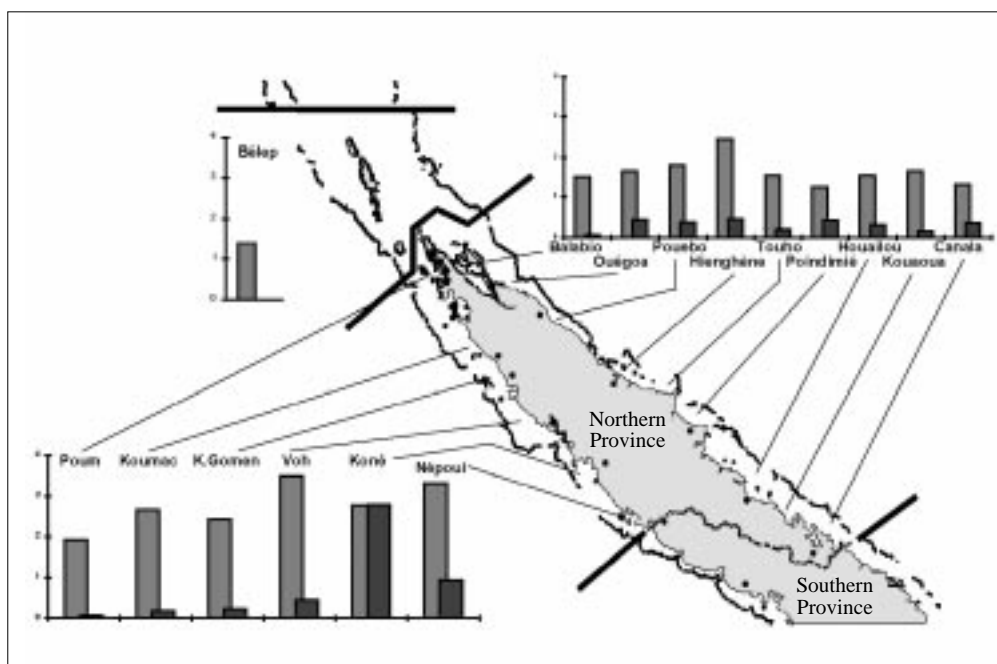


Figure 7: Comparison of fishing pressure and exploitable stocks in 1996 in the various geographical locations studied. Fishing pressure (in dark grey) and exploitable stocks (in light grey) are given in metric tonnes per km².

account all species, including those from estuaries and mangroves, which have not been subject to a stock assessment.

Recommendations and prospects

Some recommendations can be made, based on the data collected in this study. They also take into consideration projections that fishing pressure in the lagoon will double over the next ten years in the Northern Province. They target sustainable management of this resource, whose importance is vital for the people of the Northern Province.

Firstly, the system for assessing fishing activities in the Northern Province should be modified. Until now, it has only been based on the declarations made by local commercial fishermen, whose activity remains marginal. This is likely to have led to an under-assessment of catches for this activity. This assessment needs to be made more precise. Also, given their demonstrated importance, subsistence fishing catches must be assessed.

Secondly, the study which has just been completed is in some ways 'a snapshot' of the population of fish at a given moment in time. A plan to monitor the stock over time needs to be made, especially in areas most sensitive to fishing pressure, in order to study longer-term trends.

A joint analysis of fishing pressure and standing stocks would allow monitoring of exploitation levels of populations and their probable impacts on the resource. This should help prepare for the possible implementation of management measures aimed at preservation of the resource, especially if new fisheries are to be started.

From now on, it would seem advisable to re-direct part of the fishing effort towards groups of species (rabbit fish, parrot fish, etc.) and biotopes (lagoon floors especially) which are less exploited. This could be done by using different fishing techniques (fish corrals, traps). Also, this would allow lagoon fisheries to expand into new potential markets, such as those for live fish and aquarium species.

These additional aspects are part of a supplementary study which began in October 1997 and will last six months. It is principally designed to define and implement monitoring methods for fishing pressure and populations, and transfer these methods to the Province's technical services.

To help with this supplementary study, a survey of fish consumption is being carried out and will be repeated at regular intervals. It will record the amounts and main species caught for subsistence fishing. It will also contribute to clarifying exploitable stock figures. In addition, fishermen's landed catches will be recorded on a routine basis, in order to determine the quantities and qualities of fish caught.

The planned population monitoring work only concerns those coral reefs (barrier, middle and fringing) which are the most subject and sensitive to exploitation. In order to be able to make comparisons with the sites already surveyed, a single sampling method has been chosen.

This involves UVC work through diving using the transect method, which has the advantage of being a proven technique. This will make it possible to quantify the changes in populations and correlate these data with fishing pressure. It will be carried out once

a year in four geographic sectors, Koumac and Koné on the West Coast, Hienghène and Poindimié on the East Coast.

Finally, diversification of fishing techniques will be investigated, to see if they are technically and economically viable.

At the end of the study, the Northern Province will have the basic skills and information needed to formulate and implement a policy for the sustainable and balanced development of lagoon fishing resources and their exploitation.

The diversity of lagoon environments and the species that live there, and the local socio-economic characteristics of the people (especially social structure), justify the identification of homogenous units (such as villages, districts, communes).

Inhabitants of these units will be educated about taking responsibility for the management of their own units. On the basis of biological, ecological and technical data from current and future work, fishery officers will be able to guide them more efficiently in the research of rational solutions appropriate to their environmental context.

Bibliography

- ANDERSON, R.C., Z. WAHEED, M. RASHEED & A. ARIF. (1991). Reef fish resources survey in the Maldives - Phase II. Technical Report MOFA. 59 p.
- ANON. (1982). Further fishing trials with bottom set longlines in Sri Lanka. Technical report FAO-BOBP, 16, 25 p.
- ANON. (1984). Bottom longline tested as sampling gear. Technical Report, SW Fisheries Center Monthly Report, 4 p.

- ANON. (1987). A survey of village fishermen. Marine Resources Management Division, Yap State Dept Resources and Development. 66 p.
- ANON. (1990). Annual Report, Division of Marine Resources, Ministry of Resources & Development, Palau. 40 p.
- ANON. (1991). Annual Report, Division of Marine Resources, Ministry of Resources & Development, Palau. 66 p.
- BROCK, R.E., C. LEWIS & R.C. WASS. (1979). Stability and structure of a fish community on a coral patch reef. *Mar. Biol.* 54:281-292.
- BROUARD, F. & R. GRANDPERRIN. (1984). Les poissons profonds de la pente récifale externe à Vanuatu. Notes et Doc. Orstom-Port Vila. II: 131 p.
- BUCKLAND, S.T., D.R. ANDERSON, K.P. BURNHAM & J.L. LAAKE. (1993). Distance sampling. Estimating abundance of biological populations. Chapman & Hall, London. 446 p.
- DIPLOCK, J.H. & P. DALZELL. (1991). Summary of the results from the NCFE-OFCE survey of the deep slope fishery resources of the outer banks and sea mounts in the Federated States of Micronesia. South Pacific Commission Inshore Fisheries Research Project. 22 p.
- GRANT, C. (1981). High catch rates in Norfolk Island dropline fishery. *Australian Fisheries.* 3:10-13.
- HOSMER, A. & H. KAMI. (1980). PETF sea mount groundfish development project. Guam Dept of Agriculture Report. 51-88.
- ITSEE. (1993). Budget consommation des ménages 1991, principaux résultats. Vol. 1. 200 p.
- KATNIK, S.E. (1982). Effects of fishing pressure on the reef flat fisheries of Guam. M.Sc. Thesis, University of Guam. 62 p.
- KAWAGUCHI, K. (1974). Handline and longline fishing explorations for snappers and related species in the Caribbean and adjacent waters. In: *Exploratory Fishing in the Caribbean Marine Fisheries.* 9(36).
- KULBICKI, M., G. MOU THAM, G. BARGIBANT, J.L. MENOU & P. TIRARD. (1987). Résultats préliminaires des pêches expérimentales à la palangre dans le lagon sud-ouest de la Nouvelle-Calédonie. *Rapport Sci. Tech. Biol. Mar. ORSTOM Nouméa.* 49, 104 p.
- KULBICKI, M., P. DOHERTY, J.E. RANDALL, G. BARGIBANT, J.L. MENOU, G. MOU THAM & P. TIRARD. (1990). La campagne Corail 1 du N/O *Coriolis* aux îles Chesterfield (du 15 août au 4 septembre 1988): données préliminaires sur les peuplements ichtyologiques. *Rapport Sci. Tech. Biol. Mar. ORSTOM Nouméa.* 57, 88 p.
- KULBICKI, M., G. MOU THAM, J.E. RANDALL & J. RIVATON. (1991). Suivi mensuel des peuplements ichtyologiques des récifs coralliens dans le lagon sud-ouest de Nouvelle-Calédonie. *Rapport Sci. Tech. ORSTOM Nouméa.* 61p.
- KULBICKI, M., G. MOU THAM, G. BARGIBANT & J.L. MENOU. (in prep). Les peuplements de poissons récifaux et lagunaires du lagon SW de Nouvelle-Calédonie. *Rapport Sci. Tech. Biol. Mar. ORSTOM Nouméa.*
- KULBICKI, M., G. BARGIBANT, J.L. MENOU, G. MOU THAM, P. THOLLOT, L. WANTIEZ & J. WILLIAMS. (1994). Evaluation des ressources en poissons du lagon d'Ouvéa. 3ème partie: les poissons. *Rapport Conv. Sci. Mer Biol. Mar. ORSTOM Nouméa.* 448 p.
- KULBICKI, M., R. GALZIN, Y. LETOURNEUR, G. MOU THAM, P. THOLLOT, L. WANTIEZ, S. SARRAMÉGNA & C. CHAUVET. (1996). Les peuplements de poissons de la réserve marine du récif Aboré (Nouvelle-Calédonie): composition spécifique, structures trophiques et démographiques avant l'ouverture à la pêche. *Doc. Sci. Tech. ORSTOM Nouméa.* 210 p.
- LABROSSE, P., Y. LETOURNEUR, N. AUDRAN, P. BOBLIN & M. KULBICKI. (1996). Evaluation des ressources en poissons démersaux commerciaux des lagons de la Province Nord de la Nouvelle-Calédonie. Résultats des campagnes d'échantillonnages de la zone nord. *Rapport Conv. Sci. Mer, Biol. Mar. ORSTOM Nouméa.* 118 p.
- LABROSSE, P., Y. LETOURNEUR, N. AUDRAN, P. BOBLIN, P. MALESTROIT, J.R. PADDON & M. KULBICKI. (1997a). Evaluation des ressources en poissons démersaux commerciaux des lagons de la Province Nord de la Nouvelle-Calédonie. Résultats des campagnes d'échantillonnages de la zone ouest. *Rapport Conv. Sci. Mer, Biol. Mar. ORSTOM Nouméa.* 110 p.
- LABROSSE, P., Y. LETOURNEUR, J.R. PADDON & M. KULBICKI. (1997b). Incidences de la pression de pêche sur les stocks de poissons démersaux commerciaux du lagon ouest de la Province Nord. *Rapport Conv. Sci. Mer, Biol. Mar. ORSTOM Nouméa.* 15 p.

- LETOURNEUR, Y. (1996). Réponses des peuplements et populations de poissons aux réserves marines. Le cas de l'île de Mayotte, Océan Indien occidental. *Ecoscience*. 3:442-450.
- LETOURNEUR, Y., P. LABROSSE, N. AUDRAN, P. BOBLIN, J.R. PADDON & M. KULBICKI. (1997). Evaluation des ressources en poissons démersaux commerciaux des lagons de la Province Nord de la Nouvelle-Calédonie. Résultats des campagnes d'échantillonnages de la zone est. *Rapport Conv. Sci. Mer, Biol. Mar.* ORSTOM Nouméa. 130 p.
- LOCK, J.M. (1986). Fish yields of the Port Moresby barrier and fringing reefs. Technical report 86/2, Dept of Primary Industry of Papua New Guinea. 17 p.
- LOUBENS, G. (1978). La pêche dans le lagon néo-calédonien. *Rapport Sci. Tech. Sci. Mer* ORSTOM Nouméa 1. 52 p.
- MUNRO, J.L. (1983). Caribbean coral reef resources. *ICLARM Studies and review* 7. 276 p.
- NELSON, W. & J. CARPENTIER. (1968). Bottom longline exploration in the Gulf of Mexico. *Comm. Fish. Rev.* 30:57-62.
- PATIALE, H. & P. DALZELL. (1990). Preliminary account and analysis of the Government small-scale fishing fleet on Funafuti Atoll, Tuvalu. Inshore Fisheries Research Project. South Pacific Commission, Noumea, New Caledonia. 25 p.
- SAUCERMAN, S. (1994). The inshore fishery of American Samoa, 1991-1993. Department of Marine and Wildlife Resources, Biological Report. 35 p.
- SMITH, A. & P. DALZELL. (1991). Fishery resources and management investigations in Woleai Atoll, Yap State, Federated States of Micronesia. South Pacific Commission Inshore Fish. Project. 88 p.
- STEHOUWER, P.J. (1981). Report on a dropline fishing operation. Northern Territory Dept of Primary Production, Australia. *Fishery Report* 6. 28 p.
- TAUMAIA, P. & P. CUSACK. (1990). Deep Sea Fisheries Development Project. Report on second visit to Tokelau (13/8 to 22/12/86). South Pacific Commission Report, Noumea. 29 p.
- WASS, R.C. (1967). Removal and repopulation of fishes of an isolated coral reef in Kaneohe Bay, Oahu, Hawaii. M.Sc. Thesis. Univ. Hawaii.
- WASS, R.C. (1982). The shoreline fishery of American Samoa: past and present. In: *Ecological Aspects of Coastal Zone Management*. Proc. Mar. Coastal processes in the Pacific, Motopure Island, PNG. UNESCO-ROSTEA, Jakarta. 51-83.
- WILLIAMS, D.MCB. & A. HATCHER. (1983). Structure of fish communities on outer slopes of inshore, mid-shelf and outer shelf reefs of the Great Barrier Reef. *Mar. Ecol. Prog. Ser.* 10:239-250.
- WOLF, R. & F. RATJEN. (1974). Exploratory fishing activities of the UNDP/FAO Caribbean fishery development project, 1965-1971: a summary. *Marine Fisheries* 36:1-8.
- WRIGHT, A. & A.H. RICHARDS (1985). A multispecies fishery associated with coral reefs in the Tigak Islands, Papua New Guinea. *Asian Mar. Biol.* 2:69-84.



SPC MASTERFISHERMAN VISITS TWO SKIPPERS WORKING FOR SOLOMON TAIYO'S POLE AND LINE FISHING FLEET

As a follow-up to the regional course on vessel operation management and electronic aids for Pacific Island National skippers held at the New Zealand School of Fisheries in Nelson in February 1998, I went to the Solomon Islands to visit skippers Samuel Sautei and Timothy Sosimo.

The purpose of the visit was to assist the skippers in the operation of their fishing vessels, if such assistance was required, and to assess their abilities in managing the operation of their vessels. Both skippers are fishing masters who have worked on pole and line fishing vessels in the Solomon Islands for over 10 years.

Their employer, Solomon Taiyo Ltd, has its main administrative office in Honiara while the fishing fleet and tuna processing operations are based in Noro, New Georgia. Noro is a small village that has basically grown around the fishing operations of Solomon Taiyo.

Noro's port is ideally located in a deep, protected harbour which provides access to a number of bait fishing grounds and abundant offshore tuna resources. The company has been operating in the Solomon Islands for over 25 years.

At present, there are 21 pole and line fishing vessels in the fleet, and one purse seiner with two carrier vessels which service the purse seiner, transporting catches to the cannery.

*by Peter Watt,
Secretariat of the Pacific
Community,
Noumea, New Caledonia*

Solomon Taiyo Ltd is a joint venture between a Japanese company, Maruha Corp, and the Solomon Islands Government. Maruha Corporation owns 49 per cent of the company, while the Solomon Islands Government owns a majority share of 51 per cent. The company employs over 2 000 nationals, and is the second largest employer in the country next to the government.

Operation Manager, Masao Nakada, said that Sam and Timothy were the best local fishing masters working in their pole and line fishing fleet. This was the reason they were selected to attend the course in Nelson. On the 21 pole and line fishing vessels there are 15 Japanese and 6 local fishing masters.

In Japanese fishing operations a fishing master is the top man on the boat. A licensed captain must train under a fishing master for years before he is thought to be qualified enough to command a fishing vessel. Both Sam and Timothy were captains for three years before the company managers felt they were experienced enough to become fishing masters.

Every Solomon Taiyo pole and line vessel has both a fishing master and a captain. Within

the company's fleet there are 6 pole and line vessels totally crewed with Solomon Islanders. In total there are less than 30 foreigners working as either fishing masters, captains or mechanics on the 21 pole and line vessels.

Over 95 per cent of the local crew working in the fleet are between the ages of 18 and 35. It is quite remarkable when you realise that Sam and Timothy are only 29 years-old, and yet they manage 25 to 30 m pole and line vessels with 30 to 40 crewmen. The crew of the fleet are comprised of men from every island in the country.

Mr Nakada said that the company tries to mix up the crew with equal numbers of men from each island group. This tends to reduce tension aboard the vessels, as in the past problems arose when men from one island group outnumbered men from other islands.

The crews on the pole and line vessels work for a period of 10 months without a break. Although this sounds like an incredibly long period of time to work with no holidays, the crew do get a chance to relax and get off the fishing vessel when they are anchored on bait grounds near islands with small villages.

Often the crew get a chance to play football or watch a video onshore before returning to the vessel at dusk to prepare for bait fishing.

When the vessels return to Noro with their catch, the crew offload the tuna, refuel and provision the vessel with food, ice if needed and fresh water, then return to sea in three to four hours. Unbelievable!!! This has to be one of the quickest turnaround periods in the Pacific region.

Solomon Taiyo's pole and line vessels vary in length from 24 to 35 m. Some of the vessels are equipped with refrigerated sea water (RSW) tanks, while the others either have ice-making machines or carry crushed ice in insulated fish holds.

Sam's vessel, *Soltai 3*, is one of six pole and line vessels equipped with a bird radar that has a maximum range of 120 nm and is capable of identifying flocks of birds flying over schools of tuna 70 miles away.

Each pole and line vessel has between 3 and 6 live bait tanks which can hold approximately 50 buckets of bait in each tank. Each bucket holds approximately 2 kg of bait.

Ideally, 150 to 200 buckets of bait are caught before each fishing trip. Solomon Taiyo has contractual agreements with local reef owners for over 100 bait fishing grounds. Three to four bait boats accompany each pole and line vessel.

These boats are powered by small diesel engines and are equipped with a generator to operate high wattage lights which are submerged under the water to attract bait fish.

The average catch per pole and line vessel is 70 t of tuna a month, of which 90 per cent are skipjack. Each fishing trip is usually between 3 to 5 days, but when catches are really good, the fish holds can be filled with 30 t or more in one day.

Last year, Sam had a total catch of 1 525 t of tuna while Timothy caught over 900 t. Timothy had lower catches due to having a

smaller vessel with fewer crew and no bird radar.

The fleet of pole and line vessels catch an average of between 1 500–2 000 t of tuna a month, while the purse seine vessel averages 700–1 000 t a month.

With an annual average of over 35 000 t of tuna landed in Noro, the on-shore workers processing the tuna often have to work overtime to keep up with the supply.

Tuna caught by the company's fishing fleet is either canned, frozen or smoked at the Noro facility. The cannery processes 55–65 t of raw tuna a day.

Approximately 1.3 million cases of canned tuna are produced annually. Each case contains 48 tins with 200 grams of tuna meat in each can. At present, it takes 19 kilos of whole raw tuna to produce one case of canned meat (9.6 kg of processed flesh).

Solomon Taiyo is working hard to increase the cannery's production line efficiency and reduce waste. In Thailand, most tuna canneries use only 16 kilos of whole raw tuna to produce one case.

A production specialist from Mar Fishing Company in the Philippines is being recruited to train employees in more effective production line techniques to reduce waste. Waste from the cannery is processed into fish meal and sold locally or exported.

Company manager Hiroshi Nishi stated that Solomon Taiyo exported 530 000 cases of canned tuna annually to the United Kingdom. Canned tuna is also

exported to other Pacific Island countries and Japan.

A smoked tuna facility processes over 40 t of whole raw tuna daily, and most of the product is exported to Japan. In the past, 2 000–3 000 t of frozen tuna was exported to Thailand every three months. The frozen tuna was sent to be processed at a sister cannery owned by Maruha Corp in Thailand. Presently, the demand for frozen tuna from the Solomon Islands has declined, so shipments have become irregular.

The company provides housing for Sam and Timothy's families in Noro. Housing is supplied for all foreign employees, fishing masters and the first class engineers on the vessels. The other local crew live aboard the fishing vessels, and their families usually remain in the villages of their home islands.

Crews working on the vessels with national fishing masters and captains receive a monthly salary based on their duties and a bonus for every tonne of tuna landed. National fishing masters like Sam and Timothy would receive a base salary of SD\$ 2 000 a month plus a bonus of SD\$ 12 a ton, while a deck hand would receive SD\$ 500 a month plus SD\$ 4 bonus per tonne. When the fishing is good, Sam and Timothy earn over SD\$ 3 000 a month.

On vessels with Japanese fishing masters and captains, the crews only receive a bonus after the first 70 t of tuna is landed each month. The reason for the difference in bonus schemes is the company compensates the crews on the nationally operated vessels as the catch rates on



the non-national operated vessels are generally higher due to the Japanese fishing masters and captains having more experience.

Every pole and line vessel is required to report daily to the Noro base at 10:00 a.m., the position of the bait grounds fished the previous night, the number of times the bait nets were hauled, the number of buckets of bait caught, the position of the area where tuna were caught and an estimate of the number of tons landed.

Sam and Timothy record this information on a log sheet provided by the company to assist them in determining where to fish. The combined information from all the pole and line vessels indicates where the tunas are feeding and a smart fishing master can determine the direction the tuna are moving by analysing the daily reports.

Often the pole and line vessels focus their fishing activities around Fish Aggregating Devices (see Figure 1) which are deployed by Solomon Taiyo.

Over 100 FADs are deployed offshore from the islands, some as far as 20 miles or more from

the exterior reefs. The FAD design is similar to the Philippine payao, with a bamboo raft attached to a Styrofoam buoy for a flotation device, 3-strand polypropylene mooring rope with a counterweight to keep the buoyant rope from floating to the surface, and three 200-litre drums filled with cement for an anchor. Often three or four pole and line vessels will fish around a FAD if it is particularly effective in aggregating schools of skipjack.

When the FADs are not aggregating fish, the pole and line vessels equipped with bird radar will search offshore for schools, and if a large school is located, the fishing master will radio the position to other vessels in the fleet.

Two fishing trips were scheduled for me to work with Sam and Timothy. During each trip I was given the opportunity to observe the day-to-day life of the fishing masters aboard their pole and line vessels.

Every night they anchored in the lagoons located near Munda and Gizo to catch bait. The pole and line vessels and bait boats were positioned on flat sandy seabeds between 20 and 25 m.

Bright, high wattage lights were submerged under the boats to attract bait, and once sufficient quantities gathered around the light, a net was lowered into the water to trap the bait fish. Bait catches ranged from 40 buckets a night to 175 buckets; it became more and more difficult to catch bait as we approached the full moon phase. The effect of attracting bait fish with the submerged lights was diminished as the moonlight became stronger.

After the bait was hauled aboard and scooped into sea water tanks, the vessels headed offshore to search for schools of tuna. Daily reports from other fishing vessels indicated that large schools of fish were aggregating around a number of FADs offshore from Munda.

All the tuna fishing activities during two fishing trips, one four-day trip with Sam on the *Soltai 3* and one three-day trip with Timothy on the *Soltai 51*, were conducted around two of these FADs.

At times, there were as many as 5 pole and line vessels fishing around each FAD, as huge schools of skipjack were feeding in the area. One morning, 10 tonnes of skipjack were poled in 2 hours on Sam's fishing vessel (Figure 2). The total catch for the two fishing trips was 47 tonnes of skipjack.

Since returning from the skippers course, Sam and Timothy have both changed their approach to operating and managing their fishing vessels. Many of the training sessions in the course focused on methods for increasing the profitabili-



Figure 1: Solomon Taiyo pole and line vessel fishing around FAD.

ty of fishing operations, and identifying areas where financial inefficiencies occur.

Before the course, their main focus was catching as many fish as possible.

Although this is the aim of every fisherman, often the two fishing masters' fuel expenses

went over the top, as they would travel for hours offshore searching for schools of tuna.

Sometimes they would stay out too long before returning to unload their catches, and often tons of fish were rejected. Now, Sam and Timothy make shorter fishing trips, their fuel consumption is lower and the

amount of reject fish has been reduced dramatically.

Due to the positive feedback from the participants and their employers, it is hoped that next year another course will be conducted for Pacific Island national skippers.



Figure 2: Skipjack catch on a pole and line vessel

TUNA LONGLINE FISHING TAKES A DIFFERENT TURN IN FRENCH POLYNESIA

Masterfisherman Steve Beverly recently spent two weeks, fishing aboard the 26 m longline vessel, F/V *Arevamanu* (Figure 1), as part of a follow-up to a regional course held in Nelson, New Zealand for Pacific Island skippers. Fa'arei Leboucher was one of the participants in the course.

He and his father, Gilles Leboucher, are owner-operators of *Armement Arevamanu*, which operates F/V *Arevamanu*. Fa'arei's mother, Hinano, helps with the management and marketing of the catch.

F/V *Arevamanu* is one of seven longliners operating out of Port de Pêche in Tahiti that is capable

by Steve Beverly,
Secretariat of the Pacific
Community,
Noumea, New Caledonia

of targeting albacore tuna (*Thunnus alalunga*) for the frozen fish market in the USA.

All of the vessels are part of a co-operative, *Armement Coopératif Polynésien*. F/V *Arevamanu* was built in France about eight years ago, and is equipped with a Lindgren-Pitman (USA) monofilament longline system that is capable of setting and retrieving up to 2 500 hooks per day. The vessel has a blast freezer, a freezer hold, and two refrigerat-



Figure 1: F/V *Arevamanu*

ed sea water (RSW) holds. F/V *Arevamanu* targets other tunas besides albacore, such as bigeye (*T. obesus*) and yellowfin (*T. albacares*), but is also capable of fishing for broadbill swordfish (*Xiphias gladius*).

Albacore tuna, however, is the main catch, and often accounts for over 50 per cent of the total catch by weight. Most bigeye and yellowfin tuna are sold fresh at the local auction at *Port de Pêche* in Papeete, and some of the albacore is sold to local retailers.

None of this is unusual. What is different about the way that F/V *Arevamanu* and the other vessels market their catch is that a good deal of albacore tuna is sold frozen in quarter loins to mainland USA markets. The fish is processed and frozen on board.

Another unusual thing is that many of the vessels are being built in Tahiti, at *Chantier Naval du Pacifique Sud*, which is located right behind the fish auction at *Port de Pêche*. Tahiti has borrowed technology and experience from other countries, and has expanded and improved upon it.

To be able to target two different markets, the vessels in Tahiti need to be equipped with two different fish preservation systems: a chilling system and a freezing system.

The chilling system used on F/V *Arevamanu* and most of the other vessels in Tahiti is RSW. F/V *Arevamanu* has a very simple but efficient RSW system. There are two holds, each containing the evaporator stage of a freon (R22) refrigeration system in the form of coils. The coils surround the hold on all four sides, top to bottom. Prior to leaving on a fishing trip, the RSW holds are filled with fresh water and the refrigeration sys-

tem is switched on and run continuously until a 'wall of ice' forms around the coils. It takes about one-to-two days for this 'wall of ice' to form—it is several centimetres thick.

The temperature of the water in the holds drops to 0°C and will remain at 0°C as long as there is a wall of ice surrounding the coils. To maintain the ice around the coils for the duration of the trip, the engineer has to run the refrigeration system for one to two hours per day only.

After fishing commences, enough sea water (about ten per cent by volume) is added to the water in the holds to bring the temperature down to about -0.5°C to -0.1°C. Properly bled and bagged fish are put directly into the holds, and temperature is closely monitored from this point on.

During a short trip in April (eight days, six sets) all albacore and bigeye and live yellowfin tuna were chilled in the RSW tanks. All other fish were processed and frozen in the blast freezer. All of the fish from this short trip were sold locally. Typically, a longline trip is much longer, however, lasting up to 50 or 60 days. On these longer trips, all albacore are quarter loined and frozen, and sold on the international market (mostly USA).

The eight-day trip was notable, however. The total catch for six sets was 264 saleable fish of all species weighing about 6 120 kg caught on 14 400 hooks. The CPUE was 1.8 fish per 100 hooks or 42.5 kg per 100 hooks. The CPUE of the main target species, albacore tuna, was 1.13 fish per 100 hooks or about 21 kg per 100 hooks.

All fish were gilled and gutted on deck after they were removed from the fish holds during

unloading at *Port de Pêche*. Mr Leboucher believes that leaving the gills and guts in during chilling in the RSW tanks keeps the fish in better shape. Several fish were probed with an electronic digital thermometer after unloading, and temperatures were found to be -0.2 to -0.4°C.

About one tonne of mostly big-eye tuna went to the local auction and sold for an average of 600 CFP per kg (112 CFP Francs ≈ 1 USD). The balance went to F/V *Arevamanu*'s local market (Figure 2).

On average, fish prices in Tahiti have been about 200 CFP for

albacore and 550 CFP for all others at the auction block. Total average has been about 300 CFP – 350 CFP per kg. Average catch for F/V *Arevamanu* has been about 1.2 to 1.5 tons per fishing day.

Aside from the auction sales, however, the albacore from this trip sold for 350 CFP per kg and all other fish averaged 400 CFP per kg. The average for all fish was 400 CFP. Therefore, this trip had above average market results (see Table 1 for estimated Profit/Loss).

Crew shares on F/V *Arevamanu* are based on a 60/40 split. The vessel gets 60 per cent of the net



Figure 2: F/V *Arevamanu* off-loading at *Port de Pêche*

Table 1: Estimated income and expenditure for an eight-day trip on F/V *Arevamanu*

Items of income and expenditure (does not include crew share)	CFP Francs (1US\$ = CFP 112)
Income	
Income from auction sales of about one tonne of mostly bigeye tuna	600 000
Income from local market sales of albacore tuna	1 050 000
Income from local market sales of all other species	800 000
Total income	2 450 000
Expenditure	
Fuel cost: 30.34 CFP per litre. F/V <i>Arevamanu</i> uses 1 800 litres per 24-hour day of running and 800 litres per fishing day	252 000
Oil costs	38 000
Bait cost: 2 700 CFP per 22 kg box. Average use is seven boxes per set. The bait used was a sardine from California, USA—probably <i>Sardinopsis melanostica</i> (Japanese name: iwashi)	113 400
Food cost: 150 000 CFP per month. This is equivalent to about 625 CFP per man per day for a thirty day month for a crew of eight	40 000
Total expenditure	443 400
Net (before deducting crew share)	2 006 600

That means that they landed 90 tons of albacore, based on the average 50 per cent recovery. F/V *Vini Vini VI* is equipped with a Lindgren-Pitman 100 mile twin reel longline system (Figure 4).

The loins usually sell ex-vessel for 415 CFP per kg, so the value of the catch was 18 675 000 CFP, and that does not take into account the other species. There are presently seven 25–26 metre vessels in *Armement Coopératif Polynésien* that are involved in this fishery, most equipped with twin reel systems.

More vessels are presently being built at *Chantiers Naval du Pacifique Sud*, and at Ship Builders (Fiji) Ltd in Suva, Fiji.

and the crew of seven gets 40 per cent (crew complement is usually eight—the Masterfisherman did not participate in the share but was a crew member on this trip).

The 40 per cent going to the crew gets further divided as follows: captain 2 shares, engineer 1.5 shares, three crew at 1 share each, two crew at 0.75 shares each, and one reserve share of 0.75 for crew who do shore work. The total share allotment is 8.75.

The boat share (60 per cent of net) amounted to 1 203 960 CFP and the crew share (40 per cent of net) amounted to 802 640 CFP. One crew share equalled 91 730 CFP, so the share amounts for the crew were as follows: captain 183 460 CFP, engineer

137 595 CFP, and crew at either 91 730 CFP or 68 798 CFP.

All of this is interesting, but the real stories in Tahiti are the frozen albacore tuna fishery and local shipbuilding at *Chantiers Naval du Pacifique Sud*. Albacore tuna are quarter loined and frozen on board the 26 m longline vessels to HACCP standards (Hazard Analysis and Critical Control Point) and are exported to USA markets (F/V *Arevamanu* was one of the pioneers in this fishery).

One vessel, F/V *Vini Vini VI* (Figure 3), which was completed recently by *Chantiers Naval du Pacifique Sud*, off-loaded while the Masterfisherman was in Tahiti. F/V *Vini Vini VI* had 45 tons of frozen albacore quarter loins for a fifty-day trip.

The fish that are sold frozen are all processed on board. Each vessel has a processing room, a blast freezer, and a freezer hold (Figure 5).

Soon after, the fish are landed they are bled and headed and gutted (H&G). This is done on deck. The H&G fish are then passed through a window to a processing room where they are hung by the tail on a hook.

The fish cutter makes a series of cuts to remove all fins. Then a meat hook is inserted into the tail end of the half loin just in front of the caudal keel.

A large serrated knife cuts the half loin away from the frame as the meat hook pulls the loin to the side. This results in a very clean cut, leaving almost no



Figure 3: F/V *Vini Vini VI* off-loading catch at *Port de Pêche*



Figure 4: Twin reels on F/V *Vini Vini VI*

waste on the frame. The half loin is placed on the cutting table and further processed. A skinning knife is used to remove pin bones, bloodline, and skin simultaneously.

The result of this cut is two nice quarter loins that usually only need a small amount of trimming to remove remnants of the blood line and belly flap. The quarter loins are then washed,

wrapped in plastic, and placed on plates in the blast freezer.

After twenty-four hours they are removed to the freezer hold where they are stored at about

-35 to -40°C for the duration of the trip. The return on this type of loining is about 50 per cent of the whole weight on average, which is quite good.

Critics of this fishery point out that, although the price for quarter loins is more than that for frozen albacore in the round (whole) that are sold to the canneries, there is a 50 per cent weight loss through processing.

What is the point of doing all that work if the actual return is about the same? The Masterfisherman posed this question to Gilles Leboucher. Mr Leboucher answered that *Armement Coopératif Polynésien* is looking towards the future. The market for frozen quarter loins

in America is fairly new, so the price structure is still relatively weak.

In time, frozen quarter loins will gain a bigger share of the market. There is no real comparison between an albacore steak that was frozen at sea the same day that it was caught, and a tinned fish sandwich.

In time, the market for frozen quarter loined albacore tuna is expected to grow and get stronger. The fishermen of *Armement Coopératif Polynésien* will be ready for that day.

The domestic longline albacore fishery in Tahiti is expanding, which is evident from a visit to the shipbuilding works.

Chantier Naval du Pacifique Sud has just recently laid the keels for two new 26 m longline vessels similar to F/V *Vini Vini VI*, and work is progressing nicely.

Previously, they had completed two 20 m longline vessels for Navimon in New Caledonia. These vessels were delivered in early 1998, and are already fishing and doing very well for Navimon. Other Pacific Island countries could profit by looking at what is being done for domestic fisheries development by *Armement Coopératif Polynésien* and *Chantiers Naval du Pacifique Sud* in Tahiti.



Figure 5: F/V *Arevamanu* – Back deck with blast freezer and processing room

© Copyright Secretariat of the Pacific Community 1998

The Secretariat of the Pacific Community authorises the reproduction of this material, whole or in part, in any form, provided appropriate acknowledgement is given.

Original text: English

Secretariat of the Pacific Community, Marine Resources Division, Information Section, B.P. D5, 98848 Noumea Cedex, New Caledonia.
Telephone : +687 262000 – Fax : +687 263818 – E-mail : cfpinfo@spc.org.nc – Web: <http://www.spc.org.nc/coastfish/index.html>