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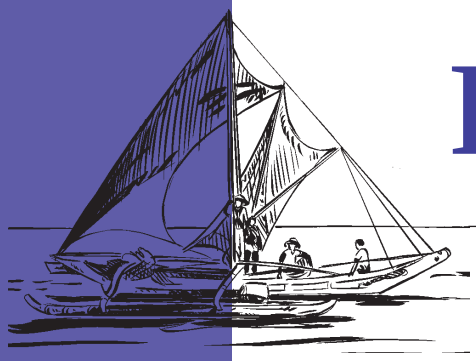


FISHERIES
Newsletter

NUMBER 91
OCTOBER – DECEMBER 1999

IN THIS ISSUE

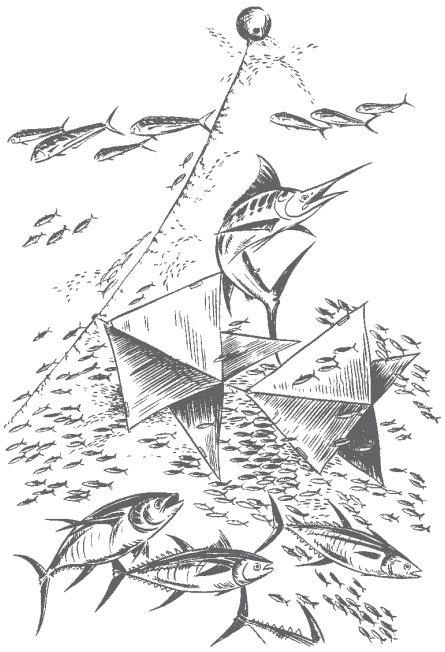
William Sokimi completed his first assignment as the Capture Section's new Masterfisherman

Secretariat of the Pacific Community
Prepared by the Information Section of the Marine Resources Division
Printed with financial assistance from France

CAPTURE SECTION

William Sokimi successfully completed his first assignment as the Capture Section's new Masterfisherman. William spent 11 weeks in Samoa (4 October to 20 December 1999) working with staff of the Fisheries Department as well as local fishermen. The aims of this project were:

- to conduct tuna longlining trials for increasing the catch rates of higher value species such as bigeye tuna and larger yellowfin tuna;
- to train the crew of the fisheries vessel, F/V *Tautai Matapalapala*, and other interested fishermen in correct on-board handling, processing and icing practices for tunas and other species, especially export quality fish; and
- to conduct several workshops in two locations in Samoa on correct on-board handling of the catch and the basic use of GPS (global positioning system) and navigation techniques.



William completed six fishing trips with 14 sets of around 400 hooks per set. A total of 272 export quality fish were caught with a landed (gilled and gutted) weight of 3,855 kg. This provided excellent training for the skipper and crew of the vessel, both in fishing technique (Figure 1) and on-board handling (Figure 2) and chilling of the catch.

William took a Minilog temperature/depth recorder (TDR) along to monitor the longline. TDRs are attached to the mainline when the line is set, and record data at set intervals. The data is later downloaded onto a computer and can be shown

Figure 1: Hauling the gear on F/V *Tautai Matapalapala*

Figure 2: Bleeding an albacore tuna straight after landing

graphically as temperature and depth lines. This is important information to fishermen as bigeye and yellowfin are known to prefer certain depth and temperature ranges. TDRs also give feedback to the fisherman on whether or not he is setting his line correctly to achieve the right depth. No correlation between depth and the catch of bigeye and yellowfin tuna could be detected during this project with the limited data available.

Three workshops were also conducted. Two of these were on on-board handling of catch and were held in Upolu and Savaii.

Both workshops were well attended and were presented in both English (by William) and Samoan (by Mr Savali, Senior Fisheries Officer). Handouts were provided so that fishermen had reference material for both the workshop and future use.

The third workshop was on basic navigation and the use of GPS. It was jointly run by the Fisheries Department and the Masterfisherman and held in English and Samoan.

The first half of the workshop was conducted by the Samoa Fisheries Project Extension Adviser, Mr Peter Watt, with William conducting the second session. The workshop was attended by 22 fishermen, who appeared to greatly benefit from the training, especially in regard to the use of the basic functions of GPS and in understanding and using a magnetic compass.

Appropriate sea safety equipment (Figure 3) was also displayed by the Fisheries Department at the workshop.

SPC's Fisheries Development Adviser, Lindsay Chapman, and Fisheries Information Specialist, Aymeric Desurmont, travelled to Martinique, French West Indies, in October to present papers at the symposium 'Tuna fishing and fish aggregating device (FAD), *(see page 5)*.

During November, Lindsay travelled to Nauru, the four states of FSM and to the Marshall Islands. In Nauru, he was asked to review the operation of the new fish market.

Lindsay suggested some changes to the staffing structure to reduce operating costs as there was limited throughput of product at the time of the visit.

In fact, most of the products at the new market were imported from Pohnpei, Kiribati and Australia, as most fishermen in Nauru sold their catch direct to the public and not to the fish market.

Pohnpei, Yap and Kosrae had requested technical assistance from the Capture Section, with FAD programmes including site survey work and deployment of FADs. Lindsay travelled to each

Figure 3: Sea safety equipment suitable for alia catamarans on display at workshop

of the states to establish the work programme for FAD assistance including the inspection of FAD materials on hand, and provided input on additional material requirements. He also looked at the vessels to be used at each location, pointing out the need for appropriate sea safety equipment. In the case of Kosrae, a list of necessary sea safety equipment was provided to the Fisheries Department.

In Chuuk, Lindsay met with staff from the Fisheries Department to look at possible areas of fisheries development and those where some of the outboard-powered Yamaha skiffs in the State could be used. There were around 1,000 of these skiffs (Figure 4), which are mostly used for transporting people around the islands in Chuuk lagoon. The Fisheries Department was looking at encouraging deep-water snapper fishing.

In the Marshall Islands Lindsay met with different staff of the Fisheries Department and representatives of different fishing sectors to find out what directions fisheries were taking and possible areas where SPC could provide assistance.

The Fisheries Department was interested in conducting 'ika-shibi' fishing trials and was investigating different vessel types to use in their trials. The gamefishing and tourism sectors were looking at FADs and had funding for several systems. There was also interest in deep-water snappers and other small-scale tuna fishing activities.

During much of the last quarter of 1999, Masterfisherman Steve Beverly stood in for Lindsay in Noumea. Steve also made a trip as a hired consultant to Africa during November and December, assisting an Australian company that is building fishing vessels for the Eritrean government (see article on page 24).

Advisory services were offered to the private sector in SPC member countries including a proposed longline company for Wallis, a new fishing company in Fiji, and a new longline vessel for a New Caledonia fishing company. A draft policy on safety standards for SPC staff whose activities involve travel or work at sea, either on boats or diving, was begun.

Project Assistant, Marie-Ange Roberts, has upgraded the format of recent Capture Section training manuals for placement on the SPC Coastal Fisheries Web. Thanks to Marie-Ange's work, the following manuals can now be accessed direct from the SPC Web Site at:

http://www.spc.int/coastfish/
(then click on "fishing")

- FAD Volume I: Planning FAD programmes (English and French)
- FAD Volume II: Rigging deep-water FAD moorings (English and French)

- FAD Volume III: Deploying and maintaining FAD systems (English and French)
- Vertical longlining and other methods of fishing around FADs (English and French)
- Deep-bottom fishing techniques for the Pacific Islands (English and French)

Figure 4: Some of the many outboard-powered skiffs in Chuuk

Tuna fishing and fish aggregating device (FAD) symposium in Martinique, French West Indies

This five-day symposium (15–19 October 1999) was jointly organised by three French scientific agencies: IFREMER (Institut français de recherche pour l'exploitation de la mer), IRD (Institut de recherche pour le développement—ex ORSTOM), and ENSAR (École nationale supérieure agronomique de Rennes). Various provincial governments, government departments and fishing organisations in Martinique, assisted these agencies.

The symposium attracted more than a 150 people, representing most parts of the world where FADs are in use. The Pacific nations were well represented with Andrew Torres from Guam, Frédéric Leproux from French Polynesia, Ian Bertram from the Cook Islands and Milton Sibisopere from the Solomon Islands reinforcing the SPC two-member team.

The symposium was split into six sessions or themes, as briefly described below. The open debates, held at the end of each day, focussed on areas that needed addressing, and research priorities. As intended by the organisers, presentations covered drifting FADs used by industrial fisheries as well as anchored FADs used by artisanal fisheries.

Selected contributions to the symposium will be published either in the proceedings of the Meeting serie '*Actes de colloques de l'IFREMER*' or in a special edition of *Aquatic Living Resources*. A more detailed review of the outcomes of the meeting will be published later in the Fisheries Newsletter.

Session 1: Regional syntheses

Nine presentations were made covering most parts of the world where FAD-associated fisheries or development work on FADs has taken place. Presentations ranged from a worldwide review of the use of drifting FADs by the tropical tuna purse-seine fisheries (by Alain Fonteneau) to specific

presentations on the Hawaii anchored FAD programme (by Kim Holland) to the Japanese Okinawan programme (by Sinichiro Kakuma).

The opening presentation by Alain Fonteneau raised concerns, regarding the Atlantic and eastern Pacific tuna fisheries, due to a rapid increase in the use of drifting FADs and the catch (and in some cases discard) of very small skipjack and bigeye tuna as a result of these changes.

Lindsay and Aymeric gave a joint presentation on 'The use of anchored FADs in the area served by the Secretariat of the Pacific Community (SPC): regional synthesis'.

Synthesising the situations of 21 different countries and territories, some of which use FADs both in the artisanal and industrial sectors, was quite a challenge.

At the end of the session, the open debate focused mainly on problems of ownership of FADs and concerns were raised about juvenile tuna catch, bycatch and discards associated with FAD fisheries. There were no actual outcomes or recommendations, although Martin Hall from IATTC (Inter-American Tropical Tuna Commission) urged participants not to look at banning FADs in any fisheries, but rather to look for solutions as IATTC did with their dolphin issue.

Session 2: FAD technology

There were eight presentations in this session, all related to anchored FADs used by artisanal fisheries.

IFREMER began with a review of the problems encountered in the Martinique FAD programme, which include vandalism, collision by cargo vessels, tangled fishing gear, hurricane damage and strong currents. IFREMER had developed three computer models to try and assist in addressing some of these issues.

Other presentations showed that everywhere anchored FADs were in use, technicians were devising new ways to face specific problems. Examples include a large cylindrical spar buoy to resist very strong currents in Curaçao, Netherlands Antilles; an oval-shaped, foam-filled fibreglass buoy to prevent fishermen from tying to it in Mayotte, Indian Ocean; 300 m of stainless steel cable at the top of an Indian Ocean FAD design to prevent damage by drifting tuna longlines in La Reunion, Indian Ocean; 200 m of PVC tubing for covering the top part of a FAD mooring to prevent abrasion by drifting handlines in French Polynesia.

Aymeric summed up the SPC work over the last 15 years, which included the production of the three volumes of the SPC FAD manual. He examined the objectives set by SPC projects on FADs as far back as 1983/84, especially those objectives which had still not been met although not through lack of trying.

The main problem areas were the FAD's average lifespan (2 years minimum) and their cost (USD 4,000 maximum). The use of mid-water fishing techniques was emphasized as a main cause for the premature losses of anchored FADs in the Pacific region.

He presented three approaches that could be followed if SPC was involved in more development work on FAD designs:

1. Further improve the SPC FAD design (probably an expensive solution);
2. Experiment with the less costly FADs used by industrial fishing companies in the Pacific region;
3. Experiment with the ultralight FADs that are used with success in the Caribbean.

Frédéric Leproux from French Polynesia presented the different FAD designs used in their successful 20-year-old programme. Frédéric outlined the fact that most of the premature FAD losses were due to the development of mid-water fishing techniques.

Andrew Torres, from Guam, outlined Guam's FAD programme, which operates with funds from the Fishery Development Fund. The fund is supported by a small portion of the taxes collected from the sale of all sports-fishing gear and recreational vessels (plus other items) in the US. Guam has 16 operational FAD sites. Andrew's assessment was that fish-bite was the most likely cause of FAD mooring failure around Guam.

The debate and questions that followed this session mainly focused on the costs associated with FAD losses and the heavy load that results in replacing FADs. There was some debate on this point although no clear direction or recommendation was given.

Session 3: Fishing methods used around FADs

Four presentations were given in this session. Marc Taquet from Martinique discussed the implementation of vertical longlining as a new technique to catch the larger (7–15 kg) blackfin tuna (*Thunnus atlanticus*) around FADs in Martinique. Marc also described the Martinique version of the sin-

gle-hook drift line, a very popular local method in which fishermen use live bait caught while trolling (mainly very small blackfin tuna or skipjack).

The evolution of fishing techniques around FADs in Reunion Island was discussed. Several mid-water fishing methods were mentioned as well as trolling.

Lindsay covered the mid-water fishing techniques presented in the recently published SPC manual, 'Vertical longlining and other methods of fishing around FADs—a manual for fishermen' and focused on the Palu-ahi and drop-stone methods, which had not been discussed by other presenters.

Ian Bertram from the Cook Islands, discussed the importance of FADs to the local fishery and the approach by both government and fishermen to the funding of future FADs. Nowadays, between 15 and 30 per cent of the FAD value is being paid for by local fishermen through different mechanisms in the Cook Islands.

At the end of the session, several fishermen from Guadeloupe (French West Indies) made an informal presentation on the way they deploy and use their own FADs using multiple strands of 'banana rope' (4 mm polypropylene cord used on banana plantations). Six to ten strands of this rope are used together to make a larger rope with sufficient strength to be used for a FAD mooring line.

The cost of each FAD is only USD 300 and more than 400 FADs of this design are currently in use by Guadeloupean fishermen. Following this presentation, many concerns were raised such as: technology (costs, lifespan, depths, etc.), ownership (conflicts between fishermen, access agreements, etc.), safety of navigation, and international maritime regulations.

Concerning safety at sea for the fishermen (some FADs are set more than 30 miles offshore, and Guadeloupean fishermen only use 5–8 m open-deck launches), local authorities have adopted a very interesting regulation: all fishing boats must carry an EPIRB (safety beacon sending the distress signal through satellites) but fishermen only pay 15 per cent of the EPIRB's real cost, the rest being subsidised.

The system has saved seven boats since July 1998. Costs of such a programme for local authorities have to be compared with costs of a full search-and-rescue operation, involving planes and ships. This solution could certainly be used in some Pacific Island countries.

Session 4: Effects of FADs on fisheries resources

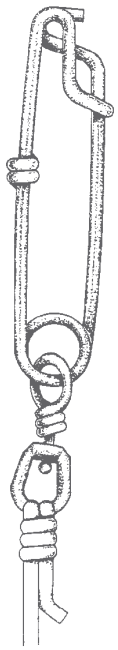
There were seven presentations covering the following areas:

- The changes in fishing operations of the US purse-seine fleet in the western Pacific;
- The contribution of drifting and anchored FADs to the success of tuna fishing vessels;
- The comparison of large pelagic fish catches in Martinique, with and without FADs;
- The use of FADs in Malaysia by the purse-seine fishery;
- The catch, fuel consumption and bait use associated with the eastern Indonesian skipjack pole-and-line fishery;
- The tuna protection plans for French and Spanish tuna boat owners; and
- The use of FADs in the Mediterranean to attract small mahi mahi taken by purse seining.

Session 5: Biology and behaviour of pelagic fish aggregations

Many good presentations were given in this session. The first set the stage for the day and looked at the main theories on why FADs work. Different hypotheses were put forward and examined and it was agreed that the most likely reason was that FADs provided 'meeting places' for tunas and other species. The next presentation looked at the fishery south of Okinawa Island in Japan and the effect of ocean currents on the catch of yellowfin tuna.

Several presentations on the work conducted by IRD in French Polynesia were given. These looked at the behaviour of tunas around FADs using sonic tagging and acoustic surveys. A model that simulated the movement of tunas around FADs, both as individuals and as aggregations, was briefly presented.

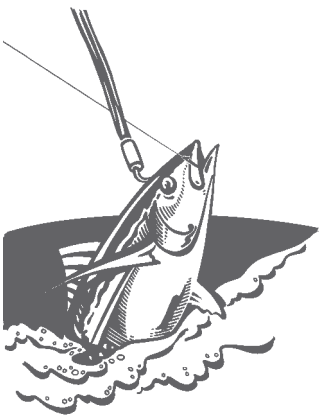


David Itano presentated the tagging programme in Hawaii and discussed the release and recaptures of fish that are caught near FADs. He noted that there was movement between FADs, both inshore and offshore as well as to offshore banks. A statistical analysis of the movements and interactions of yellowfin and bigeye tuna between the offshore seamounts and inshore FADs was given by Dr John Sibert.

The next presentation examined how oil platforms in the Gulf of Mexico attracted fish and fishermen and that some of the fish living around these platforms and around FADs were the same, including large pelagic fish such as tunas and billfish.

Two presentations addressed a question that is beginning to be of great concern: are FADs affecting fish migration and development? During the first presentation, 'Do FADs have an influence on dolphinfish migration?', Marc Taquet presented figures that indicate a positive answer to the question.

During the second presentation, 'Drifting FADs used in tuna fisheries: a biological trap?', Francis Marsac and Alain Fonteneau raised concerns about the possible negative impact of the massive use of FADs on movements of small tunas and bycatch species (mahi mahi, rainbow runner, wahoo, etc.). Data from the Gulf of Guinea purse-seine fishery, where thousands of drifting FADs have been used before the moratorium, has shown a dramatic change in species composition of schools and size of fish caught.



Several of the remaining presentations in this session looked at bycatch attraction to FADs, including mahi mahi, which was being fished in some locations. Another looked at the use of drifting pole-and-line boats as FADs in Sénégal, Africa, with schools of tuna being passed from one vessel to another when full so that catching could continue.

Session 6: FADs, socio-economics and anthropology

The legal and economic aspects of FADs, their appropriation by the fishermen, interactions between FAD fisheries and tuna-longline fisheries, and resulting conflicts, were some of the issues addressed during the nine presentations of this session.

Milton Sibisopere from Solomon Taiyo Ltd. gave a presentation on the importance of FADs to their fishing operation, both purse-seining and poling. He described the socio-economic benefits in the royalties paid for bait access and the use of the FADs by local fishermen. He also looked at the regulations and requirements for FADs under the Solomon Islands new Tuna Management Plan.

The last presentation, by Hélène Rey-Valette and Espérance Cillauren, dealt with the complexity and diversity of changes caused by the introduction of FADs and their implications for fisheries management.

Sunday technical trip

The organisers had arranged a morning trip to one of the local FADs using a large tourist vessel, and around 150 participants went to see several local fishermen working around a FAD. IFREMER had one of their vessels fishing around the FAD. Local vessels came alongside to show their catch. One vessel had a small sailfish and a 15–20 kg yellowfin tuna while another vessel had a small blue marlin.

On our tourist vessel, Kim Holland and David Itano from Hawaii put their gear together to catch our only fish of the day, a small skipjack tuna around 1.5 kg. The fish had a large hook put in it and it was released on a single hook drift line with a small buoy. It was soon attacked by a good size marlin, which managed to escape.

Local fishing in Martinique

Following the meeting, Lindsay visited several fishing areas in the southern part of the island with Martial Laurans from IFREMER.

The fish market in Fort de France was the first stop. The fish ranged from very small reef and bottom fish to a few larger lutjanids (1–2 kg) that were taken in fish traps. The tunas and marlin came from the FADs and were sold in chunks. Some people used ice on the fish while others did not.

At one of the villages, three different fibreglass skiffs came in, each with two blue marlin weighing around 60–70 kg each. One of the vessels also had a yellowfin tuna around 20 kg. All vessels had some small skipjack and blackfin tuna of less than one kilo in weight. The fish were selling at FRF 50/kg (around USD 7.50/kg).

The vessels used in Martinique were mainly fibreglass, 5–8 m in length, 1.5 m wide with an outboard engine of 60–115 hp with a few 200 hp outboards around. Fishing is done in day trips and very few vessels appeared to have any insulated storage for ice or the catch.

IFREMER vessel at the FAD off Fort de France, Martinique

Two small blue marlin landed by a local fishing around FADs

Typical fibreglass vessels used for fishing around FADs in Martinique

COMMUNITY FISHERIES SECTION

From October to December 1999 the Community Fisheries Section continued its support of women and small-scale fisheries.

Training

Palau: Peleliu workshop on seafood quality, preservation and marketing

In November 1998, the Community Fisheries Officer carried out a survey on the role of women within fishing communities in Palau. One of the recommendations made in a report of that survey was to improve training services for women in the fisheries sector.

The Community Fisheries Section agreed to assist the Division of Marine Resources in organising and running a workshop for women on seafood quality, preservation and marketing.

Peleliu Island was selected as the venue for the workshop due to the high degree of interest and dependency on marine resources by the people there. Agriculture is limited on Peleliu because of the small amount of arable land available. Taro is cultivated for family use and traditional restrictions exist on its sale outside Peleliu State.

The people are therefore very dependent on their marine resources – for family consumption, for sale and for tourism. Topics on conservation and management of marine resources were included in the workshop to emphasise the importance of sustainable use of marine resources.

Other workshop included smoking and drying fish; traditional and modern concepts of quality and seafood spoilage; and small business skills. Local resource people assisting in the workshop included Evelyn Oiterong of the Division of Marine Resources (DMR), Denise Brown and Bob Bishop of the Informal Employment and Sustainable Livelihood programme (IESL), and Charlene Mersai of the Palau Conservation Society (PCS).

During the workshop, two fish smokers were constructed from 44 gallon drums, and a solar fish dryer from bamboo and plastic sheeting. These were used to experiment with different types of smoked and dried fish, the most popular being a fish jerky half-dried in the solar

Building the drum smokers

dryer and then smoked in the drum smoker.

The workshop session on the conservation and management of marine resources was conducted by Charlene Mersai of PCS. The final session, conducted by Denise Brown of IESL, covered small business skills. A local film crew from the Palau Education Department filmed most of the workshop and a video is now available for use throughout Palau.

One of the participants, Reiko, shows the women how to skin a fillet of fish.

Information

The Reef: Our Heritage, Our Future, a video in English and Nauruan, examines how the destruction of the reef is affecting the livelihood of the people of Nauru.

For generations, the people of Nauru relied on the reef for survival. Today, the reef is relying on the people for its survival.

The video explains why modern, destructive fishing practices are being adopted instead of the safer traditional methods.

The video is intended to help create awareness of the situation and hopefully change the habits of those who use the reef.

The French version of the manual, *Setting up a Small-Scale Business: A Guide for Women in Fisheries*, has now been printed and distributed to the French Territories. French and English versions are also available of *Practical Methods for Preserving Seafoods: Salting and Drying (A Training Manual).*

Fisheries management by communities: A manual on promoting management of subsistence fisheries by Pacific Island communities is now available in English. A French version of this should be ready later in the year.

Copies of these manuals cost 1000 CFP (approx. USD 10) each.

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REEF FISHERIES ASSESSMENT AND MANAGEMENT SECTION

In Thailand

Pierre Labrosse, the Reef Fisheries Management Adviser, participated in the 'FAO Expert Consultation on Development Trends in Aquaculture' held in Bangkok from 25 to 28 October 1999. This meeting was a follow-up to the efforts made by the FAO Fisheries Department to analyse, summarise and disseminate information on the major developments in aquaculture worldwide.

It was based on the assessments and studies carried out in various regions of the globe (Africa, Asia, Near East, South Pacific, Europe, countries of the former USSR, Latin America and North America) by the 17 experts who attended this meeting*. An overall summary of this work along with the regional reviews has been presented at the 'Conference on Aquaculture for the Third Millennium, jointly organised by the FAO and NACA in Bangkok from 20 to 25 February 2000. An SPC representative attended this conference.

This meeting was an excellent opportunity to reflect on the prospects and conditions for aquaculture development, particularly in the South Pacific region. It confirmed the need to maintain and reinforce co-operation with the countries of South east Asia. Moreover, in light of the discussions, it would appear that new opportunities or directions for development could be envisaged in the region. They will, however, have to be verified.

In the Philippines

Since 1997, the SPC has been a partner in and training co-ordinator for the Pacific Node of the FishBase Project. In 1997 and 1998, the Pacific Node's activities amounted to organising a single training session for ACP countries in the South Pacific region.

With the creation of the Reef Fisheries Assessment and Management Section during the second half of 1998 and the recruitment of two specialists, the Pacific Node's activities resumed and it now has two training co-ordinators, Being Yeeting and Pierre Labrosse, who conducted a two-week training session in Manila at ICLARM's Headquarters in November.

This duty travel made it possible for the co-ordinators to familiarise themselves with the latest developments in FishBase as well as with modelling tools such as Ecopath, Ecosim and Ecospace. It also provided an opportunity to detail the activities to be conducted as part of the Pacific Node. Thus, efforts should be directed to:

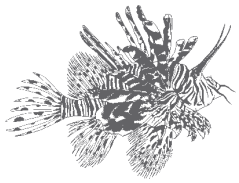
- updating information on FishBase and its use in all the countries covered by the Pacific Node (CD-ROM and Web);
- recovering and publishing data which has not yet been; and
- collecting information on the vernacular names of fish in the various Pacific islands.

Being Yeeting, Integrated Fisheries Management Associate, took advantage of his stay in the Philippines to spend a few days with the International Marine Alliance (IMA) team.

This non-governmental organisation, founded in 1985, has as objectives: preservation of biodiversity, and promotion of the sustainable use of marine resources. The IMA worked with SPC on developing a regional fisheries management strategy for reef fish destined for live sales.

This duty travel made it possible to get the latest information on the organisation's current activities and monitoring programmes, particularly those related to controlling destructive fishing practices.

It also provided an opportunity to visit the cyanide detection laboratory and to assess the data collection and processing methods in the field. These technical exchanges should make it possible to reinforce collaborative activities between the IMA and SPC.



* The initial versions of the regional evaluations are available with the Reef Fisheries Assessment and Management Section.

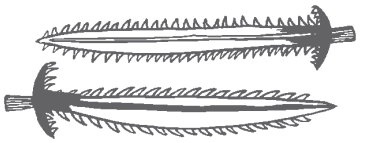
In Kiribati

Being Yeeting, Integrated Fisheries Management Associate, went to Kiribati from 12 to 23 December. This duty travel was a follow-up to a study he carried out the previous June covering the development possibilities of the live reef fish food trade (see *Fisheries Information Newsletter* no. 89, page 12) and had two objectives:

1. To present the results of the study carried out on Abiang Atoll to respective Kiribati government departments;
2. To discuss the implications of the findings on the future development and management of this activity in Kiribati.

Another duty travel mission may be planned during 2000 in order to hand over the final results of this study to the Abiang community and to emphasize the usefulness of this approach and the recommendations made, concerning fisheries management.

Other important issues were dealt with during the various discussions, such as the problem of ciguatera or the live aquarium fish trade on Christmas Island.

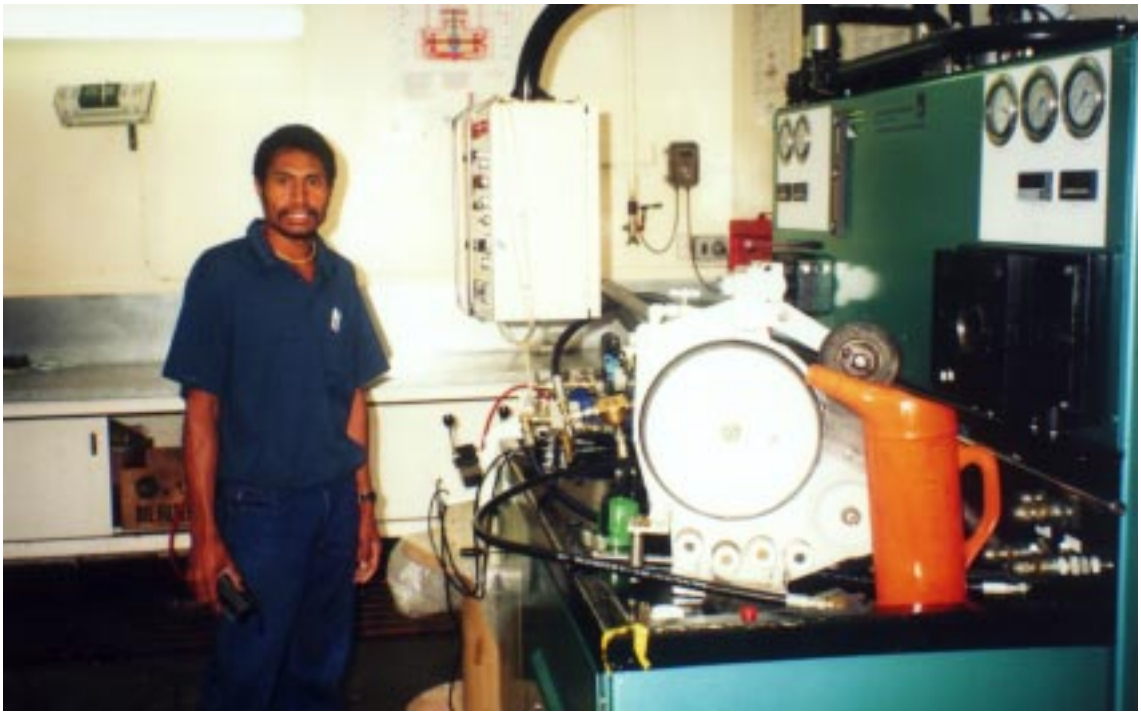


■ TRAINING SECTION

Commercial fishing skippers trained in vessel management and electronic aids

Late in 1999, the Government of Taiwan/ROC approved two project proposals from the SPC Fisheries Training Section. One of those projects is the organisation of the second regional course on vessel operation management and electronic aids for commercial fishing skippers.

As for the initial course, the staff of the New Zealand School of Fisheries will help participants gain the required skills and knowledge to successfully manage a commercial fishing vessel. Despite the limited time available (two weeks from 27 March to 7 April), the trainees will receive instruction on a wide range of topics, either in practi-



One of the participants, Samol, in one of the school's simulator rooms

cal matters (hands-on electronic devices in the school's simulator rooms) or through lectures, group discussions and workshops.

The common goal of all these activities will be to convince the participants that a fishing vessel is like a small enterprise on its own—sometimes worth several hundred of thousand dollars!—and that to succeed, the skipper needs to use management skills as much as his knowledge of fish and how to catch them.

As with all SPC courses run at the Nelson School of Fisheries, the trainees will make the most of their time in New Zealand. An invaluable exposure to the New Zealand fishing industry will complement the course content and this will be achieved through visits to various companies at Nelson port (the biggest fishing port in the country), and through sessions run by local guest speakers chosen for their experience and success in the fishing industry.

In addition, for those skippers who have never used a computer, there will be opportunities to learn the basics of computing and to practice on the SPC software, "Vessel Economics – A tool for calculating longline profitability".

The selection of course participants was made early in February and from the 25 applicants, only 12 were given a seat. It will be an interesting mixture of backgrounds with one fleet manager, two captains of prawn trawlers, and one captain from a pole-and-liner, and several longliner skippers.

The following countries will be represented: Fiji, Papua New Guinea, Samoa, Tonga, Tokelau, Cook Islands, Solomon Islands, Tuvalu and Kiribati.

The Fisheries Training Section will report on the second regional course for commercial fishing skippers in the next issue of the *Fisheries Newsletter*.

A Traineeship programme for Pacific Island fishing vessel crew

More good news about funding! The Fisheries Training Section has recently received a substantial portion of the AusAID contribution to SPC for 2000. With these funds, the Section and the Australian Fisheries Academy (AFA) will soon implement a pilot traineeship programme for selected crew of Pacific Island fishing vessels.

The idea, which emerged following discussions at the 1st Head of Fisheries meeting in August 1999, is to carefully choose young and promising crew and send them to the Australian Fisheries Academy in Adelaide, for a three-month period. There, the trainees will receive a combination of off-the-job (on shore) and on-the-job (at sea) training.

At the Academy campus, training will cover practical skills like safety, seamanship, seafood handling and radio operation, and successful trainees will obtain the Australian certificates of Elements of Shipboard Safety and Radio Telephony.

After approximately one month on shore, each participant will board a commercial fishing vessel for a two-month placement in a fishery similar to the trainee's.

The wild-catch traineeship for young people wanting a career in the fishing industry was developed in 1995 by the Australian Industry Training Advisory Board and AFA, where each year, between twenty to twenty-five trainees enter the programme. The large tuna fishery based in Port Lincoln now channels all new recruits through the traineeship. The success rate has been in excess of ninety per cent who continue on with a position in the fishing industry, some as high as skipper.

SPC and AFA believe in offering opportunities to Pacific Island fishermen to further develop their skills. Exposing them to the training and fishing methodologies of Australia will provide wide benefits to both the trainees and the fishing industries in their own country.

The SPC Fisheries Training Adviser will travel to South Australia in February to fine-tune this traineeship programme with AFA Chief Executing Officer, Grant Carnie.

The traineeship programme is tentatively planned for implementation in October-December 2000.

Planned assistance to the Vanuatu Maritime College

Last November, the SPC Fisheries Training Adviser spent two days in Santo visiting the Vanuatu Maritime College (VMC), meeting staff and planning SPC's assistance to VMC.

The director, Christian Blanchard, and one tutor, Michel Tostin, of the New Caledonia School of Marine Trades (Ecole des Métiers de la Mer - EMM) were also present to finalise collaboration projects with Ken Barnett, VMC Chief Executive Officer.

The result of this visit is a co-operative agreement between EMM and VMC, and the identification of several projects requiring SPC's assistance in 2000. These include:

- A train-the-trainer course scheduled for June at the College. The purpose of this training initiative is to reinforce the group cohesion amongst VMC staff and develop their adult teaching skills. The course will follow an Australian accredited programme (Certificate IV in workplace training and assessment). The focus of the course is on Competency Based Training and Assessment, a methodology the College will be using extensively in future years. The training provider, called Next Vanuatu, is based in Port Vila and is an offshoot of an approved vocational training institution specialising in organisational management, and workplace training and assessment. The train-the-trainer course will be funded by SPC Fisheries Training Section.

- A boat building project in Santo during the second semester of 2000 to train Marcel, the manager of the local boat-yard, in the building a new boat design (7.5 m, planing hull), using the West System (plywood saturated with epoxy resin and covered, on both sides, with fibreglass mat). This training attachment will last approximately six weeks. The benefits for Marcel and his team of boat builders will be the acquisition of a new building technique and the plans and forms for a boat design that will widen the range of options available to ni-Vanuatu fishers. This boat building project will be funded by the Section.

August Fred, VMC's second engineering instructor, will travel to Noumea during the first half of 2000. August will visit EMM facilities and will observe local training methodologies, especially the conduct of decentralised engineering workshops on outboard motors, in remote parts of New Caledonia. August will also attend an Advanced Fire Fighting course to become familiar with the fire-fighting simulator recently acquired by VMC.

It is expected that on his return, August will assist the VMC fisheries instructor in running outboard motor workshops in the different islands of Vanuatu. Funds are available from the Fisheries Training Section to cover the costs of August's attachment to EMM.

Update from fisheries training in Federated States of Micronesia

In the previous issue, we mentioned the reopening of the Micronesian Maritime and Fisheries Academy (MMFA) in Yap, under the umbrella of the College of Micronesia (COM). The new era for this training institution comes with a new name for the MMFA: FSM Fisheries and Maritime Institute (FMI).

In November last year, the SPC Fisheries Training Specialist made a visit to Pohnpei to assist FMI's newly appointed Director (Matthias Ewarmai) plan an initial sea safety and fishing course.

After a careful look at the appropriate provisions of the STCW Convention, including the Code, it has been decided that FMI would now commence their new training programme with a series of familiarisation training courses. The course will be named 'Elements of Shipboard Safety' and will be in compliance with chapter VI/1 paragraphs 1.1 to 1.7 of STCW Code.

The Elements of Shipboard Safety course required for all seafarers will now pre-empt the Safety Certificate developed by SPC's Maritime Programme which is a more detailed two-week training course and only required for those with safety or

pollution duties in the operation of a ship (Reg. A-VI/1.2).

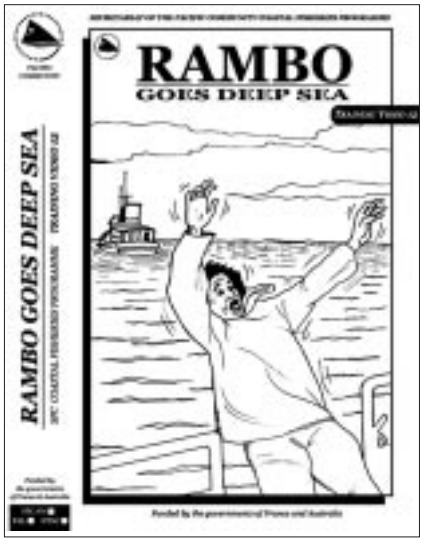
FTS assistance also focussed on pre-course arrangement. Matthias now has a better understanding of pre-course arrangement, preparation and implementation (administration, organisation, role of course co-ordinator with preparation of course notes, drawings, overhead transparencies, materials for practical sessions, etc.)

From 13 to 17 December 1999, FMI ran the first course on Elements of Shipboard Safety at the main COM-FSM campus in Palikir, Pohnpei. The Secretariat of the Pacific Community (SPC) assisted the FMI through the provision of an experienced tutor from the Fisheries Training Centre in Kiribati for the duration of the course. The SPC Fisheries Training Section is committed to assisting FMI in any way it can.

Finally FMI had expressed their appreciation on the valuable assistance from SPC Fisheries Training Section as well as from the Regional Maritime Programme.

Update on video production

In the previous newsletter we announced that the Fisheries Training Section had undertaken the production of a 15 minute video entitled, 'Rambo Goes Deep Sea'. The film relates the story of a new crew called Rambo who decides to work on a large tuna fishing vessel. This video's humorous style shows Rambo learning about the everyday dangers of working onboard a deep sea longliner. Some of the safety issues covered in the video include, being safe in the galley; jumping and running on board; springing the vessel; wearing loose clothing; falling overboard; smoking in bed and more.



This video should be used in conjunction with the SPC booklet "Safety aboard fishing vessels" and any pre-sea safety training courses. Fisheries departments, training institutions and fishermen's association will received the video no later than March this year. Funding for this project was provided by Australia and France.

Other videos available in the series are:

1. An icy tale: chilling fish on board
2. A chilling story: handling fish in the processing plant
3. Trolling with natural bait
4. Bottom fishing with hydraulics
5. On-board handling of sashimi-grade tuna
6. Air-freighting of chilled fish
7. A visit to the fish market
8. Once upon a fish stall
9. Better safe than sorry
10. Survival at Sea: a Kiribati tale
11. Fishy Business

A new sponsor for the SPC Nelson course

The 21st SPC Nelson course begins the millennium and welcomes the participation of the Government of New Caledonia in the funding of the region's most popular fisheries training program. At the twenty-ninth meeting of the Committee of Representatives of Governments and Administrations (CRGA) held in Papeete, French Polynesia 1-3 December 1999, the Government of New Caledonia had announced that it will provide extra-budgetary support in 2000 to the Training Section of the CFP for the course run in conjunction with the Nelson Polytechnic.

This year's course started on 7 February at Nelson when the 13 participants (from 10 countries and territories) were given a tour of the New Zealand School of Fisheries. The students will first follow a 18-week training programme in Nelson before flying to New Caledonia for five additional weeks of "hands-on" fishing experience. This year also saw another woman from Kiribati attending the course. The SPC Nelson course is an annual event and has been attended by 243 fisheries officers from 21 countries and territories during the 1979 to 1999 period.

PLAN OF ACTION TO CUT DEATH RATES IN THE SOUTH AFRICAN FISHING INDUSTRY

According to Eric Holliday, who operates the safety equipment company Prosafe in Capetown, death rates among fishermen are on the increase. Holliday has investigated health and safety issues in the South African fishing industry and compared death and injury rates with those of the United States and other countries.

The South African death rate in 1995 was 155 deaths per 100,000 fishermen. This figure rose to an estimated 1,000 deaths per 100,000 fishermen in 1999.

In the United States, the average death rate between 1995 and 1998 was 164 fishermen per 100,000; in the United Kingdom, this rate was 77 per 100,000 for the period 1995-1996.

Deaths and injuries on fishing vessels result from several factors. Holliday discovered that most deaths in the fishing industry are a result of vessels either sinking, flooding or capsizing and that crewmen die from either drowning or hypothermia. In the US, deaths for this type of fishing related fatality range from 57 to 84 per cent; in Alaska alone this figure is 85 per cent. In Norway, 62 per cent of fishermen's deaths are due to drowning.

The deck is the most dangerous part of the boat on South African fishing vessels; 43 per cent of all accidents occur there. The other trouble spot is the engine room which claims 37 per cent of all accidents. Accident rates in South Africa fall into several categories and the rates are as follows:

- Slips / fall on same levels: 20%
- Slips / fall to lower level: 14%
- Manual handling / strains: 13%
- Burns / shocks / chemicals: 7%
- Cuts / punctures: 10%
- Struck by / contact with: 36%

Holliday claims that vessel stability problems, lack of bilge water alarms, and poor seamanship skills in adverse sea and weather conditions are to blame and that relatively few vessels are lost due to fires and explosions. Statistics from the US indicate that longliners have a higher accident rate (25%) than purse seiners (16%). Vessel size is an important aspect with regards to safety; vessels less than 15 metres in length have a considerably higher accident and loss rate than larger vessels.

Holliday proposes several initiatives to promote safety in the South African fishing industry:

- Industry-specific Fishing Vessel Safety Management Systems be developed. A model of this is in place in New Zealand, where Maritime Safety Authority legislates the Safe Ship Management Codes;
- A Safety Management Systems that incorporates a relevant safety index rating, thereby providing a basis for self and third-party objective management;
- Contacts with international safety organisations to be established to access the most current approaches to handling safety problems;
- Vessel audits should become an industry standard.

Holliday believes that the key is to get people to think about safety. He says that some fishing companies and vessel owners are either unaware or unconcerned about improving shipboard safety. In South Africa, this lack of concern is indicated in the dearth of active policing of safety issues by the maritime authorities there.

Holliday sees the establishment of an industry and government-funded, standard setting and safety body as the only solution that remains to deal with the South African fishing industry's safety problems.

(Adapted from *Fishing News International*, January 2000)

INTERNATIONAL PLAN OF ACTION FOR THE CONSERVATION & MANAGEMENT OF SHARKS

In 1994, the 9th Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) adopted a Resolution on the Biological and Trade Status of Sharks in response to growing concerns that some shark species are overexploited due to increases in the international trade in shark parts. *Inter alia*, this resolution requested FAO and other international fisheries management organisations to establish

programmes to collate biological and trade data on sharks in cooperation with all nations utilising and trading shark products.

In response to the issues highlighted during implementation of the CITES Resolution, members of the FAO Committee on Fisheries (COFI) requested in 1997 that FAO, in collaboration with the Governments of Japan and the United States, organise an expert Consultation on the conservation and management of sharks. The objectives of the Consultation were:

- To determine the specific requirements for sustainable global and regional management of sharks species;
- To develop guidelines for such management; and
- To develop a plan of action aimed at promoting the widespread use of these guidelines by appropriate management bodies and arrangements at national, regional and / or international levels.

In late 1997 a series of workshops developed regional strategies for shark conservation and management, and contributed to background information presented to the April 1998 meeting of the Technical Working Group in Tokyo, to the Guidelines currently in preparation, and to the Draft International Plan of Action for Sharks.

October 1998 Consultation

Following a preparatory meeting in July 1998, at FAO in Rome, the Consultation culminated at the end of October, when world governments met in Rome to discuss the Management of Fishing Capacity, Shark Fisheries, and Incidental Catch of Seabirds in Longline Fisheries. The meeting considered and finalised text of International Plans of Action (IPOA) for sharks and seabirds, and agreed Elements of an International Instrument for the Management of Fishing Capacity. These documents were submitted for endorsement by consensus at the FAO COFI meeting in February 1999, and adoption by the FAO Conference in November 1999.

The stated objective of the IPOA is "to ensure the conservation and management of sharks and their long-term sustainable use".

The introduction acknowledges the increase in effort and catch of shark fisheries over the past few decades and that shark life histories make them susceptible to overfishing. It notes that the current state of knowledge of sharks and shark fishery practices causes problems in the conservation and management of sharks due to the lack of available catch, effort, landings and trade data, as well as limited information on biological parameters and difficulties with species identification.

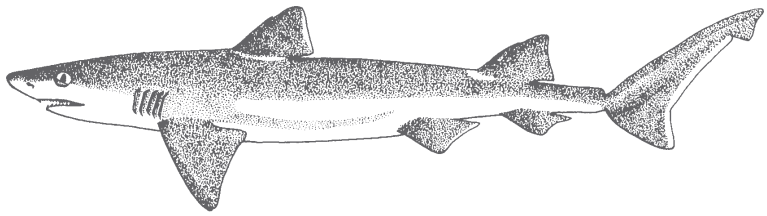
The IPOA encourages States to assess the state of shark stocks within their Exclusive Zones and those fished on the high seas. States should then determine if there is a need for them to develop a National Plan of Action for Conservation and management of shark stocks (Shark-Plan).

National plans are called for if (a) directed shark fisheries exist, and / or (b) if sharks are regularly caught in no-target fisheries. If, after their initial assessment, a State determines there is no need for a Shark-Plan, it should review that decision regularly, but as a minimum collect data on catch, landings and trade.

States are asked to report to FAO on the assessment conducted, and to present biennially (when reporting under the Code of Conduct), a brief summary of the Shark-Plan and its progress, or the results of the assessments that concluded no

Aim of a National Shark-Plan

- ☞ Ensure that shark catches from directed and non-directed fisheries are sustainable
- ☞ Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use.
- ☞ Identify and pay special attention, in particular, to vulnerable or threatened species.
- ☞ Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States.
- ☞ Minimise unutilised incidental catches of sharks.
- ☞ Contribute to the protection of biodiversity and ecosystem structure and function.
- ☞ Minimise waste and discards from shark fisheries in accordance with paragraph 7.2 g of the Code of Conduct for responsible Fisheries (e.g. requiring the retention of sharks from which fins are removed).
- ☞ Encourage full use of dead sharks.
- ☞ Facilitate improved species-specific catch and landings data and monitoring of shark fisheries.
- ☞ Facilitate the identification and reporting of species-specific biological and trade data.



plan was needed. This information will be made available to all concerned States.

States are also encouraged to cooperate and where appropriate develop regional Shark-Plans through regional and sub-regional fisheries management organisations or arrangements, and other forms of cooperation. The FAO Secretariat is directed to support the implementation of the IPOA-Sharks, including the preparation and implementation of Shark-Plans by States, through technical assistance projects. States are requested to have a Shark-Plan in place by the COFI Session in 2001. The resources to be made available to FAO will be discussed when the IPOA is presented to COFI in 1999.

Conclusions

The FAO IPOA is an important first opportunity to gain control of overfishing occuring in many shark fisheries. While entirely voluntary in nature, it identifies the actions needed for effective conservation and management of sharks. The number of States who have not only made the initial assessment under the IPOA, determining if there is a need for a Shark-Plan, but have also implemented a Shark-Plan by 2001, will reflect its success. This may have ramifications for future actions under CITES. The next CITES meeting in Kenya in 2000 will review progress under the Resolution.

For more information

Reports of the Technical Working Group, the Preparatory Meeting held in July, and papers for the October Consultation are posted on the FAO Fisheries website at:

http://www.fao.rog/waicent/faoinfo/fishery/faocons/faocons.htm.

(Note: Throughout this article, the term 'sharks' includes rays and chimaeras.)

(Source: *Waves*, Vol 6, Number 4)

■ DEVELOPING DROPLINING IN NORTHERN AUSTRALIA

*The northern Australian dropline fishery was established in the early 1980s after the 1979 declaration of the Australian 200-mile fishing zone. As in other parts of Australasia, proven stocks of goldband snapper (*Pristipomoides *spp.), red snappers (*Lutjanus *spp.) and cods (*Epinephelus *spp.) inhabit the Sahul Bank in the Timor Sea which lies within Indonesia's fishing zones and extends down into Australia's fishing zone.*

In the early 1990s Indonesian vessels using hand lines and modified traditional fish traps began operation along the Indonesian section of the bank.

The target fish are mainly found in depths ranging from 90 to 170 metres and tend to school vertically in the water column rather than spread over the bottom. For this reason, Australian fishers soon adopted dropline technology rather than traps or longlines.

Indonesian fishers, on the other hand, have to date been handicapped by not having access to high resolution fish finders. To attain commercial catch rates approaching those of the Australian vessels the Indonesians have in recent times used snapper longlines from large vessels manned by twice as many crew as found on Australian dropline vessels.

While the Indonesian fishers have concentrated on manually setting as many hooks as possible over a large area to improve their catch rates (20,000 to 30,000 per day), Australian fishers in cooperation with the government and private companies have developed a system of pin pointing schools of fish and hitting them with up to 300 hooks in a matter of minutes.

A project undertaken some eight or nine years ago was the catalyst that generated the present successful Australian dropline fishery operating in the Timor Sea. In the early days of the fishery two types of hauling gear were used: hand operated snapper reels and free rig droplines. Imported electric snapper reels and hydraulic reels were experimented with but both were found lacking.

Hand operated reels have obvious drawbacks when fishing at these depths. Free rig lines, (lines not connected to the vessel) while having other advantages, could only be hauled one at a time with the aid of a hydraulic line hauler. Though powerful, the electric snapper reels suffered from corrosion

and needed regular major overhauling. Insulation was also inadequate in wet conditions and it was not unusual for the reel's operator to receive electric shocks. The imported hydraulic reels were corrosion resistant, but were not powerful enough to haul 15 or more large snapper from depths in excess of 150 metres during periods of strong tide. The inadequacy of the imported reels was the stimulus for the design and manufacture of a local product and a subsequent trial to prove its worth.

Over a two-week period, five alternative deepwater snapper capture methods were to be tested. These included reels (hand and hydraulic), free rig droplines (lines attached to floats and thrown clear of the vessel), longlines and traps. It was decided after two days of fishing to simplify the project and abandon the traps and longlines, neither of which were catching particularly well.

The bottom rig, or catching section, on the three gears used were identical. This consisted of 15 No. 13/0 Mustad tuna circle hooks attached to 100 kg tested monofilament snoods, 200 millimetres long. Each snood was attached at one-metre intervals to a 6.0 millimetre diameter bottom rope by a small snap-on connector. Three swivels were spliced into the bottom rope at regular intervals. An eight-kilogram sinker was used to weight all rigs.

The two hand reels and two free rig droplines were operated in conjunction with two locally manufactured reels (better known as dropline machines) aboard an 18.2 metre fibreglass vessel. In addition the vessel was equipped with two colour fish finders, GPS, radar and a hydraulic line hauler.

Fishing was conducted in two areas of the Timor Sea. Gold-band snapper (*Pristipomoides* spp.) were making up most of the remainder.

13/0 tuna circle hooks were baited with squid and placed on shooting racks. Once a school of fish was located the vessel was positioned over the school and the gear shot away. Floats attached to the free rig droplines were thrown clear of the vessel. The hand reels and dropline machines were allowed to fish for exactly six minutes. The free rig droplines were hauled as soon as the other rigs were onboard. If the fish kept biting the free rig lines were solely operated for 30 minutes.

This was then followed by 30 minutes with each of the other two types of gear. A total of 9,750 hooks were set. This was evenly divided between the three sets of gear.

As expected the catch rate per hook was about the same for each type of gear: dropline machines 0.28 fish per hook, hand reels 0.29 fish per hook and free rig droplines 0.29 fish per hook. When the fish were biting it was possible, using a combination of the hand reels and dropline machines, to catch around 200 kg per hour. The average day's catch was around 400 kg. This was similar to that being landed by the commercial vessels operating nearby.

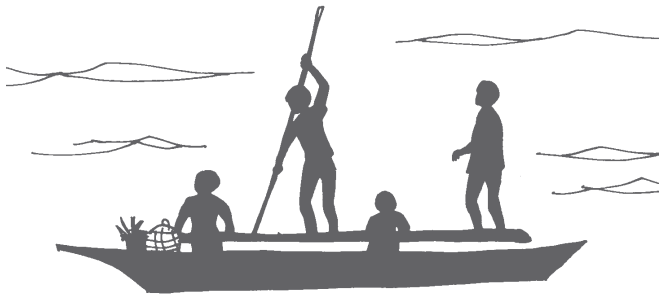
The time taken to set the three different sets of gear was about the same (two minutes). The average time taken to retrieve two dropline machine rigs was two minutes and four seconds. The average time taken to retrieve two hand reel rigs was three minutes and then ten seconds. The average time taken to retrieve two free rig droplines was six minutes and twenty seconds.

The hydraulic dropline machines kept hauling at a constant pace throughout the day. The crew operating the hand reels tired as the day wore on thus slowing down the retrieval of the lines. It took time to manoeuvre the vessel into place before the free rig droplines could be hauled aboard and even then only one line at a time could be retrieved.

The trials showed that a vessel operating the new hydraulic dropline machines had the potential to land more fish by being able to set and retrieve more hooks per day than similar size vessels using either hand reels or free rig droplines.

Over the past eight years the locally-produced dropline machines have proved to the best available machine for northern Australia's deepwater snapper fishery. Today 90 per cent of the vessels actively engaged in the fishery use the machines.

Vessels fitted with the machines have out caught all other vessels using an array of deepwater capture devices. Presently, fish-



ers operating three machines are catching around 500 kg of snapper per day. This catch rate increases during the peak of the fishing season. The largest vessel in the fleet (20 metres) uses six machines and has recorded landings of over 2,500 kg per day. During 1996 the vessels began exploring depths down to 350 metres and are now landing commercial quantities of ruby snapper (*Etelis* spp.).

Droplining technology has been and still is being tested in parts of Indonesia, Brunei and Papua New Guinea. Catch rates are presently not as high as those achieved in Australia but this is mainly due to financial constraints preventing operators from purchasing expensive fish finding equipment and hydraulic dropline machines.

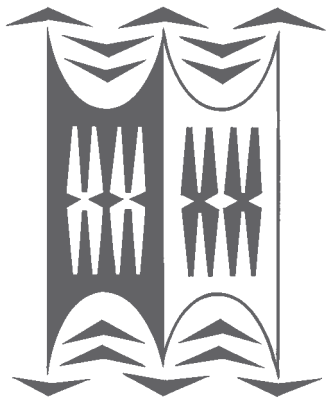
(Source: *Fishing Boat World*)

THE BIRTH OF A NEW SHIPYARD

The government shipyard flops that cost tax-payers millions of wasted dollars has not done the reputation of the country's small private shipbuilders any good. The epic *Reef Endeavour* contract disaster for a 1000-tonne cruise vessel, other contractual disputes, and now the present debacle, with the yard left without work, has smeared Fiji's shipbuilding reputation generally.

At the Wailada industrial estate at Lami, naval architect Chris Tsantikos, who for six years worked to get the *Reef Endeavour* completed, is having another go at local ship construction, this time under his own steam and in partnership with local ship operators Leo and Justin Smith.

In what Tsantikos laughingly describes as at this stage a 'completely primitive' shipyard, yet one equipped with everything needed to do the job, just six men are taking six months to build three 10-metre fishing boats.



Steel plates for them were shaped in just a few hours in Australia at a cost of just FJD 600 with sophisticated, 100 per cent accurate computer-guided laser cutters. To do the job in Fiji would take weeks and cost thousands of dollars. Moved to Wailada, the perfectly fitting hull plates are welded into a strong, seaworthy hull in practically no time.

New technique

Tsantikos says, by using the technique, he is building the 10-metre boats for FJD 10,000 to FJD 15,000 lower in plate cutting charges alone and for 60 percent of what building the same boat in Australia would cost.

'A complete boat would take about 2.5 months to finish, but we would be able to produce one every month as we would have a number under construction,' he says.

Tsantikos says his company, Bluewater Craft, sees a market for 15, 18 and 21-metre longline fishing boats and tourist cruisers.

'Inquiries are very, very good from solid people who are into fishing or intend to be.' There were four inquiries from French Polynesia, another four, with a possibility of a total of 10, from New Caledonia and 'a lot of' responses to advertisements in Australia.

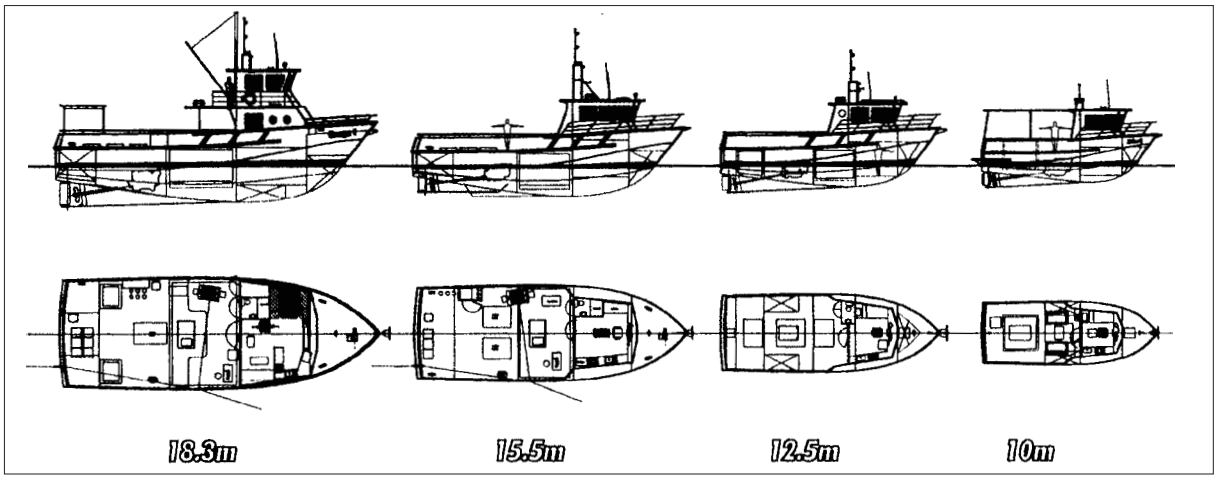
'Tahiti might be a rather difficult market because of a 35% duty on steel boats, but we may be able to get around it by building aluminium boats.

'The main problem with Australia is that we have to prove that we are actually doing it, especially for fishermen who want to see the boats. We can build exactly the same boats for about 60% of the cost of Australian boats.'

The three 10-metre pakapaka bottom fishing boats shaping up now are being built 'on spec'.

'We plan a joint venture with Trans Pacific Seafoods at Lautoka. We intend to keep 30%, Trans Pacific another 30% and the skipper 40% without investing any money. These boats will go to selected skippers who will have to go out and fish. All the management responsibility, fuel, maintenance, insurance, ice, everything, will be taken care of by Trans Pacific. As soon as we finalise finance the first boats should be in the water about 1.5 months after that. We can build a dozen boats of this size in one year easily.'

A 10-metre boat costs around FJD 150,000 including all electronics and safety gear. Fishing gear will be FJD 10,000 to FJD 15,000 plus more costs for operators who want to install generators and ice makers.



Boats to be built by Bluewater Craft

These craft have a range of 1600 kilometres, a hold with a capacity for a 1000 kilos of iced fish, a cruising speed of eight knots with a 150-horsepower Nissan diesel engine chosen for ease of obtaining spare parts. Tsantikos said he designed the craft to be as simple as possible.

'So far the kind of boats people have around here, the small guys with the 28 footers, don't work because they can't go outside the reef and they haven't got the fuel capacity to go very far, or the fish hold capacity to pay for them.

'We've done the numbers and with three crew our boats can pay for themselves and make a very reasonable living. Three thousand and five hundred litres of fuel will go a thousand miles so they can operate anywhere in Fiji. Accommodation is fairly basic; three bunks, a fully equipped wheelhouse, all the safety gear is brand new. They are seaworthy, but affordable boats and commercially viable. This is the most important thing.'

Tsantikos was born in Greece, graduated as a naval architect from the University of Glasgow, Scotland, and has designed a great variety of boats in Australia. He was hired to supervise the construction at the Shipbuilding Fiji Ltd.'s Walu Bay shipyard of a 1000-tonne cruiser for a Queensland reef cruise boat company. A two-year job became a six-year job. Disputes turned into litigation and cost overruns ultimately hitting Fiji taxpayers of millions of dollars. The *Reef Endeavour* was launched eventually as what proved to be a technical success but a costly disaster for taxpayers. What ruined the shipyard, he says, was lack of management and supervision.

'That is the thing that failed those contracts and it is unfortunate because the *Reef Endeavour*, which in some ways was a disaster for the government, proved that it could be done in Fiji. There was a chance to show that we can actually perform and we missed the chance again.

'I have a lot of faith in this country because I have worked with the people in shipyard for the duration of *Reef Endeavour*. The basic skills are here and if you work with the people here you can do a lot of things. The shipyard gave a bad name to everybody, but it gives us an opportunity to prove ourselves.'

Of the six men employed on the pakapaka boat, one is highly skilled, two are good welders and three men are unskilled. Tsantikos says the business hopes eventually to increase the workforce to about 15 and possibly move to the former IMEL (Carpenter-owned) shipyard at Walu Bay after the imminent expiry of a lease held by Shipbuilding Fiji Ltd. 'In that fully enclosed yard we could build up to 40 metre boats, a very good size for tourist and fishing boats.'

Tsantikos, who eventually plans to move his family to Fiji, was offered a job by the partly privatised government shipyard 'and declined because I felt they wouldn't make it'.

'The *Reef Endeavour* project proved what can be done in Fiji; the way it was done wasn't right. Another *Reef Endeavour* would have to be built by a completely private yard with no government involvement.

It would have to be done on a totally commercial basis; one would have to ensure that the technical side was right. The *Reef Endeavour*, apart from all the commercial and contract problems, had technical problems of design. You don't start a big project like that if the design side is not right'.

Tsantikos thinks the government shipyard could be salvaged only with a lot of private investment but 'in my opinion nobody is going to turn up for it because the history has been such that people would be very, very wary to put in more money. So the possibility is there to salvage the yard. But my thoughts are perhaps, this can be done more by local investors than by overseas ones.'

'The shipyard should be split into a slipway business and shipyard business with no ties between the two. Everybody has faith in the slipway business and will invest in it. Financiers will give money to improve the facilities, for instance a dry dock.'

'The shipyard is a different story. Nobody has faith in it apart from people like us. It should be turned into a marine industrial facility with all the building and industrial facilities rented to private businesses. That way the government would be assured of some income in the way of rent and there is also a good chance that these small private businesses would make it work in their own particular fields. This is an opinion shared by a lot of people in the industry, the shipyard is dragging the profitable slipway down with it.'

(Source: *Fiji's Business Magazine*, September 1999)

REGIONAL SYMPOSIUM ORGANISED IN NOUMEA

A regional symposium, under the auspices of the International Coral Reef Initiative (ICRI), will be organised in Noumea, from 22 to 24 May 2000. This regional symposium, "Coral reefs in the Pacific: Status and monitoring, resources and management", is being organised with two objectives:

1. To summarise the status of coral reefs, through the presentation of national reports; and

2. To identify the most appropriate tools and methods for improved use and management of coral reefs resources in the Pacific Islands.

Coral reef status and monitoring - national reports:

This session will present national reports from countries of the Pacific region on the status of their coral reefs and resources, including marine protected areas, the capacity of their monitoring networks, and current policy frameworks. These reports will present an analysis of the existing gaps for each country, indicating where efforts should be concentrated to improve the capacity to monitor and manage the reefs. These will be the first national reports on the status of coral reefs prepared since the development of the Pacific Regional ICRI Strategy in December 1995 and will constitute chapters for the next, "Status of Coral Reefs of the World", report which will be published by the Global Coral Reef Monitoring Network in October 2000.

Coral reef resources and their management

This session will follow on from the status reports to identify the best tools, knowledge and mechanisms for managing coral reef resources, including fisheries, coral rock and sand, and tourism sites. The session will seek solutions to current problems using an inter-disciplinary approach, involving economics, tourism, legal frameworks, policy formulation, traditional and cultural practices, marine protected area designation and management, mariculture, for example.

There will be both invited speakers and submitted papers to ensure that coral reef managers are provided with the latest scientific advances in knowledge.

There will be three presentation themes in this session and reporting will be made during separate working groups:

Theme 1: Natural and anthropogenic factors damaging reefs – suggestions for action

Theme 2: Fisheries and other commercial resources - suggestions for action

Theme 3: Economic evaluations of policy frameworks - suggestion for action

For more details, please contact:

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AUSTRALIAN BOAT BUILDERS MOVE TO ERITREA, AFRICA

by Steve Beverly,
Fisheries Development Officer
Secretariat of the Pacific Community

SPC Masterfisherman Steve Beverly was retained as a consultant during November 1999 to assist an Australian company, Seachrome Marine International, in conducting a training workshop for 54 Eritrean nationals on Halib Island in the Red Sea, Eritrea (northeastern Africa bordered by Sudan, Ethiopia, and Djibouti).

The workshop concentrated on longline fishing gear fabrication and in the proper techniques of setting and hauling monofilament longline fishing gear using American-made (Lindgren-Pitman) longline equipment and Australian-designed (built in Eritrea) fibreglass fishing vessels.

The Masterfisherman also advised Sea Chrome Marine International on vessel parameters, gear design, and fisheries development strategies for a Red Sea fishery using monofilament longline equipment. The workshop took place on a desert island, where a war-battered shipyard has been transformed into a productive facility, and a newly independent country has started to develop a new fishery.

Sea Chrome Marine International is a well-known company in the region and has a history of being one of the largest producers of top quality fibreglass fishing vessels in Australia.

In the past, they produced up to 50 per cent of the commercial vessels operating in the West Australian rock lobster fishery. During the early 1990s they branched out and began producing 18 and 20 m longline vessels for Pacific Island countries and territories. Several Sea Chrome longline boats have operated successfully in French Polynesia since 1993.

About two years ago the management at Sea Chrome Marine, Norm Wilhelm and Terry Dovey, were approached by representatives of the Government of Eritrea, who were interested in purchasing several Australian-made fibreglass fishing boats in two size ranges: 11 metres and 18 metres.

They were also looking for a design that would be suitable for the Eritrean navy as an armed patrol boat, primarily to be used for fisheries and coastal surveillance work. The negotiations took a bright turn for Sea Chrome when the Eritrean Government offered to buy the entire company. The package that was agreed upon included moving Sea Chrome's entire physical plant to Halib Island in Assab Bay, Eritrea and in hiring, on a contract basis, a large proportion of Sea Chrome's Australian workforce for a period of six years.

The venue for Sea Chrome's new home is Harena Boatyard, located on Halib Island. Halib Island is located in an archipeligo in Assab Bay and populated by Afar Nomads, camels, goats, gazelles, and crows (besides Australian boat builders and Eritrean workers and fishermen).

It is 70 km away from Assab, the nearest town, via a causeway and an unsealed road, or about an hour away by boat. During the 1980s, when Eritrea was still controlled by Ethiopia, the Government of Ethiopia had a shipyard built on the island that was built by the Koreans to international standards but was never fully utilised.

In the early 1990s Eritrea won independence from Ethiopia after a thirty-year war. The shipyard on Halib Island suffered from neglect and after that, was used only as a barracks for soldiers.

When the Australians arrived almost two years ago there were two or three thousand armed

Five new Sea Chrome Marine 11 metre longline boats from the Harena Boat yard on Halib Island, Eritrea. All are equipped with 24" x 27" Lindgren-Pitman monofilament longline reels. They are powered by Volvo-Penta 105 HP sterndrives.

soldiers living at the shipyard and most of the infrastructure was not working. After the soldiers moved out, the Australians brought in contractors to refit all of the buildings and to make repairs to the island's infrastructure.

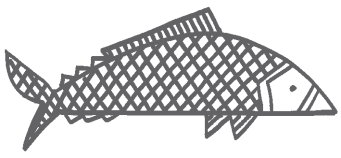
In less than two years' time, the shipyard, which is operated as a joint venture between Sea Chrome and the Government of Eritrea, has been fully restored and has produced several vessels including five 11 m and one 18 m longline boats. One 11 m version is rigged for trawling. They have also completed several 10 m and 17 m patrol boats, some of which have been exported to neighbouring African countries.

The shipyard rivals that in any developed country. There is a boathouse capable of holding several vessels at a time in various stages of construction up to 18 m and larger. The boathouse holds some of the moulds for the vessels as well as all fibreglassing equipment including several resin guns used for laying up hulls and superstructures. The shipyard has onsite: a travel lift for launching new boats or for slipping boats for repairs; a machine shop where all engineering work is done; a wood-working shop where wood components are fabricated; an electrical shop that supervises wiring and installation of all lighting and electronics; and, a metal works shop where all fitting and welding is done.

A storage workroom used for fabricating fishing gear, also serves as sleeping quarters for the fifty-four fishermen trainees during the training workshop. There is a larger barracks on the boatyard compound that houses the hundred or so Eritrean workers who are benefiting from the technological training being offered by the Australians. Each shop in the shipyard has one or more Australian supervisors, who not only do the fibreglassing and welding and installations, etc, but who also train several Eritrean counterparts at the same time. Eventually, the shipyard will be 100 per cent Eritrean owned and operated.

The Australians live in their own compound at Harena Boatyard that consists of several pre-fabricated buildings. Each man has his own air conditioned room with modern amenities. In the centre of the compound is a kitchen and dining room capable of feeding up to twenty-five men at a time. Sea Chrome has two cooks on hand, every day except Sunday, who prepare three meals a day for the Australian crew.

The Australian crew get rotated back to Fremantle, Western Australia for rest and recuperation on a regular basis.



The boathouse at Harena boatyard showing several vessels in the works: an 11 m fishing boat and a 17 m patrol boat in the foreground, and an 18 m longliner behing the 11 m

An 11 m Sea Chrome boat rigged for trawling. This boat caught all the bait used during the longline training course

Prior to the start of the training project, Pete Taylor, Sea Chrome's fisheries technician, had started instructing the captains and crews of the new 11 m and 18 m boats in how to make up longline fishing gear for monofilament systems. He had also conducted several trips on one of the 11 m boats and on a larger vessel that had been fitted with a Lindgren-Pitman Super Spool and an LS-4 Line setter. This vessel, F/V *Hanish*, was a former Egyptian trawler that had been seized by the Eritrean Government for fishing illegally in Eritrean waters.

Reportedly, there were over fifty similar vessels now owned by the Government of Eritrea. Pete had some success with the two vessels but was experiencing some difficulties with the equipment on *Hanish* and with the gear configuration.

During the first week, the training project on Halib Island concentrated on gear fabrication. Pete had already trained the fishermen in how to splice and how to make up branchlines. Work on fishing gear was carried on with a few modifications and eventually completed for five 11 m boats and one 18 m boat. Radio buoys for three 18 m boats and for the *Hanish* were rigged as well.

The 11 m boats are not equipped with RDFs or radio buoys. Two styles of branchlines were made up, 3 m and 10 m. The 3 m branchlines were for bottom longlining and the 10 m branchlines were made for pelagic longlining. They were all made from 2.0 mm monofilament with a half meter of stainless steel wire trace. Two types of hooks were used, a 3.6 stainless steel Japanese tuna hook, and a 14/0 tuna circle hook. All floatlines were made from 6.4 mm tarred mainline and were 10 m long.

By the end of the week most of the trainees had mastered the basics of making up longline gear: splicing tarred line, coiling the floatlines, rigging floats, swaging monofilament and stainless steel wire branchlines, and coiling the branchlines into bins. A few had learned how to properly rig a radio buoy with a net around the float collar and a bridle. During this week, sea trials for the first 18 m boat, F/V *Vasco*, were conducted.

During the following week of the workshop the captains and crews of the 11 m boats were trained in proper setting and hauling techniques. During these trials advice was given on several needed modifications to the boats, to make fishing safer, easier and more efficient. On the first trip, each boat set gear without bait. After the captains and crew proved capable of operating the boats and gear, real sets were made using trawl caught fish as bait. All sets done from the 11 m boats were bottom longline sets in water averaging 30 m. The fish caught on these sets were mostly sharks and rays but a few saleable species were also caught (jacks, snappers, and groupers and one they call catfish).

The L-P gear worked very efficiently as bottom longline gear. Setting and hauling were almost identical to pelagic fishing. The main difference was that the baskets were larger (50 to 60 hooks), the branchlines were shorter (3 m), and the floatlines were longer (50 m with anchors on the two end floatlines).

Since there were no line setters on the 11m boats, the line was towed during setting. The sets were all done fairly close to Halib Island. Blind sets were

An 11 m longliner, showing placement of the Lindgren-Pitman 24" x 27" longline reel, and the control station. The insulated fish box is just forward of the reel and a branchline bin is secured in chocks just aft of the reel.

F/V *Vasco*, the first of many 18 m longliners from Harena Boatyard. *Vasco* is equipped with a Lindgren-Pitman 38" x 48" Super Spool and an LS-4 Line Setter. The boat is powered by a Caterpillar 3406 diesel.

done over sandy bottom very near to the channel while the baited sets were done farther away just to the west of Fatuma Island (another of the islands in the archipeligo in Assab Bay).

Similar training was carried out on the 18 m longliner, F/V *Vasco*. A blind set was made using 15 hook baskets. After a few initial problems were worked out, *Vasco* was sent out to fish in the middle of the channel (the straits of Bab El Mandeb) between Eritrea and Yemen, where the water deepens to about 200 m. The set was done as a typical tuna set.

Masterfisherman Steve Beverly instructs the Eritrean crew in how to use a line setter on board F/V *Vasco*.

Four hundred and fifty hooks in 30 baskets of 15 hooks were set using Indian mackerel (*Rastrelliger* sp) as bait. The floatlines were 10 m and the branchlines were 10 m. All hooks were 3.6 Japanese tuna hooks. The sagging rate of the line was eye-balled at 0.7, using the method of grabbing the mainline as it exists the line setter and counting to eight. This made the set relatively deep.

The line was set in the morning and hauled in the afternoon. The catch was disappointing: several *Carcharhinus* sp sharks and one pink snapper (*Pristipomoides typus*).

Later, a night set was made from *Vasco* using a bottom longline configuration in 30 to 50 m water in an area just to the northeast of Assab. Four hundred hooks were set in 50 hook baskets. The floatlines were 50 m while the branchlines were 3 m in length ending in a 14/0 tuna circle hook. The bait was mixed trawl fish caught by one of the 11 m boats that had been rigged for trawling.

The line was set beginning at 2030 and hauled at 2330. The line setter was used but only at the slowest speed, so that the line would not tend to tangle on the bottom. As it turned out, however, the line did snag and part. It had to be recovered by travelling to the radio buoy at the far end and hauling from there. Hauling was completed at 0630.

The catch consisted of about 200 kg of snappers and groupers and one or two coral trout. The main species were *Lutjanus bohar*, followed by *Epinephelus chlorostiga* and *E. microdon*. A few *Plectropomus* sp were also caught.

Towards the end of the workshop a brief trip was made on *Hanish* (the Egyptian trawler) for a bottom longline set in order to give an evaluation of the boat. *Hanish* was equipped with an L-P Super Spool and a line setter plus all of the ancillary gear.

Three 50 hook baskets were set using the same configuration as the bottom longline set from the *Vasco*. The difference was that the line setter was used only as a line guide. The hourglass rollers on the line setter were used but the drive wheels were not used.

In other words, the line was towed so that it would lie straight on the bottom with less chance of fouling on the bottom. Hauling started at 0915 and was completed by 1110. The catch was 15 catfish, one jack, and five rays. Compared with the set made from *Vasco* using the line setter, this line came up more smoothly, although sea conditions were better.

When the workshop was completed the Masterfisherman was given a tour of the fisheries

A 17 m patrol boat for the Eritrean Navy

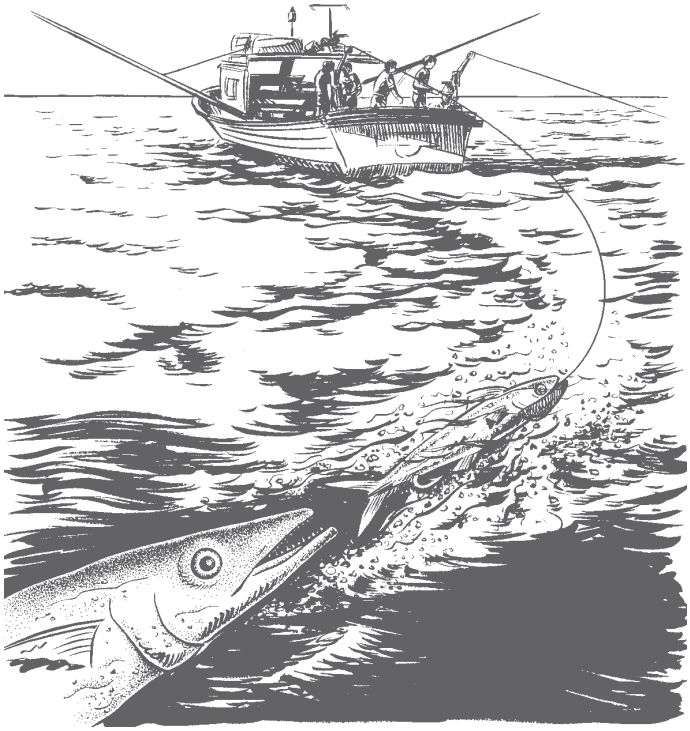
complex in Assab. Two years ago the government of Japan built a fishing infrastructure for Eritrea that consists of a wharf with breakwater, a desalinisation plant, a flake ice maker, a block ice maker, chill rooms, processing rooms, two blast freezers, and a holding freezer.

The Ministry of Fisheries was using the facility to process fish caught by the local fleet, which consisted of mostly traditional Arabian style dhows (with Yemenese crew) using gill nets.

The Ministry of Fisheries purchases the fish (snappers, groupers, and jacks), processes them into frozen wrapped filets (pin bone in) and then stockpiles them in the holding freezer. It appeared that they had several tonnes of processed fish in store, but had not yet developed a steady market for their product.

The fish processing factory was under tight sanitary controls. Everyone entering had on gum boots and sanitary outerwear, and stepped into a foot wash before entering the cutting room. The workers were all properly attired, including hairnets. The cartons were all labelled with species, count, weight and date. The factory appeared to be ready for HACCP certification. The Ministry of Fisheries is hoping to export fish to EU markets.

The boats being built at Harena Boatyard will soon be fishing into this complex. One possibility for the future, considering the composition and relative abundance of the bottom fish catches, is the live reef fish trade in Asia. Nearby Dubai has regular airlinks to Singapore and Hong Kong. Even if the fishery in the Red Sea does not match other places, however, Eritrea is likely to become a major producer of boats for Africa and the Middle East.



USE OF ACOUSTIC METHODS TO CHARACTERISE THE TUNA ENVIRONMENT AND ESTIMATE TUNA BIOMASS WITHOUT REFERENCE TO CATCH DATA

by Arnaud Bertrand & Erwan Josse, Institute of Research for Development (IRD - formerly ORSTOM)

Introduction

If tuna abundance in the longline fishery could be estimated without reference to catch data, it would be possible to overcome the problems associated with catchability. Direct abundance estimates have been made in French Polynesia using acoustic methods. From 1995 to 1997, the ECOTAP* Programme carried out a research project designed to improve understanding of the behaviour and distribution of tunas catchable at depth in the French Polynesian EEZ longline fishery.

The use of acoustic methods is one of the key ECOTAP Programme activities. Such techniques are increasingly being used to study small pelagics, but had not to any extent been extended to the study of tunas and their environment before the ECOTAP programme. The contribution of this technique to the ECOTAP Programme was a determining factor, mainly in the two following areas:

- Characterising the pelagic habitat in French Polynesia;
- Studying the distribution and estimating the abundance of tunas in the longline fishery.

The main results and benefits achieved by acoustic methods are summarised in this paper. Such results have direct applications in resource management and exploitation.

Characterisation of the pelagic habitat in French Polynesia

The distribution of tunas, which are fish with a high metabolic rate, can be linked to the availability of forage. Micronecton, formed of small crustaceans, fish and cephalopods (1–10 cm approximately) is the main tuna prey, but little research has been done on its distribution in the Central Pacific. Acoustic methods allow a two-dimensional and unbroken sweep over the pelagic habitat and are an excellent instrument for studying micronecton distribution.

In the ECOTAP Programme, acoustic methods were used to determine the distribution of micronecton in relation to the main oceanographic features present in the EEZ of French Polynesia (Bertrand et al., in press). It is important to report that, with the equipment and settings used, the acoustic data recorded during the ECOTAP Programme were representative of the fish and cephalopod biomass, which represents the dominant micronecton biomass in the pelagic ecosystem of French Polynesia.

The ECOTAP programme's research results have made it possible to define three zones, which remained highly constant throughout the two years of the programme, lying in a northwest south-east direction and displaying different characteristics (Figure 1).

- The first zone is located to the south of a line between 11 and 14°S in oligotrophic waters of the South Pacific central gyre. It is characterised by very low biomass and very few micronecton aggregations
- The second zone is largely located between the Marquesas Islands and Zone 1. This zone lies in a convergence zone, allowing the accumulation of organic matter. It shows the highest biomass readings and a high occurrence of micronecton aggregations.
- The third zone is located to the north of the Marquesas and shares many characteristics with Zone 1, although the two zones are hydrologically very different. In this zone, the zooplankton biomass is at its maximum level, but the presence of de-oxygenated water at deeper levels (Figure 1) restricts the volume of the habitat and, consequently, the abundance

* ECOTAP—*Etude du Comportement des thons par l'Acoustique et la Palangre de la zone économique exclusive de Polynésie Française*, (Study of Tuna Behaviour using Acoustics and Fishing in the French Polynesian EEZ), a joint programme between SRM (ex-EVAAM), IRD (ex-ORSTOM) and IFREMER. Funding was provided by the Government of French Polynesia and the other programme partners.

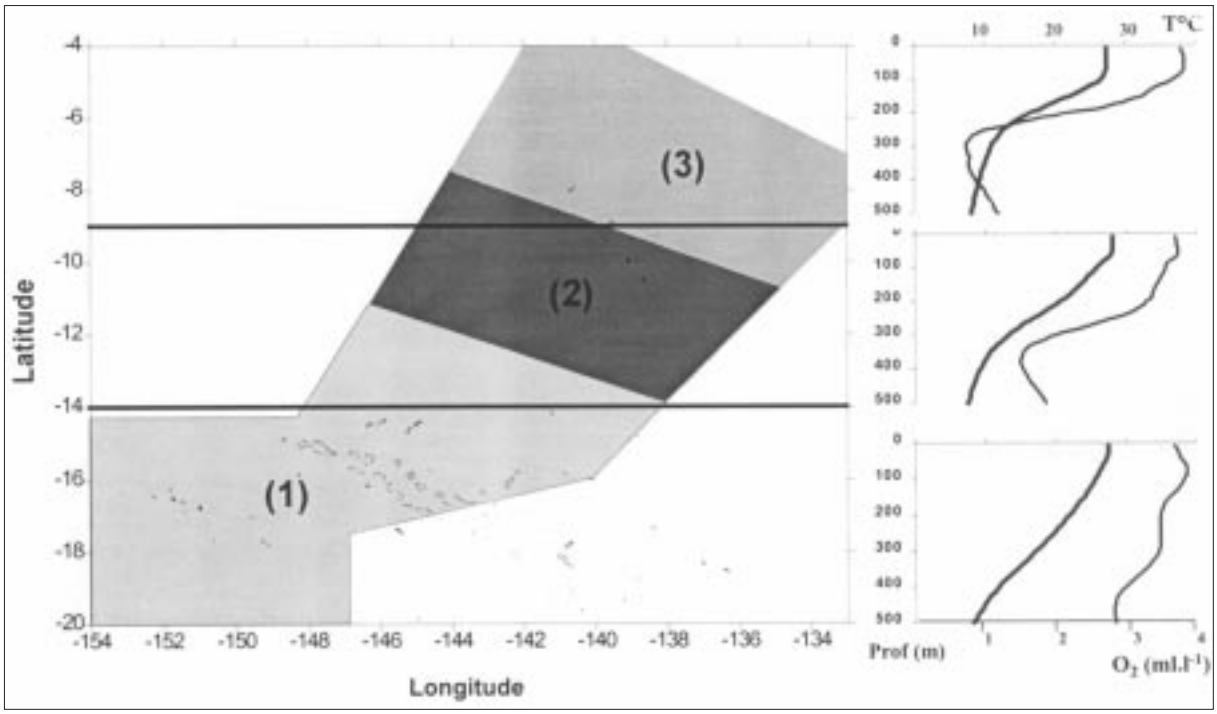


Figure 1: Zones defined in dividing up the research area using physico-chemical parameters (horizontal divisions) and from the micronecton distribution (surface divisions). The mean temperature (thick line) and dissolved oxygen (thin line) profiles for each hydrological zone are also plotted.

of micronecton. The micronecton biomass shows moderate density here when compared to the region under study as a whole and aggregations are infrequent.

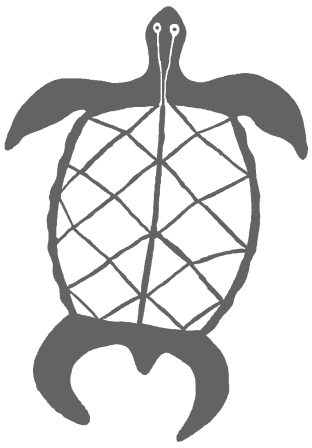
The location of the maximum micronecton abundance area differs from what is usually reported in the literature. Those results represent major progress in the understanding of tropical ecosystems.

A summarising diagram of the functioning of the pelagic ecosystem in French Polynesia (Figure 2) may be described as follows. The primary production engendered by the equatorial upwelling is focused on the equator; it permits maximum zooplankton production, offset slightly to the south (2–5°S).

This spatio-temporal displacement is due to the meridional component of the South Equatorial Current and the time these animals take to develop.

The micronecton can be recruited from either of the two zones. In one, the maximum zooplankton abundance area, the micronecton larvae are thought to take advantage of the presence of phytoplankton to feed in the surface layers.

As they grow, they are thought to be transported southwards by the meridional component. In the second, the convergence zone itself, the larvae and adults may find appropriate food, i.e. phytoplankton and particles from the bacterial chain, but also zooplankton.



To the south of the convergence zone, there is no oxygen limit at the greatest depths, but there is a food restriction. The two different hydrological structures between 4 and 8°S and between 13 and 20°S therefore generate a biomass and aggregation distribution which are similar for different reasons.

In conclusion, the use of acoustic methods has made it possible to show that micronecton distribution should be considered with reference to the lower trophic levels but also to other parameters such as dissolved oxygen. Acoustic methods can therefore produce a multi-dimensional characterisation of the habitat with extensive vertical scope. In addition, the results from such studies are a useful instrument for validating the tuna forage abundance prediction models.

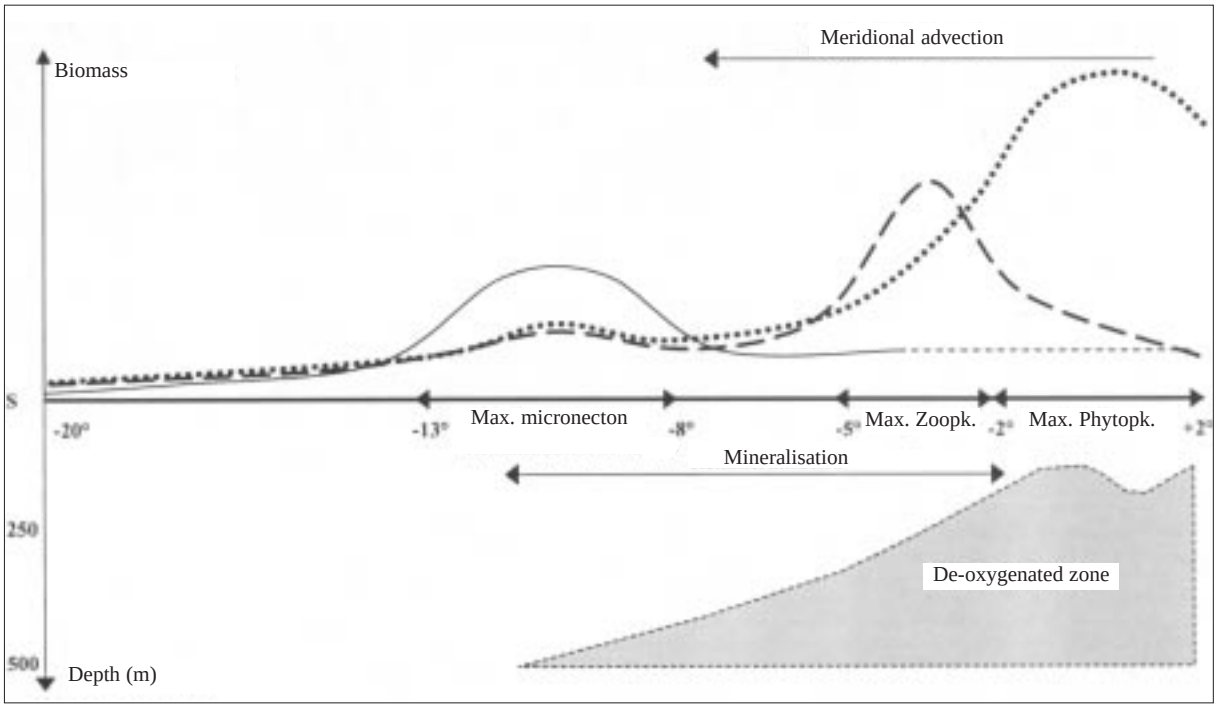


Figure 2. Diagrammatic representation of the latitudinal distribution of phytoplankton (dotted line), zooplankton (broken line) and micronecton (continuous line) biomass at 140°W according to the latitudinal distribution of the de-oxygenated zone (according to Bertrand et al., in press).

Estimation of tuna abundance in the longline fishery

Unless every single fish is caught, any attempt to estimate the abundance of a fish population will necessarily be biased. The abundance measurements carried out with passive gear such as the longline are particularly biased.

Catch per unit effort (CPUE) figures depend on catchability and therefore the accessibility and vulnerability of the resource, as well as the efficiency of the gear-type. Until now, tuna observations were only possible when they were actually caught or present in the form of a surface aggregation.

The only source of data to study distribution and estimate scattered tuna abundance over a range of depths up to 500 m was longline catches. However, the CPUEs recorded by professional longliners are not necessarily an accurate indicator of tuna abundance in the fishery because the hook depth must coincide with the fishes' habits, which is not always the case (Hanamoto, 1987).

Acoustic methods make it possible to observe fish echoes throughout the water column. However, in order to be able to match an echo to a fish of a specific species, either the targeted fish must be caught or the individual target strength (TS) of such a fish must be known. No research had been carried out on measuring tuna TSs.

Experiments were therefore performed as part of the ECOTAP Programme in order to determine a TS range for yellowfin and bigeye tunas (Bertrand et al., 1999a, b; Josse & Bertrand, submitted). With such results available, it becomes possible to directly study tuna distribution in the longline fishery and estimate their abundance using acoustic methods (Bertrand & Josse, submitted).

A summary of the two methods used to measure the TS of free-swimming adult tunas will be presented. Lastly, this TS range was used to select the individual echoes which could be attributed to tunas during the acoustic surveys carried out using longlines and to estimate tuna biomass in the French Polynesian EEZ.

Measuring individual target strength (TS) by coupling observations from a split-beam echoso-under and ultrasonic tagging

A good knowledge of target strength is the pre-condition for any quantitative or qualitative fisheries study using acoustic methods. The method presented here (Bertrand et al., 1999a, b) involves coupling TS mea-

surements to the telemetric tracking of a tagged tuna of known size and species. When the fish passes through the echo-sounder beam, its target strength can be measured (Figure 3). This method is appropriate for field measuring the target strength of large pelagic fish. TS variability can be studied with reference to the behaviour of a clearly identified fish swimming freely in its environment. The TSs of four yellowfin tunas (*Thunnus albacares*) and two bigeye tuna (*T. obesus*) were measured in this way (Table 1).

Table 1: Summary of target strengths (TS) of yellowfin tuna (*T. albacares*) and bigeye tuna (*T. obesus*) as measured by (1) Bertrand et al. (1999 a, b) and (2) Josse & Bertrand (submitted)

Species	Fork length (cm)	Estimated weight (kg)	Mean TS (dB)	Reference
T. albacares	60	4	-34.8	(1)
T. albacares	90	14	-33.0	(1)
T. albacares	108	25	-30.4	(1)
T. albacares	120	30	-26.1	(1)
T. obesus	49.9	3	-32.8	(2)
T. obesus	50.1	3	-31.9	(2)
T. obesus	110	30	-24.4	(1)
T. obesus	130	50	-21.4	(1)

Field determination of the target strength (TS) of tunas associated with a Fish Aggregating Device in French Polynesia

The first method, implemented six times during the ECOTAP Programme, made it possible to measure the TS of a clearly identified fish but also to monitor developments in this TS as determined by the behaviour of this fish swimming freely in its environment. Such a method is particularly useful for scattered deep-swimming large fish. The second method (Josse & Bertrand, submitted) makes it possible to measure target strength from a large number of fish aggregated around a FAD. Fish were caught by trolling to determine the species composition and size structure of each component of this aggregation.

This method made it possible to measure the TSs of young bigeye tuna approximately 50 cm in length (Table 1) at a two-year interval. The TS measurements from tunas associated with a FAD can also be used to study the behaviour of the aggregation: repetitive nature of structures over time, size stratification depending on depth, and effect of boat speed on depth of detections.

The two approaches developed within the ECOTAP Programme, one involving measuring the TS of a clearly identified tuna swimming freely in its environment and the other involving measuring the TS of aggregated tunas, are complementary. They both make it possible to obtain field TS values which can be used in biomass estimations. One is more directly concerned with scattered fish swimming over a wide depth range, which is the case with adult tunas, while the second relates to surface aggregated fish, which is the case with juvenile tunas.

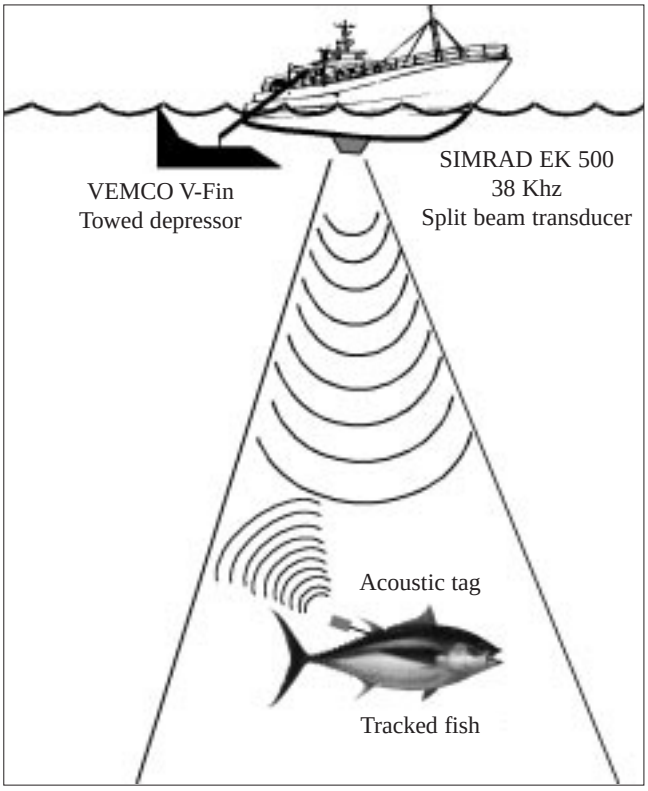


Figure 3: Diagram showing the principle used to measure the target strength of a tuna from the coupled use of acoustic surveying and telemetric tracking (according to Bertrand et al., 1999a).

The second approach is less costly and technically easier to carry out than the first. It should also be usable not only around moored FADs but also when fish have aggregated. Lastly, measuring the TS of aggregated tunas has the advantage of being directly usable to estimate aggregation biomass.

Acoustic estimation of tuna abundance in the longline fishery

The results of TS measurements from the ECOTAP Programme were referred to in order to select individual echoes which could be identified as tunas during the acoustic surveys (Bertrand & Josse, submitted).

A total of 361 such echo groups were selected. The mean density was 1.33 fish per km^2. It would appear that acoustic methods make it possible to count echoes matching tunas representative of the abundance of all three longline fishery tunas (albacore, yellowfin and bigeye). The densities of tuna obtained using acoustic techniques (Table 2) were converted into biomass using the mean individual weight gained from catches landed during the ECOTAP Programme (Table 1). The densities thus obtained are quite consistent with abundance estimations worked out from IATTC data (Bertrand & Josse, submitted). Extrapolation of the density estimates as measured by acoustic means north of 20°S in the French Polynesian EEZ (surface area of some 2,900,000 km^2) yields a biomass of approximately 100,000 tonnes.

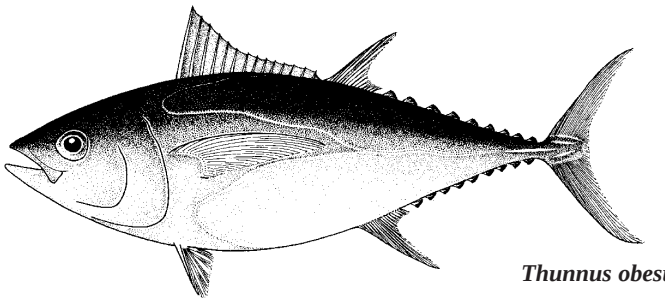
This study shows that the distribution of tunas in the longline fishery can be estimated using acoustic methods without reference to catch data. Further, acoustic surveys make it possible to achieve a direct biomass estimation, which is not possible from CPUEs because data from a longtime-series are required.

It is not yet possible, however, to distinguish between the different species of tuna. Improvements in these acoustic methods will definitely make easier data processing possible. There are many potential applications. These may relate to stock management but also to the improvement of fishing techniques.

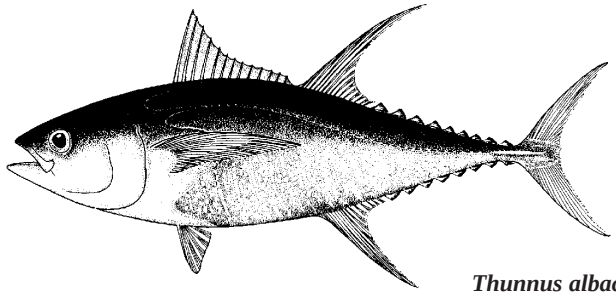
A comparison between acoustic estimations and longline catches will also make it possible to gain a better understanding of catchability factors. Lastly, acoustic observation of tuna may yield an understanding of space occupation and tuna distribution and behaviour.

Table 2: Density of echoes identifying tunas detected by acoustic methods during ECOTAP cruises over the whole study area and by zone. The mean weights of tunas caught during ECOTAP cruises make it possible to convert densities into biomass (according to Bertrand & Josse, submitted)

	Total	Zone 1	Zone 2	Zone 3
Density (number/km^2)	1.33	1.33	1.87	0.69
Mean weight of tuna (kg)	25.4	24.2	23.9	33.2
Density (kg/km^2)	33.8	32.2	44.8	22.8



Thunnus obesus



Thunnus albacares

Conclusions

The contribution of acoustic methods to the ECOTAP Programme has been considerable. These techniques have made it possible (1) to characterise the pelagic habitat in French Polynesia and thus better understand the functioning of the oceanic ecosystem; and (2) to observe tunas outside fishing activities and estimate their abundance. The ECOTAP Programme has pioneered this technique and opened the way for many future studies.

The practical results that may be directly usable in French Polynesia are many. The most productive zone for micronecton, in other words tuna forage, is located between the Marquesas Islands and a NW-SE line located between 11 and 14°S.

The tuna catches are higher in this zone or more simply in the region between latitudes 8–9 and 13–14°S. Inside this maximum tuna abundance zone, because of possible competition between bait and micronecton, it is preferable to fish where, locally, large micronecton aggregations are not observed with the echo sounder. The acoustic surveys have also made it possible to perform an initial direct tuna abundance estimation for the longline fishery. In this way, the tuna biomass has been estimated at 100,000 tonnes north of 20°S in the French Polynesian EEZ, which is quite logical.

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