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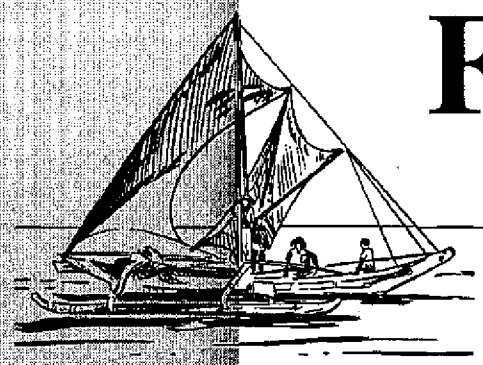
FISHERIES

Newsletter



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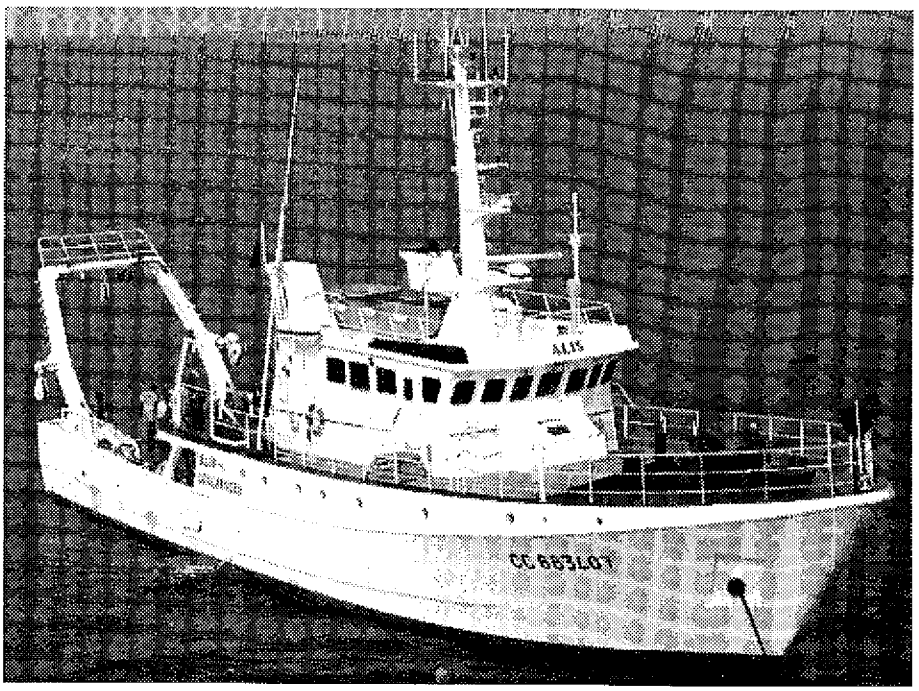


The RV *Alis* carried out a cruise in the waters of French Polynesia as part of the Territory's research programme on tuna.

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

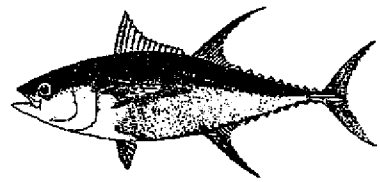
TWENTY-FIFTH REGIONAL TECHNICAL MEETING ON FISHERIES (RTMF)

The signing ceremony for a major new project to study tuna (the South Pacific Tuna Resource Assessment and Monitoring Programme, or SPRTRAMP) was the highlight of the Twenty-fifth Regional Technical Meeting on Fisheries, held at SPC headquarters in Noumea from 14 to 18 March.

This five-year project is funded by the European Union. It will carry out continuous monitoring of tuna fisheries in the region and refine the resource assessment work initiated by SPC's Regional Tuna Tagging Project.

The purpose of the meeting was, as usual, to review the activities carried out in the region under the various SPC fisheries programmes, to discuss major issues relating to the development of Pacific fisheries, and to enable the people in charge of fisheries departments to exchange information and ideas.

Morning sessions were devoted to consideration of programme activities and afternoons to technical discussions of such topics as an overview of the Western Pacific tuna fisheries, an update of assessment of yellowfin, skipjack, bigeye and albacore stocks, an outline of SPRTRAMP, the status of Pacific Island inshore fisheries, the development of broadbill swordfish longlining in the Pacific region and the processing of novel tuna products in the Pacific.



The Oceanic Fisheries Coordinator summarised the activities of the Oceanic Fisheries Programme over the past 18 months. The Fisheries Statistician then reviewed the status of data provision by each major tuna fishing nation in the region, emphasising that data provision had improved significantly over the past few years, with acquisition of data from American purse seiners, Japanese purse seiners and long-liners and, notably, Taiwanese longliners. Participants expressed support for the Oceanic Fisheries Programme and for the maintenance of the statistical monitoring function, a priority strongly emphasised by the Fifth Meeting of the Standing Committee on Tuna and Billfish.

Participants then heard reports on the Sixth Standing Committee on Tuna and Billfish, the Third Meeting of the Western Pacific Yellowfin Research Group and the Fifth Meeting of the South Pacific Albacore Research Group.

The activities of the Coastal Fisheries Programme were then reviewed. In discussing the Capture Section, the Fisheries

Participants at the 25th Regional Technical Meeting on Fisheries

Development Adviser stressed the important role of the SPC Masterfishermen as catalysts for disseminating fishing technology throughout the region.

The Post-Harvest Fisheries Adviser described the work of his section, concentrating on the development of alternative tuna products.

During discussion of the Training Section, the Meeting noted that its diverse activities reflected the wide-ranging training and educational needs of the region's fisheries sector. The Meeting recommended that the Section continue its efforts to:

— Support national fisheries training and educational institutions and human resource development initiatives;

— Develop and coordinate national and regional initiatives in standardising fishing vessel crew certification;

— Implement organisational and enterprise management training initiatives;

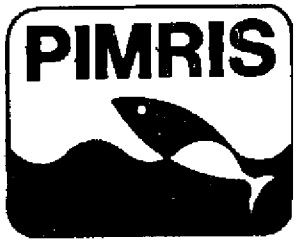
— Coordinate and seek appropriate funding to facilitate development of a vocational fisheries certificate programme suitable for implementation in national technical institutions;

— Support and develop public awareness of safety-at-sea issues, particularly through the provision of media resource materials such as videos and posters.

The main components of the Resource Assessment Section were reviewed, with special reference to the development of trochus management regimes, reviews of coastal fisheries monitoring programmes, advice on bait fisheries for longlining and assessments of coastal fisheries resources. The Section's regional activities also include the maintenance of a database on ciguatera, the support of an FAO aquaculture project and a review of giant clam culture activities.

The meeting next considered the activities of the Information Section, which involve the gathering, editing and redistribution of fisheries-related information through the region. The participants expressed their appreciation for the Special Interest Group Information Bulletins and the bibliographies produced by the Section.

Participants were also invited to hear the Coordinator of the Pacific Islands Marine Resources Information System (PIMRIS) present the deliberations and recommendations of the Sixth Meeting of the PIMRIS Steering Committee.

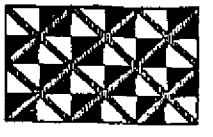


A working paper was then presented on the review of regional institutional arrangements in the marine sector. This review will be conducted soon and will concentrate on how to most effectively direct work in the marine sector to meet the region's future needs in development, management and conservation of marine resources.

The next subject on the agenda was quarantine protocols for marine species. The Secretariat's approach had involved three phases: a baseline study of introductions of aquatic animals in the South Pacific, a review of quarantine policies and the development of principles for assessing the potential ecological impact of marine species introductions (to be conducted).

Finally, the participants listened to statements by other organisations involved in fisheries development in the region: the Australian Centre for International Agricultural Research (ACIAR), the French Institute of Scientific Research for Development in Cooperation (ORSTOM), the Overseas Fishery Cooperation Foundation (OFCF), the United Nations Development Programme, the United States Agency for International development (USAID), the University of the South Pacific (USP), the Western Pacific Fisheries Consultative Committee, the International Center for Living Aquatic Resources (ICLARM), the South Pacific Regional Environment Programme (SPREP), the Centre for Tropical Coastal Management Studies, The Resource Development Associates (RDA), the Western Pacific Regional Fishery Management Council (WPRFMC), and the Forum Fisheries Agency (FFA).

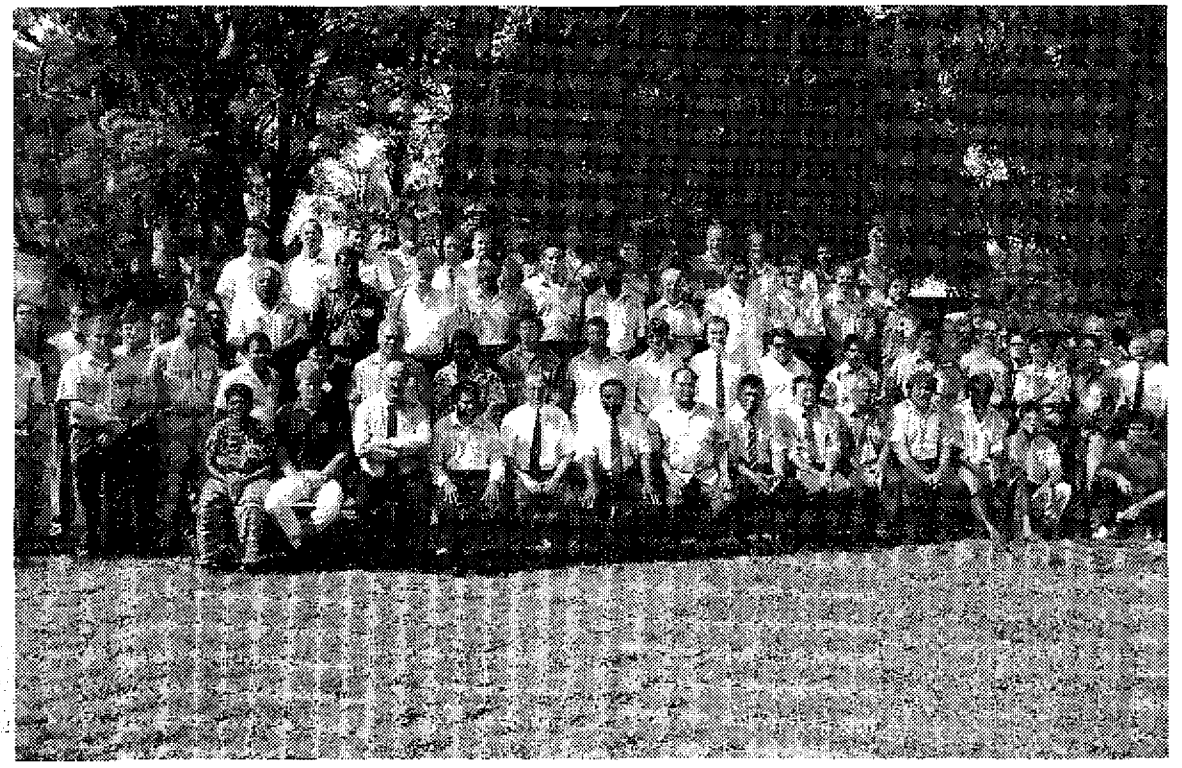
The meeting was interesting and productive, covered a wide range of topics and provided important guidance for SPC's future work in fisheries. As always, much business was conducted outside the meeting room, and many delegates benefited from the opportunity to establish personal contact with representatives of other countries and institutions/organisations.



The meeting brought together 70 participants from 24 SPC member countries and 21 international or other organisations.

In accordance with the procedure of rotating the Chairmanship alphabetically between member countries, Mr Rufo Lujan of Guam chaired the meeting while Mr Maruia Kamatie of Kiribati was appointed Vice-Chairman and Chairman of the Drafting Committee.

The Twenty-Sixth Regional Technical Meeting on Fisheries will be held in March 1996 at SPC headquarters in Noumea.



The 25th RTMF was attended by 70 participants from 24 SPC member countries and 21 international or other organisations.

RESOURCE ASSESSMENT SECTION

Duty travel by the staff of the Inshore Fisheries Research Project (IFRP) was kept to a minimum during the first quarter of 1994 due to budgetary constraints. Time was devoted to preparing for the 25th Regional Technical Meeting on Fisheries (RTMF) and to finalising publications. Two more IFRP Technical Documents were finalised in February and were printed in time for RTMF.

The first of these was a collection of papers presented at the *Workshop on People, Society and Pacific Island Fisheries Development and Management*, which was held during the 23rd RTMF in 1991. The other contained an assessment of the exploitation of coral reef fisheries in Palau that resulted from an in-country assignment in September 1991. The draft report was submitted to the country shortly after this, but publication was delayed by the pressure of work resulting from national assignments.

During RTMF the IFRP conducted a technical session on the present status of Pacific Islands coastal fisheries. This included a review of the present status of coastal fisheries in the region and estimates at national level of the volume and value of coastal fisheries production. This project, one of several regional activities conducted by the IFRP staff between assignments arising from member country requests, has included the establishment of databases for archiving material on national fisheries production and identifying sources of information. A brief summary of the information produced by the IFRP on coastal fisheries production was published in *Fisheries Newsletter #66*. The presentation at the 25th RTMF also included reviews of the present

status and likely direction of coastal finfish and invertebrate fisheries.

Following the RTMF, the IFRP hosted a two-day attachment by Mr Krishna Swamy of the Fiji Fisheries Division. Mr Swamy is currently in charge of the Resource Assessment and Development Section of the Fiji Fisheries Division and is studying for his Master of Philosophy degree with the University of the South Pacific. Mr Swamy has chosen to look at the exploitation of mud crabs (*Scylla serrata*) in Fiji and has amassed a considerable amount of data from exploited populations on the main island of Viti Levu.

This includes several length-frequency data sets which may be used to generate growth and mortality parameters for crab populations. During the attachment, the length-frequency data were analysed using the ELEFAN suite of programmes. Some preliminary estimates of growth and mortalities were obtained that corresponded well with results from studies on this species elsewhere. It was hoped that the data could be run with other length-based stock-assessment computer packages to test these results, but this was not feasible given the limited time available.

The IFRP continued to give limited support for aquaculture in the region through funds provided by UNDP for the period between the termination of the first phase of the South Pacific Regional Aquaculture Development Project and the commencement of the second phase.

During the first quarter of 1994, a training attachment to the Fiji Fisheries Division freshwater aquaculture station at Naduroloulou has been planned for a Western Samoan tilapia farmer. It will focus on the management aspects of commercial tilapia production. This is a follow-up activity to the construction of a demonstration tilapia farm in Western Samoa, which was carried out with the assistance of the Fiji Fisheries Division through funding support from the interim UNDP aquaculture funds.

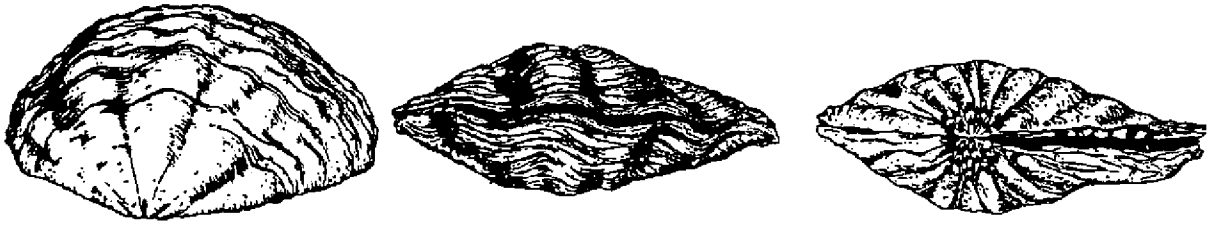
Funding is now almost exhausted and UNDP has not responded positively to suggestions it be continued until the new FAO regional aquaculture project is established.

Fisheries Resource Adviser visits Fiji and Tonga

In February the Fisheries Resource Adviser visited Fiji and Tonga as part of a pre-feasibility study towards a possible Phase III of the International Giant Clam Project in collaboration with the Australian International Development Assistance Bureau. The Fiji Fisheries Division's Mariculture Research Station at Makogai, under the guiding hand of Fisheries Officer Aisake Batibasaga, is an impressive demonstration of appropriate technology in action.

The giant clam hatchery is built into what was left of a former leper colony after the best buildings had been shipped away, and the whole station grew piecemeal out of a quarantine experiment started in 1986 during Phase I of the Australian Centre for International Agricultural Research (ACIAR) Giant Clam project. Work recently has concentrated on building up stocks after the devastation caused by Cyclone Kina (January 1993), and Makogai is now using cyclone mitigation techniques for the ocean nursery based on floating raft culture, then cage culture, at depths greater than eight metres.

In Tonga, external assistance towards giant clam research has been much more substantial, with the advent of a Japanese International Cooperation Agency mariculture project that is completely renovating the hatchery facilities built into the Sopu headquarters of the Ministry of Fisheries. One notable achievement of this project has been the culture of several batches of the newly described "devil" clam *Tridacna tevoroa*, which is confined to Tonga and



***Tridacna tevoroa* shells**

the Lau Group of Fiji and is extremely rare. As suggested when it was first brought back to Suva from Vatoa by fisherman Alf Robinson, this clam appears to grow much faster than *T. derasa*, at least for the first year. Apart from this, in both countries, extension work towards actual reef-reseeding and clam-farming has been delayed, and this is the need that the SPC study has been investigating.

POST-HARVEST SECTION

AARD/ACIAR Fish Drying Workshop

For a number of years, the Australian Centre for International Agricultural Research (ACIAR) has supported collaborative research into improved technology of dried fish production in Indonesia, where dried fish is an important, cheap and widely consumed source of animal protein. Problems associated with low-quality products and losses during processing, storage and distribution are very common. Numerous research projects to help alleviate many of these problems have attracted ACIAR support since 1984.

A Fish Drying Workshop was jointly hosted by Indonesia's Agency for Agricultural Research and Development (AARD) and ACIAR.

The workshop was held at AARD headquarters, Jakarta, on 9–10 February 1994 and was attended by scientists from research institutes in Indonesia, Philippines, India, Malaysia, Thailand, Taiwan, Poland, Australia and the United States of America. Other organisations represented included the ASEAN Food Handling Bureau, FAO and SPC.

The objectives of the workshop were:

- to assess fish-drying technology and socio-economic aspects of the dried fish industry in Indonesia, in particular the research results of a project on developing a low-cost agrowaste fish drier. This project was funded by ACIAR and jointly executed by Indonesia's Research Institute for Marine Fisheries (RIMF) and the Department of Food Science and Technology, University of New South Wales;
- to examine ways in which fish-drying technology and dried fish marketing can be improved; and
- to draw up strategies for the implementation of research results for dried fish processors.

The following sessions were held during the two-day workshop:

- Policies on fishery agribusiness and agro-industry development;
- Socio-economic issues of fish drying;
- Salting and drying studies;
- Drying and its application; and
- Microbiology and entomology.

The components of the workshop most relevant to the Pacific were the last three sessions covering scientific and technical studies on dried fish processing.

Professor N. Haard of the University of California provided an outline of the chemical and biochemical changes that occur at various stages of processing in the raw material, during salting/drying and in the final dried product during storage. He described earlier research work on processing certain marine species pre-rigor and post-rigor that resulted in products with different flavour and texture characteristics.

Dr J. Pitt, CSIRO, gave an overview of the problems associated with mould growth on poorly processed dried fish products. He estimated that mould affected 10–20 per cent of dried product in Indonesia. He added that his research work to date indicated that moulds that produce aflatoxins (potent carcinogens) are not viable on salted dried fish products.

Dr John Madden, University of Tasmania, described investigations carried out on insect control in the dried fish industry in Indonesia under a number of ACIAR-funded studies. He provided an overview of the insect species that cause the most damage to dried fish products. These include flies, domestic beetles and mites.

R. A. Souness (UNSW) and S. Wibowo (RIMF) reviewed the research work carried out to develop a low-cost agrowaste fish drier. The aim of the project was to develop a drier that

would allow processors to continue making dried products when sun-drying is not possible, either when it is raining or at night. The project had two main components, the development of the furnace and the development of the fish-drying chamber that utilises the heat from the furnace for drying fish products.

A very efficient furnace was developed which used rice husk as the agrowaste material (a similar furnace has since been developed that will burn coconut husk). The project was less successful in developing an efficient drying chamber. This suffered from defects such as low air velocity and poor control over the temperature of the drying air. Products were unacceptable because they were cooked and were inconsistent in quality.

Although fish drying is a much bigger concern in Indonesia, with 1.5 million tons of fish processed compared to very small volumes of fish preserved in the Pacific, natural sun-drying is still an important processing technique in the region. Isolated island communities still practise traditional salting and sun-curing of fish (these techniques are being revived and practised on a commercial scale in one or two countries, e.g. Marshall Islands); certain valuable types of beche-de-mer products are processed by sun-drying (e.g. sandfish); and growing in importance are the value-added cured products such as marinated dried tuna (often called tuna jerky).

ACIAR
AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

Some of the problems affecting Indonesian fish products are common to the Pacific. The workshop was therefore a useful and valuable event. It helped to highlight the technical and scientific areas of importance to the Pacific, and provided the opportunity to discuss with researchers the acceptability of the technology developed by SPC in the production of marinated dried tuna products. ACIAR has been giving valuable support to SPC under this collaborative project.

ACIAR will be publishing the papers presented at the workshop in its Technical Report Series. Those interested in obtaining copies can contact Barney Smith, Research Programme Coordinator (Fisheries), ACIAR, P.O. Box 21, Cronulla, New South Wales 2230, Australia.

Women at a fishing village on the outskirts of Jakarta (Indonesia) prepare fish for sun-drying.

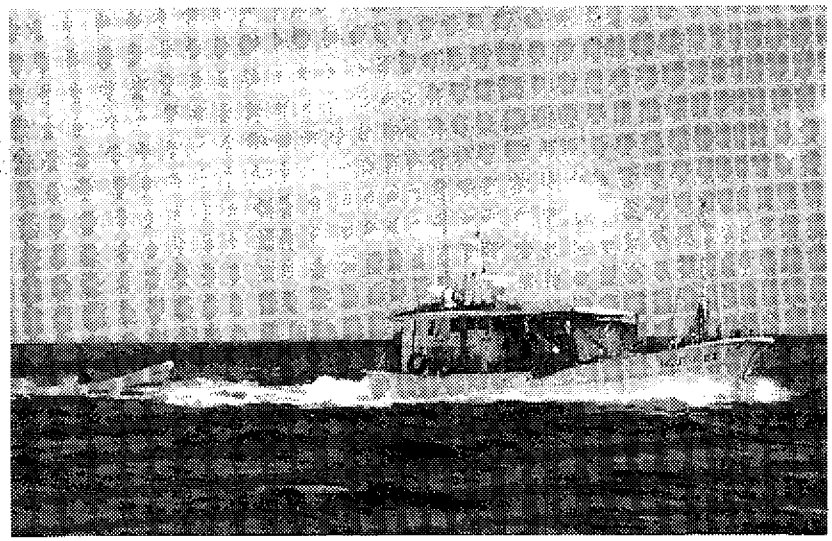
TRAINING SECTION

FAD fishing workshops in Tongatapu

Without a doubt, one of the greatest challenges a Pacific Islands fisheries extension officer is likely to face during his career is the promotion and development of a new fishing method or fishing concept. SPC's Coastal Fisheries Programme has a substantial history of providing technical assistance to fisheries extension officers in the promotion and development of offshore fishing methods. Primarily through masterfishermen country assignments and fisheries officers' practical training courses, a diverse range of technical skills has been 'extended' to Pacific fishers.

In acknowledgment of country interest in promoting the efficient use of nearshore pelagic resources, the Capture Section has devoted increasing effort in the past five years to the deployment and utilisation of FADs. Assistance has primarily been in the area of FAD deployment, but a recently developed undertaking between the Fisheries Training and Capture Section, to enhance fishers' skills resulted in two one-week FAD fishing courses in Tonga.

Following a previous FAD deployment country visit to Tonga by Masterfisherman Paxton Wellington, Fisheries Training Officer Michel Blanc and Masterfisherman Peter Watt travelled to Tonga early in February to assist with the workshops. Before the workshops started, Michel and Peter had spent more than six weeks developing a series of tutor resource modules on FAD fishing. Covering a range of subjects such as trolling methodology, vertical longlining, safety,



Extension vessel *Ngutelei* heading to the FAD

Landing a yellowfin tuna from the vertical longline

fish handling and business management, each module contains teaching hints, practical information and detailed diagrams and illustrations for overhead projection. For the Tonga workshops, each module was sent in advance to Tonga to allow Extension staff time to complete translation into the Tongan language.

The two one-week workshops were organised in close collaboration with Ministry of Fisheries staff and included two days of practical fishing, with the three days of classroom time equally divided between lesson and practical sessions. For the 40 local fishermen attending, the chance to learn the finer points of vertical longlining and deep trolling was very well received and local Ministry of Fisheries staff gained new confidence in their ability to 'extend' practical fishing technology to fishers.

Given the success of the workshops in Tonga and the increasing attention of fisheries administrations to the economics of FADs as a means of promoting greater fishing efficiency, the workshop programme could become a popular extension tool in countries with active FAD programmes.

The complete set of teaching modules will shortly be published and circulated to fisheries administrations. SPC will support the development of in-country workshop programmes for interested countries.

Low-cost FAD trial in Tonga

A single float and marker flag is all the flotation required on a recently deployed experimental FAD close to the island of 'Eua in the Kingdom of Tonga.

The FAD uses an old car axle and a short length of chain for anchorage and the mooring line is a single length of 3 mm monofilament.

According to the Tonga Fisheries Adviser, Bob Gillett, the FAD costs only T$ 600 compared with the T$ 5,000–6,000 per unit for the two recently deployed conventional FADs.

Tonga Fisheries Division will closely monitor FAD usage and catch levels over the next months and will also be able to compare the longevity of the two types of FADs.

For the fishermen of 'Eua, both types of FAD are within striking distance. Judging from their enthusiasm in assisting with FAD deployment, they will be regular visitors to the FAD fishing grounds.

Light-weight experimental FAD deployed

New training video completed

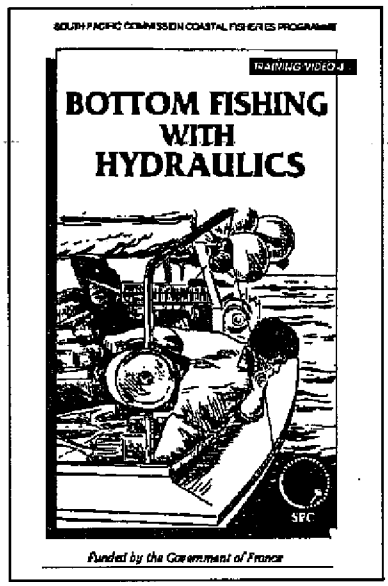
A training video on bottom fishing with hydraulics has been completed recently by Training Section and Media Unit staff. The first available copies of the video were distributed to participants at the 25th RTMF.

The video introduces viewers to the basic elements of hydraulic systems and their application to small fishing craft, particularly in relation to the use of hydraulic powered reels for bottom fish fishing.

Most of the video was filmed during the 1991 SPC Nelson Polytechnic Pacific Island Fisheries Officers Training Course, with additional filming being undertaken in Fiji during 1993.

The video is the second in a series of three fishing-method videos currently in production. The third video (on small-scale longline fishing) was also shot during the 1991 course and will be completed during 1994.

Both videos will be distributed to fisheries administrations and training institutions. They will also be available on request from SPC.



CAPTURE SECTION

Inshore sportfishing???

A sportfishing workshop was held in Koror from 4 to 8 April 1994. The purpose of the workshop was to introduce the concept of light-tackle sportfishing to the public and private sectors, establish the requirements for a sustainable industry and train participants in sport-fishing techniques. The agenda included an overview of the international requirements for a sportfishing industry, business aspects of sportfishing, safety at sea, boating etiquette and customer service.

Peter Watt, SPC Masterfisherman, who has been involved in the sportfishing project since its conception, attended the workshop to present fishing vessel requirements, safety at sea and boating etiquette modules that were designed specifically for the workshop.

When most people think of sportfishing, they think of a 15 metre game-fishing boat equipped with a flying bridge, expensive trolling rods and reels mounted in the gunwales, fishing lures in the water and a 700 kg marlin ready to strike.

The Marine Resources Division (MRD) of Palau has a different idea when it comes to developing the sportfishing industry. MRD would like sportfishermen to come to Palau to catch reef fish that weigh between 1 and 15 kg with light-tackle sportfishing gear.

What is light-tackle fishing gear? It consists of light-weight spin or fly casting rods and reels equipped with 6 to 30 lb (2.7 to 13.6 kg) test nylon mono-filament line. The thrill of the sport is catching a good-sized fish that tests the limits of the gear and skill of the angler.

You are probably asking yourself, 'Why would someone travel all the way to Palau to catch reef fish'? The answer is that light-tackle fishing is the fastest growing sportfishery in the world. In the United States fishing is the most popular recreational sport and in Japan there are over 18,000,000 people who partake in recreational fishing activities.

In the past, most recreational fishing took place in fresh-water lakes and rivers, but with increasing numbers of fishermen and many of the fresh water resources suffering from pollution, fishermen have had to search for alternative fishing areas.

Salt-water lagoons and fringing reef areas have provided new sport opportunities for frustrated fishermen. A variety of fish species can be caught either from shore or from a small boat with light fishing tackle. Light-tackle salt-water sportfishing has now grown into a world-wide industry. Enthusiasts travel to remote locations as far abroad as Venezuela, Costa Rica, Belize, the Bahamas, Papua New Guinea and Kiribati.

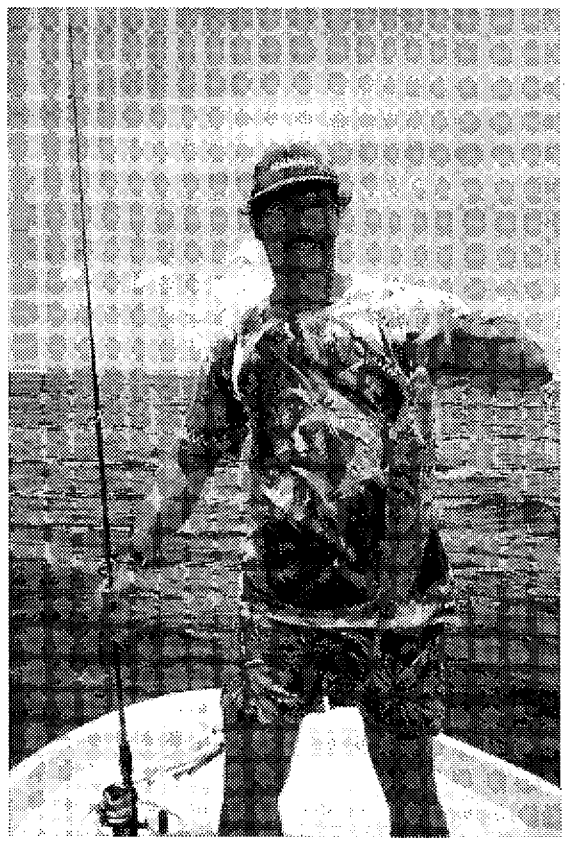
The condition of the inshore resources in Palau has progressively deteriorated over the past years. Data collected by MRD from local fish markets show that the population of many of the inshore fish species has declined due to over-harvesting. The Government recently imposed an annual ban on the export of reef fish from March to July as a measure to protect the inshore resources. The individuals most affected by the new regulations are the commercial fishermen. MRD intends to develop a sportfishing industry as an alternative source of income for them.

Also, as natural resources in Palau are limited, MRD felt the fishermen involved in the inshore fishery should receive the highest financial benefits from the resource. The financial rewards from tourists partaking in sportfishing activities that capture specific fish species far exceed the value of the same fish species captured by commercial fishermen. Tourists not only pay for charter vessels and fishing guides, but also spend money in hotels, restaurants and shops.

In March 1994, a professional light-tackle fisherman, Sandy Moret, from Florida, USA, visited Palau to assess the potential for a sportfishing industry. After two weeks of spin and fly cast fishing trials, Sandy stated that 'Palau offers some of the fastest, most exciting and varied light-tackle cast fishing in the world and has a very valuable resource'.

This was quite a statement from a professional fishermen who has fished most of the famous sportfishing destinations in the world. Sandy recommended that, if Palau was to develop a sustainable sportsfishing industry, a catch-and-release programme would need to be implemented; otherwise the resource would become overharvested quickly. He estimated that 10 sportfishing boats could dramatically reduce the populations of reef fish susceptible to light-tackle fishing gear in three years. Following Sandy's recommendations, MRD is planning to implement regulations and policies to protect the resource.

If the Palau sportfishing project is a success, it could well be used as a model for other countries in the region to follow.



SPC Masterfisherman Peter Watt holding a long-nose emperor after a tremendous fight!

SOUTH PACIFIC REGIONAL TUNA RESOURCE ASSESSMENT AND MONITORING PROJECT

This five-year project is funded by the European Union. It will carry out continuous monitoring of tuna fisheries in the region and refine the resource assessment work initiated by SPC's Regional Tuna Tagging Project.

United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, 14–31 March 1994

The second session of the United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks was held at UN headquarters in New York from 14 to 31 March 1994.

The goal of the Conference is to provide a framework for managing straddling stocks (SS) and highly migratory stocks (HMS) on the high seas. The Conference is a 'child' of the United Nations Conference on Environment and Development (UNCED), which mandated it to:

- Identify and assess existing problems related to the conservation and management of SS and HMS;
- Consider means of improving fisheries cooperation among states; and
- Formulate appropriate recommendations.

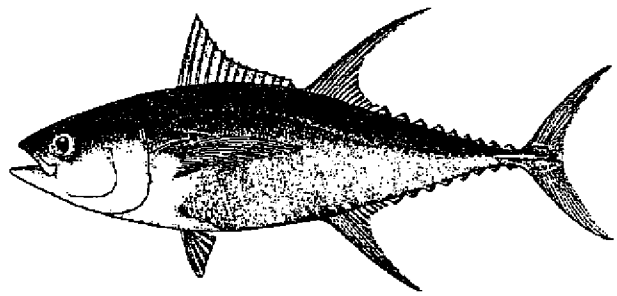
The Conference is intended to elaborate on existing provisions under the United Nations Convention on the Law of the Sea (UNCLOS), which enters into force in November 1994.

UNCLOS confirms the rights of coastal states to determine conservation and management measures for SS and HMS within their areas of national jurisdiction, and calls upon coastal states and states fishing on the high seas to cooperate in determining and implementing conservation and management measures for these stocks where they occur on the high seas.

UNCLOS covers high seas issues and cooperation among states in Articles 63 and 64, but is fairly vague as to how such cooperation is to be achieved. It is on this area that the current conference is focusing.

At the first session of the Conference, held in New York in July 1993, much time was spent in delegations formally presenting statements on the various issues. At this stage, there were some very divergent views, for example:

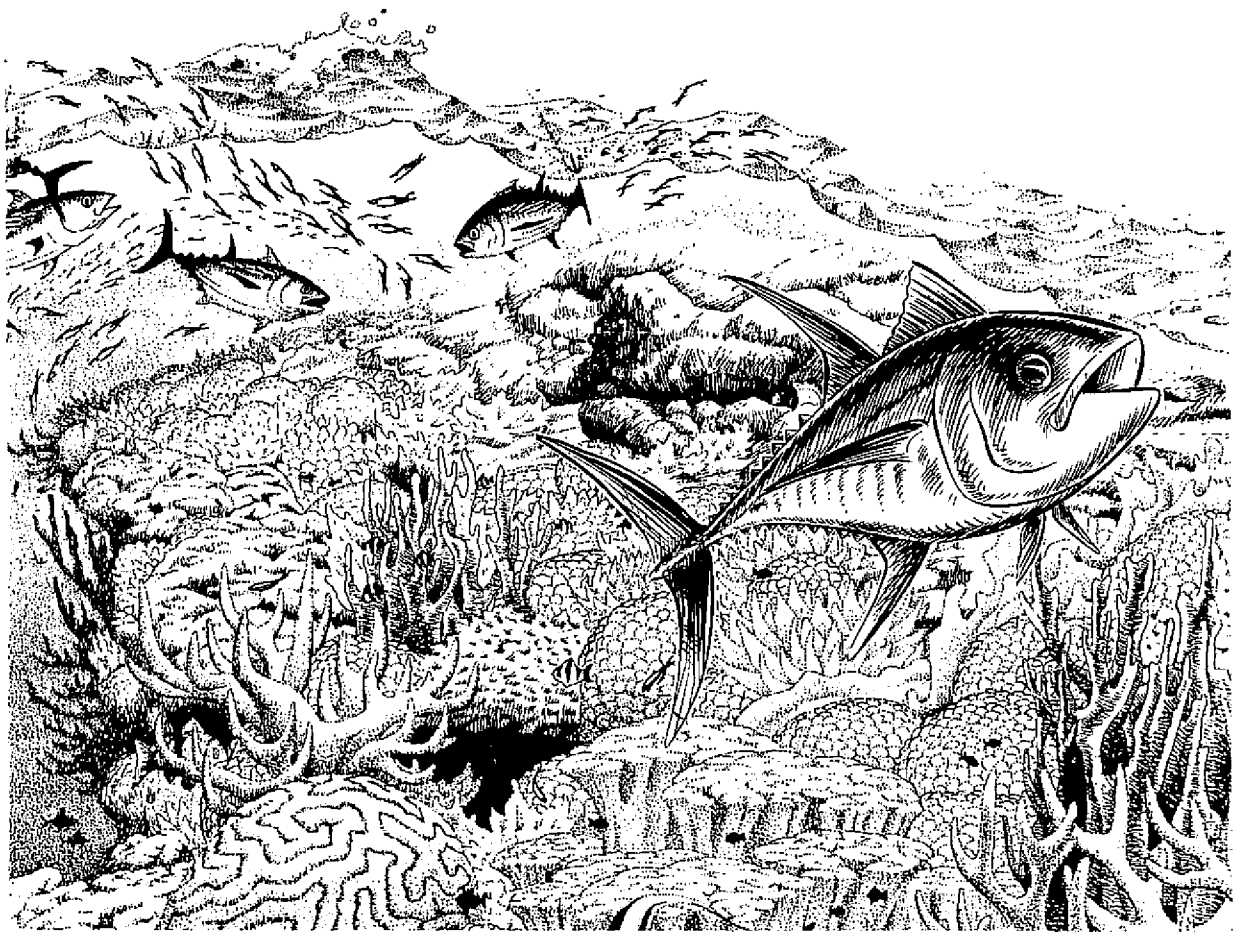
- Many coastal states wanted the Conference to address conservation and management on the high seas only; distant-water fishing nations (DWFNs) were adamant that conservation and management must be applied to stocks throughout their range;
- Many coastal states had the view that cooperation could be achieved through a variety of mechanisms, including bilateral and multilateral arrangements; DWFNs (particularly Japan and the Republic of Korea) continued to push the view that formal fisheries management organisations (so-called Article-64-type organisations) are necessary;
- Coastal states advocated the precautionary approach to fisheries management, as directed by UNCED; DWFNs resisted the incorporation of precautionary concepts into principles for high seas fisheries management; and
- Possibly the key area of dispute has been how to obtain compatibility and coherence between national and international conservation measures for the same stock. Coastal states will not countenance any erosion of sovereign rights in respect of their EEZs; DWFNs strongly resist any extension of coastal states' rights beyond 200 miles.



At the second session, it appeared that many delegations were prepared to soften their views to some extent in the interests of achieving a workable outcome of the Conference. Some of the important concessions were as follows:

- More general acceptance on the part of most DWFNs of the principle of applying the precautionary approach to fisheries management;
- Greater acceptance by DWFNs that fisheries management arrangements other than an 'Article 64-type' organisation can achieve the cooperation necessary for management of SS and HMS;
- Growing realisation by Pacific Island delegations that they will need to establish more formal cooperative links with DWFNs for the purpose of regional tuna fisheries management;
- General acceptance by DWFNs of flag states' responsibilities for compliance with regional management measures and the need for flag states to cooperate with regional monitoring, control and surveillance measures;
- Acceptance by most coastal states that conservation measures in EEZs and on the high seas need to be compatible, and a growing awareness that such measures will only be effective if applied to stocks throughout their range; and
- General acceptance of the principle that developing countries be given special consideration because of their economic, nutritional or cultural dependence on living marine resources, and special assistance (financial, technical and educational) so that they can fulfil their obligations with respect to conservation and management of SS and HMS.

At the end of the second session, the Chairman of the Conference presented a Revised Negotiating Text, which will serve as the basis of discussions during the third and final session, to be held in August 1994.



WOMEN-IN-FISHERIES NETWORK ESTABLISHED

The Women and Fisheries Network was established in 1993 following a small regional meeting convened by CUSO and funded by the International Centre for Ocean Development (ICOD).

The meeting, which took place in Suva from 28 to 29 August 1992, was attended by women-and-development scholars and activists concerned with the issues of women and fisheries from three Pacific countries. The Network is intended to include as core members, women (and women's groups) that are actively engaged in fisheries activities in the region.

The Network's objectives are to support through research, analysis and advocacy work, the fisheries activities and livelihoods of Pacific women by:

— encouraging (and publicising the results of) research on women-and-fisheries issues in the region;

— informing and educating women about fisheries issues and development, including regional and national policies, programmes and projects and women's fisheries activities and projects;

— lobbying for development support for women's fisheries activities, including access to fisheries technology and training, to advance women's fisheries livelihoods, both subsistence and small-scale commercial;

— seeking representation for women in fisheries within policy-making and decision-making bodies at both national and regional levels;

— initiating, supporting and/or evaluating pilot fisheries projects for women (especially in aquaculture);

— providing critical analyses, from a women-and-development perspective, of national and regional fisheries issues for national and regional forums with a view to influencing fisheries policies; and

— linking with development groups both regionally and internationally (and within donor countries) to share research and information on issues and strengthen campaigns aimed at protecting or advancing women's fisheries interests.

The network has an office at 14 MacGregor Road, Suva, Fiji. Office hours at the moment are 8 am to 5 pm on Tuesdays and Wednesdays. The phone number is: (679) 305031. The Board of Trustees meets on the first Monday of every month and on the following Monday in the case of a public holiday. The meetings are held at the above-mentioned address from 12 noon to 2 pm. Anyone interested are welcome to attend.

A brochure with an attached membership form is available on request. The network has just produced its first newsletter.

(Contributor: Milika Naqasima)

TONGA TARGETS TUNA

Fishing for tuna has always been important for Tonga but there has been a recent flurry of activity. Fishing companies targeting tuna are being formed, Tongans are purchasing tuna vessels from overseas, and vessels here are acquiring tuna fishing gear.

Why all this excitement? There are many reasons, involving the tuna resource, fish prices, and a new government policy that opens up the resource.

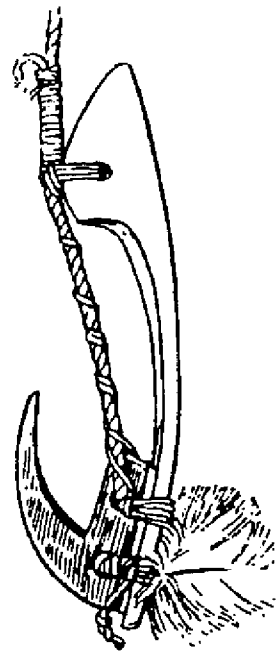
Four species of tuna are found in commercial quantities in Tonga: albacore, yellowfin, bigeye and skipjack. In the late 1970s research was carried out on these fish by the Skipjack Survey and Assessment Programme and thousands were captured, tagged, and released. This work showed that tuna tagged in the Tonga 200-mile zone and adjacent areas moved to Papua New Guinea, Tahiti, New Zealand and Micronesia.

Although over a million tonnes of tuna are caught annually in the area where Tonga's tuna migrate, the amount actually caught in the waters of Tonga is a relatively tiny 300 tonnes. Fishery scientists believe that the region's tuna catch could be increased, which leads to the conclusion that there is a large potential for increasing Tonga's tuna catch. Because Tonga's inshore and reef fisheries are mostly heavily exploited, the interest in tuna fishing in Tonga can be understood.

Pearl-shell lure

Tuna are caught by a variety of methods. There were many traditional Tongan techniques, including the well-known *tofe* pearl-shell lure for catching small tuna on the surface. On a large commercial scale tuna are now caught by pole and line fishing (up to 50 fishermen on a boat using individual poles and livebait), purse seining (surrounding a whole school with a net), and longlining (a line up to 100 km long from which baited hooks are set). For various reasons only longlining has proven effective for catching fish in Tonga. Old-style longlining was developed in Asian countries and has been used in Tonga by both Asian and Tongan vessels since the early 1950s. The target species was mainly albacore for canning at Pago Pago.

The newer method of longlining uses a smaller vessel and a thin monofilament longline from which 1000 to 3000 hooks are set. The important point is that, although these boats catch fewer tuna, the tuna are landed in prime condition and handled extremely carefully, so that the market price may be 20 times as great as that for tuna caught using the older Asian longline gear.



For example, a single fish caught by a Tongan-owned and operated monofilament longline vessel sold for T$3000 (T$37/kg) in Japan recently.

Although fishing with the new monofilament gear has been under way for less than a year in Tonga, it has been very successful in neighbouring countries. Starting from a single vessel a decade ago, a fisherman in Fiji expanded his operation and in 1993 he had 18 monofilament long-line boats and exported $20 million of high grade tuna.

Because of certain oceanographic features in Tonga, that successful Fijian fisherman has stated that the potential for longlining in Tonga should be at least as great as that of Fiji.

Both the tuna resource situation and potential business profitability have contributed to the recent tuna excitement in Tonga. Another factor has been Government policies.

In mid-1993 the Ministry of Fisheries adopted a policy that the promotion of tuna fishing should be a high-priority activity. Subsequently a cabinet-level decision was made that allows all Tongans access to the Kingdom's tuna resources. The Ministry's vessel *Ekiaki* is now being fitted with commercial monofilament gear and it is the intention that, after a period of trial fishing under an American-sponsored project, the vessel be used for training fishermen from the private sector who desire to learn more about monofilament longlining. The Ministry's support of tuna fishing has not been limited to large commercial operations; the placement of fish aggregation devices (FADs) which are

buoys anchored in the open sea, has enabled small troll fishermen to catch more tuna.

Airfreight constraint

Although there is cause for optimism in Tongan tuna fishing, there are still problems to overcome. Because the high-quality tuna must be airfreighted overseas, the industry is at the mercy of the airlines. A major constraint is that each productive tuna vessel requires three tonnes of air cargo space per week. Also, the present shortage of repair facilities and skilled fishing captains would slow the growth of the industry.

The biggest news in Tonga fishing during the past year has been the increased tuna-related activity. The resource is there, business potential has been demonstrated, and the Government is providing support. Now the challenge is to put all the pieces together.

(Source: *Matangi Tonga*)

SEA TURTLES MIGRATE TO FIJI

Three green sea turtles recently migrated 1,600 km (1,000 miles) from American Samoa to Fiji. They were tagged with satellite transmitters at Rose Atoll in November 1993. This tiny atoll is the last remaining area for green turtles in Samoa. Only about 30 green turtles nest there each year. After laying their eggs there, the turtles then migrated straight for Fiji. Their journey took 34–45 days at an average swimming speed of 1.8 km per hour (1.1 mph).

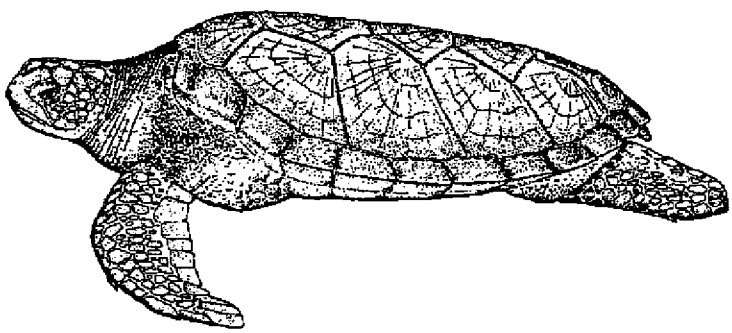
One turtle went to Nateva Bay on Vanua Levu, the second went to Naweni Point, also on Vanua Levu, and the third went to the Lau Group. They will probably stay at those locations for two or three years before returning to Rose Atoll to nest again.

The study was conducted because sea turtle populations have seriously declined in American Samoa, as they have throughout the South Pacific.

Little is known about these turtles. As nature would have it, turtles do not generally nest and feed in the same area. Instead, they undertake large-scale migrations between their nesting and feeding areas. Available data indicate that migratory patterns of turtle stocks in the central South Pacific are vast and complex.

Consequently, turtles throughout the South Pacific are a shared resource among the Islanders. This greatly complicates conservation efforts for these animals. It does little good, for example, to protect turtles at their nesting sites in one country, only to have them killed for food or tortoise-shell jewellery when they migrate to their feeding areas in another country. A turtle eaten in Fiji, for example, results in one less turtle in American Samoa. All Pacific Islanders must therefore work together to save this unique and valuable resource.

To promote conservation awareness of this valuable but dwindling resource, the South Pacific Regional Environment Programme (SPREP) has declared 1995 the 'Year of the Sea Turtle' in the Pacific region. The turtles are federally listed in the US as endangered species and the CITES convention restricts international trade in sea turtles and turtle products.



(Source: Department of Marine & Wildlife Resources)

YEAR 1995 DECLARED 'YEAR OF THE SEA TURTLE'

A regional meeting on marine turtles in July 1993 at Apia, Western Samoa, proclaimed 1995 as the 'Year of the Sea Turtle'. This was confirmed by the member governments of SPREP at Suva, Fiji, in September 1993.

The turtle meeting also called for Pacific island countries to ban international trading in turtles and turtle products, and for countries to allow turtle

harvesting only for subsistence and cultural uses, and where possible, place a moratorium on the in-country commercial trade in turtles and turtle products.

Why all this attention? Why have two regional meetings called for restraint in the killing of all turtles for commercial and subsistence uses?

The Pacific region contains some of the last remaining significant populations of sea turtles in the world. Three of the seven turtle species found in the world commonly breed in the Pacific. Three other species are found here, but are less common. Turtles also migrate across and outside the region, so they are shared resources that must be managed by common agreement by a number of countries.

Turtles have special local value – as food and culturally – for many Pacific island peoples. Turtles can be harvested from the sea, but the number caught must not exceed the number replacing them from the stocks of young turtles that are replacement breeders.

Unfortunately, this is not happening. Turtle populations are declining rapidly in the region because of increasing commercial and subsistence harvesting. Turtles are now being killed faster than they can grow.

Turtles live a long time and grow slowly. They take 20 to 50 years to start breeding. So if large numbers of breeding females are killed now, the decline in the population is not noticed till much later. The current decline in turtle numbers is due to action taken many decades ago. In the same way, the greater numbers being killed now will not be felt for some decades – by which time it may be too late to act and conserve them, as the turtles may have disappeared.

There are several reasons for the rapid decline in turtle numbers: firstly, there are rapidly growing numbers of people in the region who are demanding more turtles for food and for cultural needs. Secondly, more turtles can be caught using modern fishing techniques and equipment. Thirdly, the traditional restrictions on when and how turtles were caught are disappearing, so more turtles are being caught and eaten. Lastly, marine pollution and fishing nets accidentally drown many animals.

So what can be done about the demise of sea turtles in the Pacific? SPREP runs a regional turtle conservation programme that monitors the numbers and movements of tagged turtles around the region. If you catch a tagged turtle, send the details on the tag to your local fisheries or conservation officer, and release the turtle.

Secondly, if you must catch turtles, then leave females alone, especially if they are about to nest. If you must take eggs, only take a few and leave the rest.

The Pacific's sea turtles are endangered animals. Every nesting female caught means fewer turtles for our grandchildren. We must act today to conserve our natural heritage and our resources for the future.

(Source: SPREP's *Environment Newsletter*)

SHARK OIL EXPORTS IN PAPUA NEW GUINEA

A small business in Papua New Guinea has started producing unrefined shark oil for the Japanese cosmetics and health products market.

Daniel Takendu from West Sepik Province is a former civil servant who decided just over a year ago to go into the shark fishing industry.

He was contacted by an Indonesian company interested in the gulper shark, a small shark 1 m long and weighing 15 kg, which is normally found at depths of 250–450 m. It is caught using a longline anchored to the ocean floor.

This shark is particularly sought after in Asia and South America, where it is exploited for the oil contained in its liver. Mr Takendu began working as an agent for the Indonesian firm, which paid him a salary and covered his operating costs. He then opened his own company and obtained a fishing licence and, little by little, the business grew. He now charters two boats from the Indonesian firm and employs their crew, but keeps the profits from shark oil exports for his own enterprise, which employs six people.

'No one had ever heard of this type of shark here', he says, 'since it's a shark which is caught in deep waters.'

'Once it's been brought up, its liver must be taken out. This animal has a very large liver, accounting for about a quarter of its entire weight. When the liver has been removed, the oil must be extracted from it. Processing takes place on board the ship. The liver is heated and the

oil runs out. All you have to do is collect it in tanks.'

Another extraction process uses aluminum containers and heat from the sun. The livers are placed in the containers, which sit on the deck in the sunshine. The oil separates and is then collected in drums, explains Daniel. Whatever method is used, the oil extracted on board the ship is brought in to port, where it is transshipped into special containers before heading for the Japanese market. Processing is done in Japan, explains Daniel.

'The raw oil is processed into three main products: shark's liver oil capsules (good for one's health), high-quality soap, and cosmetic oils, which, according to Japanese manufacturers, slow down aging of the skin.'

At the beginning, Mr Takendu started his company by harvesting sea cucumbers and sharks' fins and exporting them to Asia. He would now like to expand his operations into the area of shark oil exports by processing the product locally in Papua New Guinea. His current problem is obtaining land from the government to build his plant. The industrial zone planned at Wewak in Papua New Guinea will probably not be appropriate for this type of industry, which needs to be near port facilities and have easy access to the sea.

In the meantime, Daniel has decided to diversify production and so he is also fishing another species of shark, a pelagic one, whose meat he exports to Japan. He has also tried to expand his export markets, especially to include Australia, but quarantine regulations are a barrier, particularly regarding testing mercury levels in his product. Testing is not required, it would seem, for exports to the Japanese market. Daniel therefore has more than one project on tap. Meanwhile, his company, Fishery Services and Consultancy, operates in six provinces all along the north coast of Papua New Guinea and along the east coast to Port Moresby, the capital.

In the space of a year, Daniel Takendu has firmly established himself, and his company now collects all the profits from its operations. The Indonesian firm involved at the outset now only collects charter fees for the two boats chartered by Daniel's company.

(Source: Radio Australia)

US MANDATORY SEAFOOD INSPECTION HACCP ANNOUNCED

The United States Department of Health and Human Services Secretary Donna E. Shalala announced on 21 January 1994 a major new food safety initiative in which the Food and Drug Administration (FDA) will require the US seafood industry to establish safety controls based on the Hazard Analysis Critical Control Point (HACCP) principles and subject to regulatory oversight and review.

Proposed regulations to implement the new system are being published for public comment. After a 90-day comment period, final regulations will be published which will become effective one year after their publication.

Because over half of the hazards that can affect imported seafood are likely to occur before it enters the US, and as there are too many weaknesses in the current system of sampling and testing imported products, FDA concluded that problems can be more efficiently controlled if the seafood is subject to HACCP controls before it is offered for import.

FDA points out that most of the major developed countries that export seafood (including the European Union) are in the process of adopting HACCP for their seafood products.

FDA is proposing under the announced regulations that US importers develop HACCP plans that will be required by US processors. Essentially this requires that the products produced in foreign countries for export to the US be produced under the same HACCP and sanitation controls that are to apply to domestically produced seafood.

Further details on the new regulations may be obtained from:

Mr Thomas Billy
Office of Seafood, Food and Drug Administration
200C St. SW., Washington DC 20204 USA
Tel: (202) 245-7656
Fax: (202 245-7675

(Source: *The Fish Inspector*)

PURSE-SEINE FISHING IN THE WATERS OF KIRIBATI

In 1993, the Kiribati authorities formed a partnership with Otoshiro, a Japanese fishing company, as part of a purse-seine fishing project. Negotiations opened early in the year and concluded later that same year, with a delegation from Kiribati travelling to Tokyo in November 1993 to work out the final details and sign the agreement. The joint fishing company was due to begin operations in December 1993.

Mr Teekabu Tikau, Assistant Secretary at the Ministry of the Environment and Natural Resources in Kiribati, explained exactly what the terms of this agreement were, how the new company would operate, who was going to manage operations and where the fish harvested in Kiribati would be sold.

He began by saying that this was one of the first agreements of its kind involving the Pacific in terms of a direct agreement with the Japanese market. The project was designed to set up a joint purse-seine fishing venture. The Japanese would own 51 per cent of the shares in this company, with the Government of Kiribati holding the remaining 49 per cent. He went on to say that Otoshiro would be supplying a purse-seiner to the joint company which would then have to repay the cost of this vessel.

The joint venture would be set up and registered in Kiribati. The US$ 5 million seiner supplied by Otoshiro would fly the Kiribati flag, in exchange for which the Japanese company would collect the profits from sales and handle the firm's management. Mr Tikai explained that the fish harvested would be mainly sold on the Japanese market. One might then ask how the operation will benefit the authorities in Kiribati. Is the Government perhaps planning in the long term to acquire a larger share of the capital of this new company? What are the agreement's clauses on this subject?

According to Mr Tikai, there is a clause in the agreement which provides that, after seven years, the Government of Kiribati will be able to acquire all the shares in the company, should it wish to do so.

He noted that the company would also be able to purchase other purse-seiners if operations proved profitable with this first seiner. There is also a possibility of expanding this joint project to include longline fishing or other harvest techniques. All of the catches taken by this first seiner are to be sold on the Japanese market.

Negotiations between officials in Kiribati and Otoshiro opened at the beginning of 1993, and by early November, the two parties had, for all practical purposes, reached agreement on the document's wording. All that remained was to get the go-ahead from both governments for operations to begin.

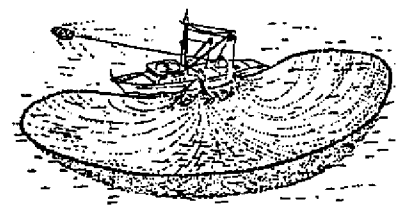
A delegation from Kiribati went to Tokyo at the end of November to finalise and sign the agreement. Operations were to have commenced in December, 1993. This will be a 15-year agreement, but it will be possible to revise its terms during this period.

Mr Tikai explained that the first review would take place in five years and the next three years later. The company's Board of Directors would include two directors representing Kiribati's interests and two for the Japanese firm, while the company's chairman would be Japanese. He also said that initially Kiribati would provide ten crewmen and that it would be possible at a later date to replace other members of the Japanese crew. Mr Tikai noted that training was an important component in this project. Otoshiro would have to provide a training programme which would also be reviewed every two years. Mr Tikai considered training a very important element of this project.

In terms of revenue, what will be the repercussions for Kiribati?

Mr Tikai said that the joint company would have to repay the loan for the vessel at a rate of US$1 million per year, beginning in the second year. So, before the end of the sixth year, the cost of the seiner should be completely repaid. He added, however, that one of the agreement's clauses also provides for the possibility of the company taking out a very low-interest rate loan from other development agencies. He concluded by noting that this would have an impact on the profits recorded by the company at the start of operations.

(Source: Radio Australia)



WHITEBAIT OR STOLEPHORID ANCHOVIES

This profile on anchovies is not intended to be a detailed biological review of the species but rather to be an article of general interest on a group which is of economic importance in the South Pacific region and in the neighbouring Indian Ocean.

by Paul Dalzell
South Pacific Commission
Noumea, New Caledonia

Readers of *Time Magazine* (5 July 1993) will recall the article on the vast shoals of small whitebait or stolephorid anchovies along the coast of Western Australia and the large numbers of predatory sharks that these had attracted. Landings of anchovies (Family Engraulidae) during 1990 (FAO 1992) comprised some of the world's largest fisheries, including the Peruvian anchoveta (3,700,000 t), European anchovy (540,000 t), Japanese anchovy (440,000 t) and South African anchovy (200,000 t). Indeed the Peruvian anchoveta yielded annual catches in excess of 10,000,000 t between 1964 and 1971.

The total reported annual harvest of stolephorid anchovies is about 250,000 tonnes, with most of the catch being landed in South-East Asia. The largest catches of anchovies are landed by Indonesia and the Philippines, which both catch more than 100,000 t/year at present.

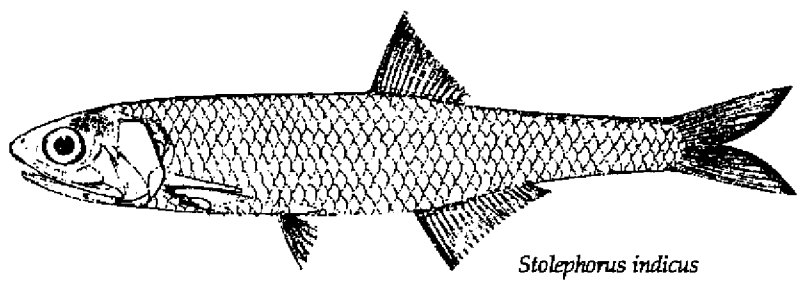
In Asia and the Middle East stolephorid anchovies are consumed fresh, dried and as fermented products. Fermentation of anchovies is particularly common throughout South-East Asia and fermented pastes and sauces are common to most countries of the region, e.g. *patis* in the Philippines, *nam-pla* in Thailand and *nuoc-mam* in Vietnam. Ruddle (1986) provides a useful summary of the fish fermentation industries in South-East Asia.

The stolephorid anchovies are found throughout much of the Indian and Pacific Oceans and extend north to Japan, south to South Africa and as far east as Tahiti. All species live in the nearshore neritic zone except *Encrasicholina punctifer* or buccaneer anchovy, which is oceanic and may be found at considerable distances from the coastal margin. Apart from *E. punctifer*, stolephorid anchovies are found along coastal shelves and lagoons where primary production is high and where there is some freshwater influence from rivers and runoff. Stolephorid anchovies are absent from atolls, apart from *E. punctifer*, which may be found in the ocean outside the lagoon.

Originally it was thought that the stolephorid anchovies were contained in the single genus *Stolephorus*. However, Nelson (1983) split the genus into *Stolephorus* and *Encrasicholina*. There are a number of different morphological characteristics that separate the two genera but effectively the *Encrasicholina* are the five smallest species. They include *Encrasicholina devisi, E. heteroloba, E. oligobranchus, E. punctifer and E. purpurea.* There are 19 further species in the genus *Stolephorus*, bringing the total to 24 species. The species *E. heteroloba, E. devisi, E. punctifer* and *Stolephorus indicus* are the most common and most widespread of the stolephorid anchovies. Other species, such as *E. purpurea, E. oligobranchus, S. brachycephalus, S. multibranchus* and *S. ronquilloi* are endemic or have very limited distributions The most up-to-date and informative guide to the species of the two genera and their distributions is the second volume of the FAO species catalogue on clupeoid fishes (Whitehead et al. 1988). The distribution of stolephorid and other anchovies in the South Pacific region is summarised by Lewis, Smith & Ellway (1983)

By contrast with Asia, there has been limited traditional use of stolephorid anchovies in the South Pacific region. Rapson (1955) reported seasonal catches of stolephorid anchovies in southern Papua New Guinea, and similar subsistence fisheries are found elsewhere in the Pacific (A.D. Lewis, Fisheries Programme, pers. comm.). However, these species are a good source of live bait for Okinawan style pole-and-line tuna fishing.

Fisheries for live bait, based mainly on stolephorid ancho-



Stolephorus indicus

vies, were established in New Caledonia, Papua New Guinea, Palau and Solomon Islands to support domestic pole-and-line tuna fisheries (Dalzell & Lewis 1989). Of this group of countries, only Solomon Islands has maintained pole-and-line fishing. Bait catches, which comprise about 73 per cent stolephorid anchovies, presently amount to 2,500 t/year (Nichols & Rawlinson 1990).

Stolephorid anchovies are also caught in the live-bait fishery in Fiji but they account for only 10 per cent of the total catch (Lewis et al. 1983). The Hawaiian anchovy (*E. purpurea*) is also caught for live bait to support a small pole-and-line fishery in Hawaii that supplies fresh tuna for domestic markets.

Capture of live bait for pole-and-line fishing is conducted at night by attracting schools of fish to underwater lamps and then catching them with a dip net. Variations of this technique are used to catch stolephorid anchovies in South-East Asia. In some locations, the dip net is not mounted on a boat but on a bamboo platform set on stilts in the shallows. In Indonesia, such structures are known as *bagans*. They are a common sight along the north Java coast.

Other methods for capture include small meshed trawls, beach seines, small gillnets and fish corrals. Fish corrals guide the anchovy schools through a series of chambers to a terminal chamber where they are caught using a dip net. They are a common sight around the coast of the Philippines, particularly in shallow shelf areas of the Visayan Islands such as between the islands of Negros and Panay.

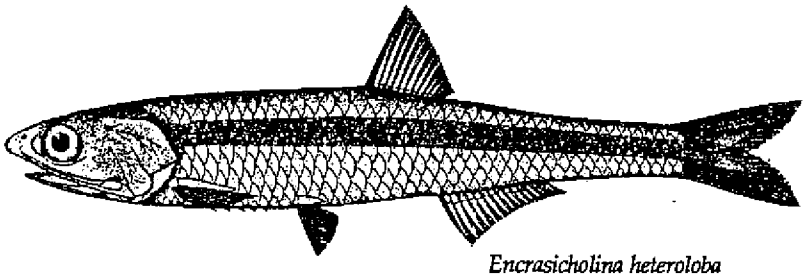
Several studies have been conducted on stolephorid anchovy stocks in India, South-East Asia, the South Pacific islands and Hawaii. Stolephorid anchovies can be characterised as small (maximum size usually 7–12 cm), rapidly growing fishes that have short life-spans, typically between one and two years, and high mortality rates. The largest species of this group, *Stolephorus indicus*, may reach 18 cm and have a life-span of three years but this is exceptional. With smaller species such as *E. purpurea* and *E. heteroloba*, the turnover of the population is very rapid and there may be two to three generations within the population in one year.

Stolephorid anchovies are planktivores, feeding mainly on copepods and other crustaceans (Milton et al. 1990). Spawning occurs throughout the year, particularly near the equator, but may demonstrate seasonal peaks allied to major climate changes such as the monsoons, which in turn are also periods of peaks in planktonic production (Dalzell 1987).

Climate, particularly wind and rainfall, appears to have marked influence on stolephorid anchovy populations. The Singaporean biologist Ah Kow Tham noted this for *Stolephorus* populations during his landmark studies of the interactions of climate and physiochemical factors on the fishery yields of the Singapore Straits in the late 1940s (Tham 1953). Tham modelled the catch rates of stolephorid anchovies in *kelong* traps in Singapore Straits and related this, among other things, to rainfall, salinity, wind strength and zooplankton biomass. Recruitment of *E. heteroloba* in Palau has been shown to be related in part to rainfall (Muller 1976) as have catch rates (and recruitment) of stolephorid anchovies in Papua New Guinea (Dalzell 1984).

From a fisheries perspective the short life-spans and high mortalities of stolephorid anchovy populations means that they can be fished very heavily and their biomass markedly reduced, but that the population will recover in a short time, usually in a period of a few weeks to a few months. In the Hawaiian bait fishery in Pearl Harbour, as much as 80 per cent of the biomass of *E. purpurea* might be captured per month by commercial fishermen (Somerton 1989). In Papua New Guinea, stolephorid anchovy catches over a year were equal to three to four times the standing stock (Dalzell 1990). Standing stocks could be reduced from several hundred tonnes to a few tonnes in the space of a year, but recover the following year despite continued fishing.

The main use of stolephorid anchovies in the South Pacific has been for live bait, and nearly all the present production is from Solomon Islands. Most of the high islands in the Pacific also have stolephorid anchovy resources that are, for the most part, not being exploited. The



Encrasicholina heteroloba

size of the stolephorid resources around high islands is related to shelf and lagoon area. The greatest resources of these anchovies are therefore to found in the large island archipelagos of Melanesia. Further, the evidence from bait fishing suggests that sustainable yields of the order of 0.4 to 0.6 t/km^2/yr are possible from stolephorid anchovy populations (Dalzell & Lewis 1989).

What are the prospects for stolephorid fisheries in the South Pacific region? Although there is a high demand for stolephorid anchovies in South and South-East Asia, production of these fishes continues to rise. Further, these fishes do not command high prices in Asia, so there is no potential for exports of stolephorid anchovies. Indeed the reverse is true and in some countries of the South Pacific dried anchovies from Asia can be found in stores and supermarkets. Small domestic fisheries for fresh and dried anchovies may offer some economic potential, as in Fiji (Anon. 1992).

Persons interested in the biology and ecology of stolephorid anchovies can consult the publications listed below. The most recent work on Pacific stolephorid anchovies has been conducted by the Australian Centre for International Agricultural Research (ACIAR)/Commonwealth Scientific and Industrial Research Organisation (CSIRO) Baitfish Biology Project led by Dr Steve Blaber of CSIRO. This project has looked in detail at the biology of baitfish, including stolephorid species in Solomon Islands (see contributions in Blaber & Copland 1990), Kiribati (Rawlinson et al. 1992) and Fiji (contributions in press).

Amongst the studies carried out by Dr Blaber and his team was an investigation of the importance of stolephorid anchovies and other baitfish as forage for reef and lagoon fishes. This is an important issue in the South Pacific, where commercial and subsistence fishermen are concerned about the influence of baitfisheries on the productivity of reef and lagoon fisheries.

The ACIAR/CSIRO project has also produced biological studies on a variety of other related clupeoid fishes, including the gold spot herring, sardines and sprats. Persons interested in other aspects of stolephorid anchovy fisheries such as processing and marketing are recommended to consult the recent study of this topic by the Bay of Bengal Programme (Bostock et al. 1992), which was featured in *Fisheries Newsletter* #65.

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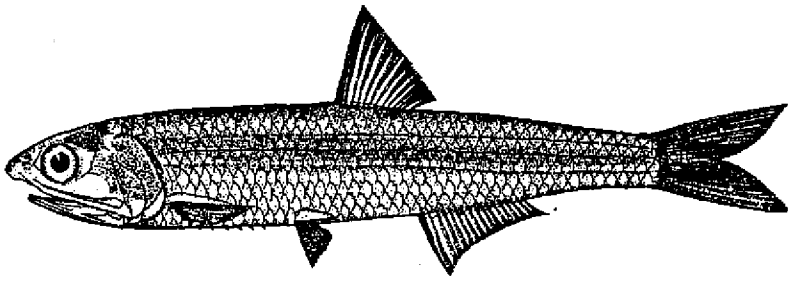

Encrasicholina devisi

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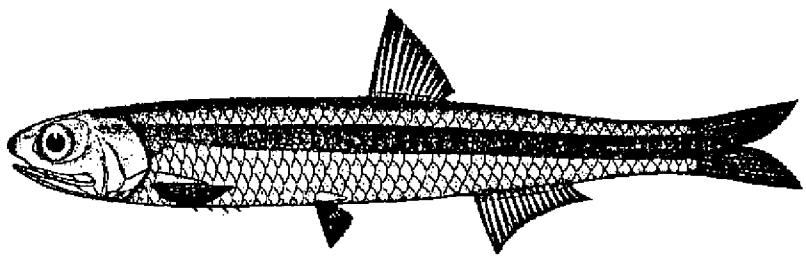

Encrasicholina punctifer

FISHERIES IN PALAU

by James Crossland
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Current situation

The Republic's living marine resources include inshore and offshore vertebrate species such as reef fish, pelagic fish, bottom fish, turtles, birds, crocodiles and marine mammals; invertebrate species such as shrimp, clams, trochus, lobsters, pearl oysters, crabs, octopus, corals and others, as well as a wide variety of marine plants. Palau's coral reef ecosystem is widely recognised as one of the richest and most diverse in the world and as such it is one of the nation's most valuable natural resources. As such it also attracts a growing number of tourists (35,000 in 1992) to Palau to dive in pristine environments and to view fish, corals, wrecks and other attractions.

Exploitation of this resource base takes place in various ways. Fishing within the lagoon and out on the reef slopes is commonly conducted on a subsistence or semi-subsistence scale, with a portion of the catch finding its way to marketing centres in Koror, where it is sold locally or abroad.

Techniques used for subsistence and commercial-level fishing range from simple collecting of sea cucumbers, sea urchins, clams and other species at low tide, often by women and children, to hook and line fishing, underwater spear fishing, net fishing and trolling conducted almost exclusively by men.

These latter activities often involve the use of about 800 outboard motor boats typically from 16 feet to 25 feet (approx. 5 to 8 m) in length. At least 20 per cent of the households own power boats and given the extended family in Palau, most fishermen have indirect access to power boats of this type. In 1993, a total of 777 fishermen landed a total of 769 t of fish and invertebrates at three major fish markets with a dockside value of US$ 2.1 million (excludes aquarium fish, cultured giant clam and trochus).

Fishing for commercial button shell, trochus, is a seasonally significant source of revenue for many local fisherman. Average annual catches during the June collecting season range from 100 to 300 t.

In 1992, after a harvest moratorium of three years, the fishermen landed a total of 265.1 t, with a dockside value of US$ 645,000. 251.9 t of cleaned and dried raw product from this harvest were exported to Asian markets, bringing in into the economy US$ 1.1 million. In 1993 only two states responded to the trochus harvest season declared by the Congress and catches recorded were only 29.3 t with a dockside value of US$ 58,600.

Export of ornamental aquarium organisms by the private sector began in 1991. In 1993, a total of 38,553 live fishes was exported, bringing in additional foreign earnings of US$ 48,600.

Offshore fishing for pelagic species, particularly tuna, is conducted primarily by foreign vessels and fishermen. In the case of the US and Japanese fleets, licensed vessels are not required to land fish in Palau; other vessels (mainly Taiwanese and mainland Chinese associated with locally based sashimi tuna-transshipping companies) are required to offload their catch in Palau. Revenues realised from vessel access fees (excluding US) totalled about US$ 1.2 million in 1993.

In 1992, locally based tuna-transshipping companies exported 4,007 t of tuna with an estimated market value of around US$ 36 million. The companies contributed about US$ 2 million in the form of tax and fees, which represents about 6 per cent of the estimated fish market value. In addition to these foreign vessels, one locally owned and operated pole and line boat supplies fresh tuna for domestic consumption.

The contribution of the marine resource sector to Gross Domestic Product in 1993 has not been tallied but is expected to be highly significant. The value of non-market production is estimated to be three times that of the inshore commercial production.

Precise data on total landings of fish and marine products are generally lacking. Purchase records from the major fish retailers show commercial landings and dockside values for 1991, 1992 and 1993 respectively as follows: 350.8 t (US$ 1.032 million); 599.1 t (US$ 1.624 million) 418.91 t (US$ 1.077 million); while subsistence production is estimated as three times that of the commercial landings. Given the relatively small habitat size, it is likely that over-exploitation has already taken place in most areas. In order to get a complete figure for landings, unrecorded domestic con-

sumption and purchases by local fish markets must be included.

Equally lacking is information on exports. DMR's analysis of the airlines' outgoing way bills indicates that a large volume of marine products is leaving the country as air freight. Outgoing marine products for 1991 show 775 t from 13,748 containers; for 1992 exports of 1,005 t were recorded from 17,767 containers. This significant increase is attributed to export of aquarium fish for that year. Large but unknown quantities are exported as carry-on baggage and therefore do not get recorded.

For 1992 estimated 203 metric t (market value of ca. US$ 700,000) of edible fish was exported by individual fishermen or companies that did not land their fish at the Palau Federation of Fishing Associations (PFFA), PMCI, Oh's or Melekeok Cooperative. In addition, over 220,000 organisms, mainly cultured giant clams, valued locally at over US$ 220,000, were shipped during 1992.

Estimating the value of exports of most inshore marine products, which include crabs, lobsters, finfish and come in various forms (live, fresh, frozen, processed), is difficult without having access to actual sales invoices. Combined with the export of unfinished trochus shells, beche-de-mer, giant clams and tunas they represent most, if not all of the Republic's export earnings for 1992.

Organisations

National Government agencies concerned with marine resource exploitation and development include the Ministry of National Resources and the Ministry of State.

Within the Ministry of State, the Palau Maritime Authority is responsible for negotiating and issuing fishing licences to foreign entities. The PMA's jurisdiction extends from the 12- to the 200-mile limit. The PMA is responsible for the development, conservation and management of migrating species of fish within both the territorial seas and the 200-mile fisheries zone.

Within the territorial waters, ownership of marine resources is vested in individual State Governments. Trade negotiations are handled by the Bureau of Foreign Affairs, and the Division of Foreign Relations oversees matters involving international boundaries.

The Ministry of Resources & Development includes the Bureau of Natural Resources and Development, which directs the activities of the Division of Marine Resources. The main functions of the Marine Resources Division include marine research and development, resource management, technology transfer, technical advisory and extension services, statistical monitoring and recommending legislation. In addition, the Division is charged with the operation of the Micronesian Mariculture Demonstration Center (MMDC) which devotes efforts to developing and promoting commercially viable marine species and serves as a base of operations for visiting international researchers.

A fishermen's cooperative, the Palau Federation of Fishing Associations (PFFA), was established in 1975 to offer shoreside facilities and services to local fishermen. PFFA suffered financial losses and was declared insolvent in 1982. In 1993 PFFA was taken over by the National Government, and is currently managed as a quasi-government agency by the Palau Fishing Authority (PFA), a semi-governmental organisation supervised by an appointed board. These entities oversee the operation of a 100 gross ton cold storage facility and three ice machines with a combined production capacity of 16 t per day. In addition, PFA and PFFA manage ten 35-foot diesel vessels donated by the Government of Japan, and provide fishing gear at cost to local fishermen.

Enforcement and surveillance of Palau's 200-mile extended economic zone is currently undertaken by the Attorney-General's Office, which maintains a 60-foot diesel patrol boat and crew of contracted officers.

Problems and issues

Development constraints

An immediate need exists to improve the present system for collecting, analysing and disseminating fisheries statistical data, for both finfish and shellfish species in the case of the inshore fishery for reef fish. More precise information is required regarding the number of fishermen, fishing effort, volume of commercial and subsistence catch, and sales to local markets. Equally important is the information on exported and imported marine products. In the absence of this type of information, fisheries management legislation and policies will be difficult to support.

Although precise data are lacking, several sources of information suggest that fish harvests from within the reef may have reached maximum sustainable yield. To prevent the danger of over-exploitation of key species immediate management action is required. Rigorous monitoring is necessary to keep management apprised of the situation before the fishery collapses. The other required action is to encourage fishermen to become involved in the harvest of pelagic species such as tuna, mahimahi, and others.

In the private sector, three big commercial traders are actively engaged in servicing foreign licensed vessels and transshipping their catch of tuna to Japanese sashimi markets. However, participation by local people in fishing and in key management positions is extremely limited, thereby also limiting potential benefits that could accrue to Palauauns. The environmental impact stemming from the congested harbour and lack of sanitary facilities is becoming a major concern to the developing tourism industry.

Poaching of inshore and offshore marine resources by foreign vessels has been a persistent problem in recent years, clearly demonstrating the need for regular surveillance.

Traditional conservation methods, such as reef tenure, have been eroded near population centres. In general, modern conservation practices have not been implemented to rectify this situation.

Potential marine reserves have been documented. They need to be formally established and management plans prepared and implemented. Surveillance and enforcement capabilities, as well as inspection and monitoring programmes, need to be established and staff trained. The Ngerukewid Islands Wildlife Preserve requires more frequent surveillance.

More than 100 t of canned fish are imported annually. Canned tuna and sardines are locally regarded as affordable convenience foods; however, importation of canned and frozen fish will continue to be a drain for foreign exchange.

The export development of Palau marine products, mainly reef fish to foreign markets, is constrained by the lack of cargo space links with the major marine product markets, namely, Japan, Taiwan and parts of the United States. Even when space is available, our limited quantities preclude us from maintaining the high minimum product demand normally required by foreign importers.

Objectives

Objectives for development of Nation's Marine Resources during the Plan Period are to:

- increase local participation in employment and other income-generating opportunities in all commercial fishing, shore-based processing and servicing and export facilities, marine-based recreational ventures, mariculture and other related activities;
- develop long-term integrated resource management policies that take into consideration the principles of sustainable development and that maximise participation and coordination among resource owners, managers and other user groups;
- explore possibilities for local participation in the harvest of oceanic resources for sashimi tuna markets;
- broaden the export base to include cultured and underutilised species and value-added products.

BEHAVIOURAL RESEARCH ON TUNA USING SONIC EQUIPMENT AND EXPERIMENTAL LONGLINING IN FRENCH POLYNESIA

by René Abbes*, Pascal Bach** and Erwan Josse**
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Introduction

Various research activities on tunas have already been carried out in the Exclusive Economic Zone (EEZ) of French Polynesia: aerial radiometry, livebait stock assessments, PROGERMON cruises, fishing trips on the RV *Marara*, and tagging operations as part of the South Pacific Commission's Tuna and Billfish Assessment Programme in the area it serves. Most of this work was connected with surface tuna exploitation.

As these research operations were going ahead, the South Pacific was becoming a major theatre for the deployment of FADs around island coastlines. Over 1000 FADs were moored throughout the region between 1980 and 1990, including almost 200 in French Polynesia's EEZ, for the purpose of supporting and/or developing artisanal inshore fishing fleets.

Although Asian longlining fleets had been present in the region well before the 1980s, their activities became much harder to quantify after the EEZs were declared. Access agreements between France and both Japan and South Korea were signed in 1980. One condition of these agreements was that logs recording catches in the EEZ should be forwarded to the French authorities by the fishing boat owners. Today, however, there is no choice but to conclude that the data provided are inadequate in terms of both quality and quantity.

In 1993, a review of the information available on the tuna resources of the Territory's EEZ revealed a somewhat paradoxical situation when the information available was related to the Territory's own fishery development plans:

- there is a relatively good knowledge of the surface stocks, mostly exploited by fleets of *bonitiers* which sell their catches (1500 mt per year approx.) entirely on the local market.
- no information is available on the interactions between FADs and the resource, although these devices continue to be a fishing aid for a proportion of the artisanal fleet;
- there is a virtually total lack of data on the size of the deep stocks on which all the hopes of development of a semi-industrial longlining fleet are currently relying.

To respond to the urgent promptings of the Territorial authorities, who are the prime movers in all recent fishery development projects, the fishery biologists based in the Territory proposed a five-year supporting research programme. This programme is the result of cooperation between three research bodies: EVAAM, IFREMER and ORSTOM. The cruise (called ECOTAPP) carried out by the RV *Alis* in French Polynesia from June to August 1993 was part of this general programme and indeed marked its inception.

Objectives

Brief description of programme objectives

The main goals of the programme are as follows:

- to improve knowledge on the spatio-temporal distribution of adult tuna stocks in relation to their environment;
- to study the behaviour of the resource both in its natural environment and under the influence of a type of fishing gear (longline) or fishing aid (FAD or drifting objects).

ECOTAPP objectives

The cruise of the RV *Alis* had the following aims:

- acquisition of information which will make it possible to secure a better understanding of the spatio-temporal distribution of the various tuna species (*Thunnus albacares*, *T. obesus* and *T. alalunga*) targeted by the longline fleets;

* *IFREMER: Institut français de recherche pour l'exploitation de la mer*
** *ORSTOM: Institut français de recherche scientifique pour le développement en coopération*

- study of the preferred bathymetric distribution of the various species with reference to the physical and chemical characteristics of the water masses;
- analysis of the behaviour of the resource under the effect of an aggregating structure at two levels of perception, firstly the individual and secondly the aggregation.

Shipboard equipment

The monofilament longline and its instruments

The equipment to be used for experimental fishing comprises a drum, a shooter, the main line and branch lines and all the equipment required to rig the line (intermediate floats, radio beacon buoys, minor repair equipment). The hydraulic drum has a capacity of approximately 25 miles (40 km) of 3 mm monofilament line. Each branch line is 6 fathoms (11 m) long and 2 mm in diameter. To one end is fixed the hook (a hook with a MUSTAD 8/0 barb) and to the other a snap.

The longline is fitted with two types of instruments: time depth recorders along the main line and hook timers on each branch line.

Material for collecting environmental data

The Seacat SBE 19 sonde was used to simultaneously gather pressure, temperature and conductivity data; the SPE 21 thermosalinograph made it possible to continuously collect sea-surface temperature and sea-surface salinity data. In addition, in order to obtain thermal profiles of particular sites (especially close to FADs) an XBT shooter was carried on the ship.

Sonic tagging equipment

The sonic tagging equipment comprises ultrasonic tags, a directional hydrophone and an ultrasonic receiver. The hydrophone was fitted to a paravane towed alongside the ship when tracking the tagged fish. Data are stored in a receiver and then transferred to a microcomputer.

Specimens for sonic tagging operations were caught using a trolling line or a vertical longline. The longline was fitted to a wooden reel and comprised a main line 180 to 270 m long and 1.5 mm in diameter plus 3-fathom long branch lines fitted with self-striking hooks.

Research activities

Fishing with instrument-equipped longlines

The hydraulic line hauler was located on the boat's centreline so that the mainline feeds straight out to the swivelling gallows located just behind the port cable winch. A second gallows was located in the midsection of the rear deck, under the trawl winch, to pay the line out onto the shooter during setting. Mounted in the middle of the transom, the shooter makes it possible to pay out the main line at an adjustable speed.

It is fitted with a beeper alarm whose adjustable frequency is determined by the length of line already paid out. This device makes it possible to attach hooks at previously defined regular intervals. The onboard layout of the longlining equipment is shown in Figure 1.

The longline (see Figure 2) is kept horizontal by 2 x 18 litre floats connected to the main line by 2 snaps at the end of a 45 m buoy line. Each end of the longline is connected to a float fitted with a radio-direction-finder beacon buoy.

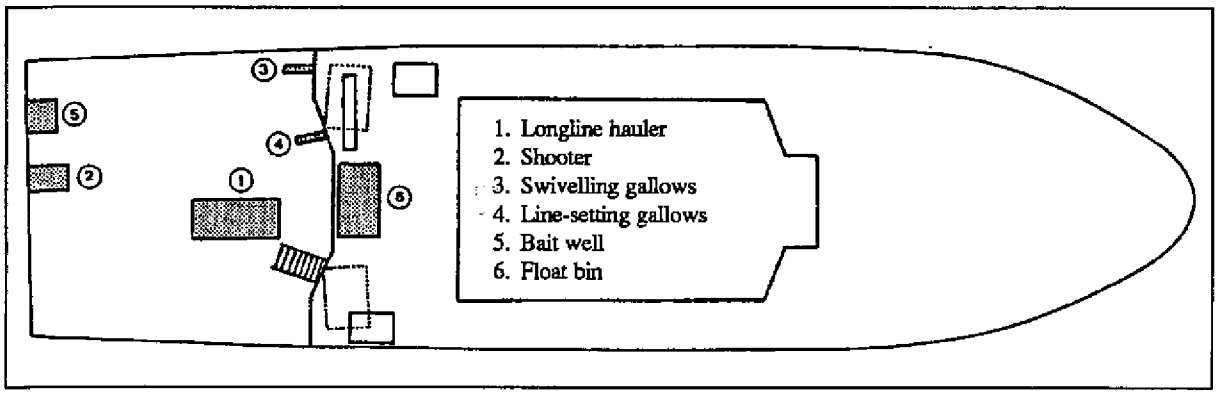


Figure 1. Layout of monofilament longlining equipment on the R/V *Alis*

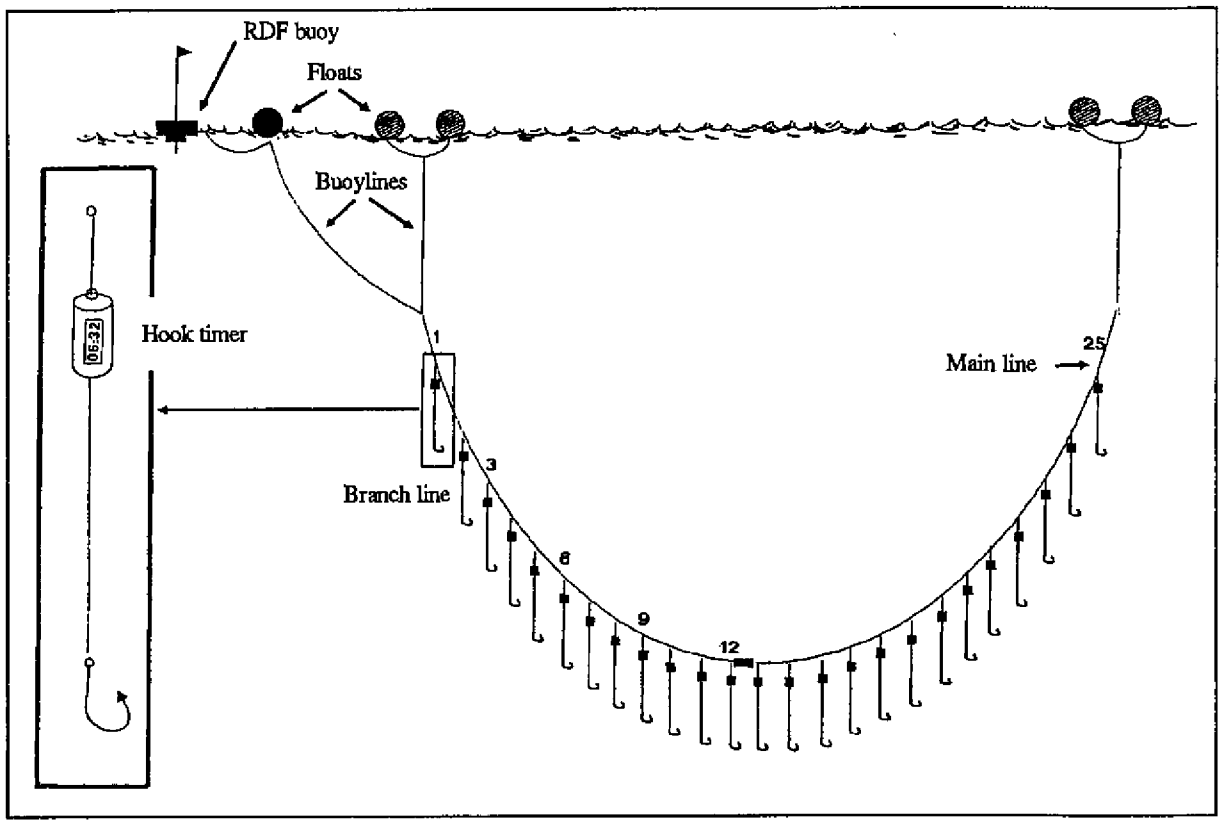


Figure 2. Instrument-equipped longline used during ECOTAPP cruises

In general, the longline was set at 6 am and hauled at around 1 pm, after approximately 7 hours in the water. Some sets were done at night. The longlines, fitted with 150 to 500 hooks, were made up of 25-hook sections, with a distance of 50 m between branch lines in each segment. New Zealand squid was the bait used, size-rated at 4.5 specimens per kilo.

Apart from the hook timers (approximately 350) fitted to the branch lines, each longliner was also equipped with time depth recorders. At the end of each set, the Sea-Cat sonde was shot.

The data from each set were entered into five files or groups of files:

- *Station file*: This comprises general station characteristics, in particular weather data, times and positions of starting and finishing setting and swivelling the longline, the characteristics of the gear used and catch weights and numbers for the main species groups.
- *Longline/fish file*: For each individual fish caught and timer triggered, this file records the station number, the position of the hook on the longline and on the longline segment, the time the fish was hauled aboard and hooked (if these data are available), the hook depth and the order in which the fish were caught.
- *Biometrics file*: In this file are entered all the biological observations carried out on each specimen: order in which fish were caught, species, size and weight and, for the main species, sex, gonad maturation stage, stomach fullness index and degree of digestion, the nature of the samples taken (stomach contents, gonads, hard parts [vertebrae and first dorsal spine] to determine age).
- *Time Depth Recorder (TDR) file*: This information comprises a station number and TDR number and includes the time depth data collected.
- *Hydrological file*: This contains the station number and records depth, temperature and conductivity data collected by the Sea-Cat sonde.

Sonic tagging operations

A wooden reel known as an FAO reel was mounted on the port handrail for the purpose of catching deep-swimming tuna for sonic tagging. The end of the main line was equipped with 5 branch lines each approxi-

mately 3 fathoms in length. Spaced about every 15 m, these branch lines were fitted with self-striking hooks baited with skipjack. A snap was used to attach them to the mainline. The top end of the line was released after attaching two 5-litre floats and a 1-litre tell-tale float. This gear item was always deployed near FADs for the tagging operations.

The tagging operation itself involves fitting an ultra-sonic tag to the area between the caudal fin and the last soft dorsal spines. Plastic loops are used to fix the tag. These are pushed through the fish's body using a bent hollow needle. The tags are fitted with pressure sensors transmitting to a directional hydrophone mounted on a paravane drawn behind the boat. The hydrophone is itself connected to a receiver which decodes the signal and calculates the depth at which the fish is swimming.

The boat follows the fish in a direction corresponding to the maximum signal intensity. The boat's position (supposedly equivalent to the fish's position) is recorded every five minutes using a GPS receiver. Two yellowfins were tagged during the cruise.

Analysis of acoustic signals

The sounder used is a dual-frequency (38 and 120 kHz) scientific sounder (Biosonic brand). This sounder is connected to a transducer fitted to a paravane towed alongside the boat. During the ECOTAPP cruise, only the 120 kHz frequency was used, with the 38 kHz frequency proving too noisy beyond a depth of 100 m. The received and amplified signals are transmitted to an echo-integration system which, after a variety of calculations, will make it possible to calculate acoustic density values per depth stratum and consequently fish density.

Brief description of cruise

The cruise of RV *Alis* took place from 22 June to 18 August 1993. During this time a set of scientific tasks was carried out on a continuous basis: automatic recording of the boat's position and of sea-surface temperature and salinity every 5 minutes; recording of metereological data every 6 hours and dropping of an XBT sonde every 12 hours.

The first part of the cruise (from 22 June to 6 July) was given over solely to fishing with an instrument-equipped longline between the northern Tuamotu group and the border of the EEZ to the north-east of the Marquesas. The second part was restricted to a zone around the Marquesas and included instrument-equipped longline fishing, acoustic test fishing around FADs and sonic tagging of tunas. The third part took the vessel to the Leeward Islands and the Society Islands where a series of echo-integration, sonic tagging and longline fishing activities were carried out.

Preliminary results

It is still too early to provide detailed results of the experimental fishing done during the cruise. The raw data are given here, together with some preliminary comments.

The 8,944 hooks deployed during the 26 sets achieved during the cruise yielded 259 fish weighing a total of 7,713 kg. These fish belonged to 23 species, which are listed in Table 1.

Table 1: List of common and scientific names of fish caught

Common Name	Scientific Name
Albacore	*Thunnus alalunga*
Bigeye	*Thunnus obesus*
Yellowfin	*Thunnus albacares*
Skipjack	*Katsuwonus pelamis*
Wahoo	*Acanthocybium solandri*
Mahi mahi	*Coryphaena hippurus*
Blue marlin	*Makaira mazara*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*Tetrapturus angustirostris*
Broadbill swordfish	*Xiphias gladius*
Giant barracuda	*Sphyraena barracuda*
Kingfish	*Lampris regius*
Sunfish	*Mola mola*
Lancet fish	*Alepisaurus ferox*
Pomfret	Bramidae gen. sp.
Castor oilfish	*Ruvettus preciosus*
Blue shark	*Prionace glauca*
Hammerhead shark	*Sphyrna sp.*
Silky shark	*Carcharhinus falciformis*
Oceanic whitetipped shark	*Carcharhinus longimanus*
Bigeye thresher shark	*Alopias superciliosus*
Thresher shark	*Alopias sp.*
Sting ray	*Dasyatis violacea*

Tunas account for 40.3 per cent of total catches, sharks 30.9 per cent (with particularly high abundance around the Marquesas) and billfish 17.4 per cent. Without being exceptional, the yields (in terms of number of fish per 100 hooks) are good because they average 86.3 kg, all species combined, and 53.6 kg of high commercial value fish.

Yields therefore rank alongside the averages obtained by professionals during the same season. On the other hand, they differ in their species composition and particularly in the relative abundance of bigeye tuna compared to albacore and yellowfin. Bigeye accounts for more than 30 per cent of total yellowfin in catches, but less than 10 per cent in longline landings from ships which seem to fish at lesser depths than those tested with the *Alis*. TDR recordings show that in most cases the hooks were distributed over the 100 to 500 m water level and that many of them were therefore deployed in waters where the temperatures were between 8° and 12°C. This temperature range would appear to be particularly attractive to the bigeye tuna, most of which are caught on the deepest hooks.

The TDRs showed the influence of currents on the performance of the longline. In the Marquesas in particular the maximum depth varied by a factor of two, sometimes during the same set.

The raw data from sonic tagging were transferred to a micro-computer for correction and elimination of irrational values due to difficult reception of signals from the sonic tag. After this first stage, it then became possible to visualise fairly swiftly the vertical movements of fish in time.

Horizontal fish movements of tagged specimens will be derived from the GPS positions automatically recorded every five minutes together with the surface temperature and salinity data.

The vertical movements now need to be related to the hydrological conditions prevailing in the water layers accommodating these fish. Depth data should now be translated into temperature data.

The data recorded during the acoustically assisted assessments now require analysis. A total of 180 hours of experimental data recording was done with the Biosonics sounder. During these activities, a threshold detection value was used; however, although all fish echos have been kept, some of the information collected can be attributed to noise. Indeed, the state of the sea or the varying densities of layers of plankton can have a major influence on extraneous noise.

The recordings will therefore be analysed by a software which will make it possible to eliminate undesirable echoes and perform estimates of absolute densities and biomass.

Conclusion

This first cruise on board ORSTOM's RV *Alis*, as part of the joint EVAAM, IFREMER, ORSTOM research programme, made it possible to acquire new data on the distribution and behaviour of tunas in the EEZ of French Polynesia. Although it is still too early to draw conclusions from this cruise, it has demonstrated how worthwhile it would be to carry out a study of this kind in French Polynesia's waters and also that the methodological choices made were sound.

This is an ambitious programme and the objectives set cannot be achieved in a single cruise. These experiments now need to be repeated over a number of years and in a variety of hydrological seasons.

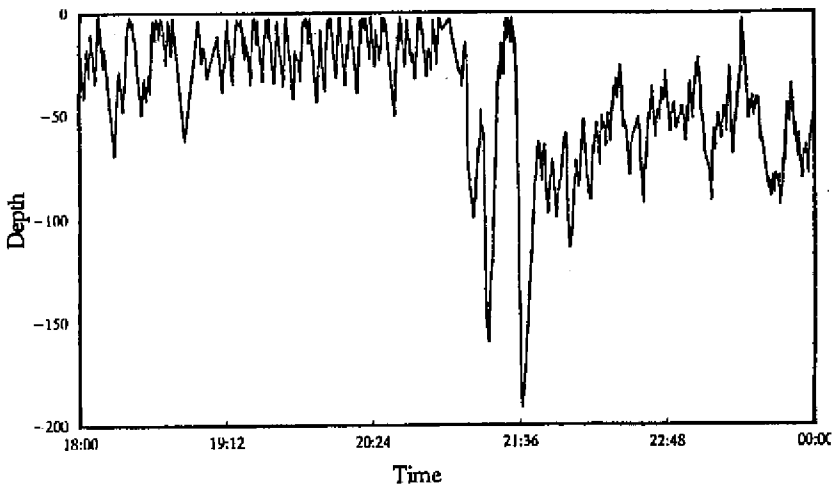
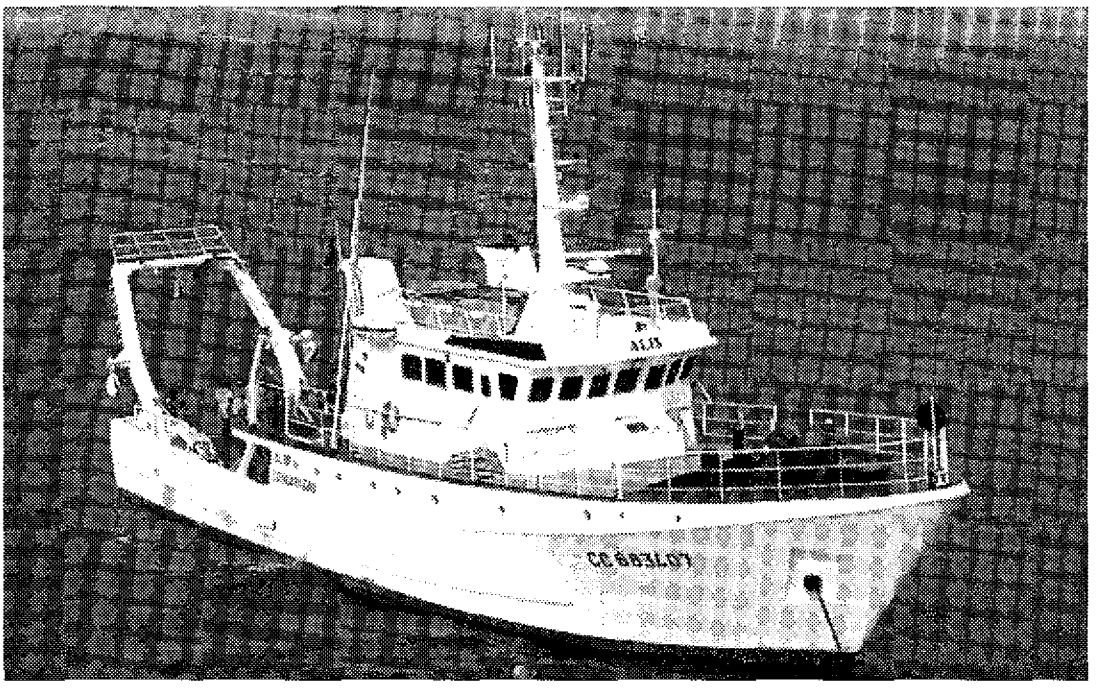


Figure 3. Extracts from the vertical movements of a yellowfin tuna (*Thunnus albacares*), 67 cm in fork length, tagged to the north of the island of Nuku Hiva (Marquesas).

It should not 'however' be forgotten that this article is derived from a cruise report and that the data are for the moment still being reviewed. Where fishing activities are concerned, it would be unwise to make a direct comparison of the *Alis's* results with those of other fishing fleets or other studies, because the experiments were carried out on a systematic basis and not by seeking the areas where abundance was highest.



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