

SOUTH PACIFIC COMMISSION

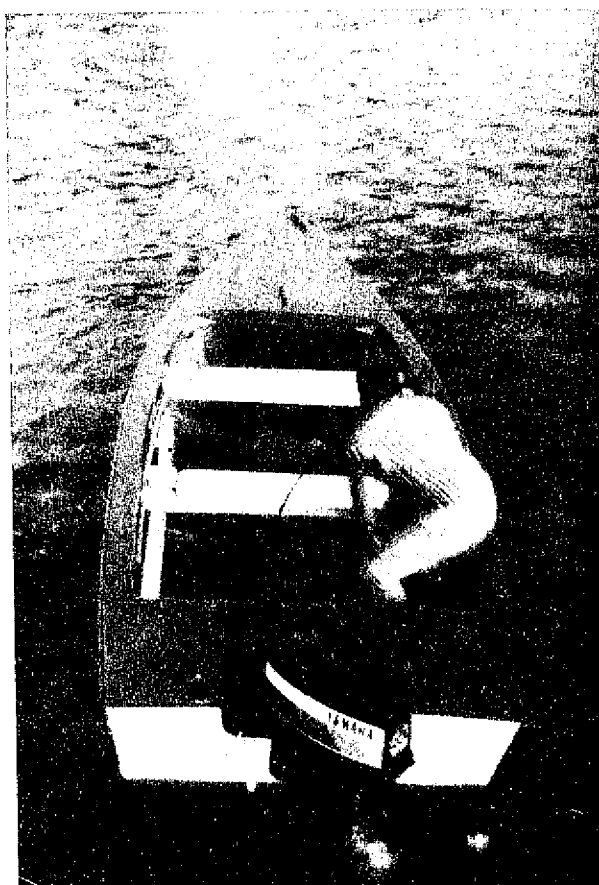


# FISHERIES NEWSLETTER

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ARTISANAL FISHING CRAFT USED  
IN TUVALU, INCORPORATING  
SAIL FOR SAFETY

Prepared by Jean-Paul Gaudechoux, Fisheries Information Officer

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## ■ NEW FISHERIES DEVELOPMENT ASSOCIATE RECRUITED

Masanami Izumi arrived in Noumea on 10 June 1991 to begin a two-year assignment as Fisheries Development Associate in the SPC coastal fisheries programme. This newly established position is the result of an agreement between the Overseas Fishery Cooperation Foundation (OFCF) of Japan and SPC for the development of small-scale fisheries in the Pacific Islands region and for the further development of fisheries relations between the member countries of SPC and Japan.

Masanami worked for the FAO/UNDP Regional Fishery Support Programme in Fiji from 1985 to 1988 and at the OFCF Tokyo office from 1988 to 1991 as a fisheries expert. His work involves fisheries management and development, project operations of coastal fisheries development in the region, as well as translation (Japanese and English) of fisheries and oceanographic articles. He is researching in the areas of fisheries oceanography, fisheries development and bibliographic fisheries information.

As his first project, he is working on the compilation of a marine resources bibliography

for the Federated States of Micronesia (FSM) and the Republic of the Marshall Islands, following the publication in 1988 of the *Palau Marine Resources Bibliography*. A large number of publications about Micronesia were written in Japanese during the Japanese mandated era before World War II. He will examine both published and unpublished materials appropriate for the bibliography, including Japanese references, during a survey trip from September to November 1991.

Material in Governments' offices, fisheries-related offices

and institutions, and libraries will be searched in both countries. Outside FSM and Marshall Islands, university libraries, international organisations and research institutions will be surveyed in Suva, Honolulu, Guam and Tokyo. International organisations and universities in Canberra, California and Rome will be surveyed by letter. The work will be completed as a database programme in close co-operation with the Pacific Islands Marine Resources Information System (PIMRIS). Publication is expected in early 1992.



## ■ DEEP SEA FISHERIES DEVELOPMENT PROJECT NOTES

The DSFD Project has been engaged in three field assignments in recent months under its visiting Masterfisherman programme.

### Parachute sea anchors for vertical longline fishing in Western Samoa

As previously reported, Masterfisherman Peter Watt continues working in Western Samoa on the development of FAD-based tuna fishing with hand-hauled vertical longlines.


Recently the success of the technique and the growing number of fishermen adopting it has resulted in some competition for space at the FADs off Upolo.

Each fishing craft ties off a surface line to the FAD along which the multiple vertical longline droppers are clipped. As might be imagined, with several boats attempting to fish

a FAD simultaneously some opportunity for conflict arises. In an attempt to solve this problem, and at the same time allow as many craft as possible to fish a particular FAD, Watt has developed the technique of drift fishing through the FAD zone with the vertical longlines tethered to the fishing craft. To do this successfully the wind-

borne drift of the craft has to be slowed by using a parachute sea-anchor.

Because commercial parachute sea anchors are relatively expensive, Watt has arranged for the manufacture of parachutes in Apia, making use of locally available materials such as cheap tarpaulin cloth. These


inexpensive parachute sea anchors also provide fishermen with a very useful safety device in case of breakdown and in storms. Present training efforts concentrate on demonstrating the use of parachutes to fishermen who have already begun vertical longline fishing. 

### Flying fish capture trials in Fiji

Although flying fish are considered an important resource in many Pacific Islands, particularly in Polynesia, they go unexploited in other areas. Following a suggestion by the FAO/UNDP Regional Fisheries Support Programme (RFSP) and with the concurrence of Fiji Fisheries Division, the Project agreed to assess the potential for the capture of flying fish using traditional Polynesian

scoop nets and battery-powered light in the Suva area. Project Masterfisherman, Tuainetai Rata, who has extensive experience in this fishing technique, was subsequently assigned to conduct the trials along with staff of the RFSP and Fiji Fisheries Division.

The early trials, although hampered by poor weather, produced small numbers of flying

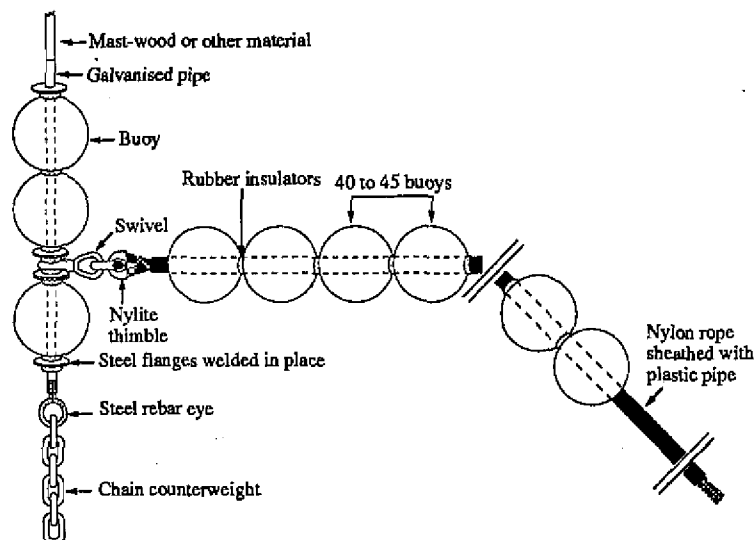
fish. This catch was much in demand by Suva game-fishermen to use as troll bait. As it is likely that flying fish abundance in Fiji waters peaks during the summer months, the trials will be continued by RFSP staff with the eventual aim of fostering development of a local artisanal fishery. 

### FAD project in North Tarawa to trial new raft design

As part of an integrated rural development project in North Tarawa, Kiribati, co-ordinated by SPC, the DSFD Project assigned Masterfisherman Paxton Wellington to conduct

bottom surveys by echosounding in the Tarawa lagoon and offshore from Buariki village, with the hope of identifying suitable sites for FAD deployment. It is intended that

one deep-water and several shallow-water FADs will be deployed to enhance local fishing efforts.

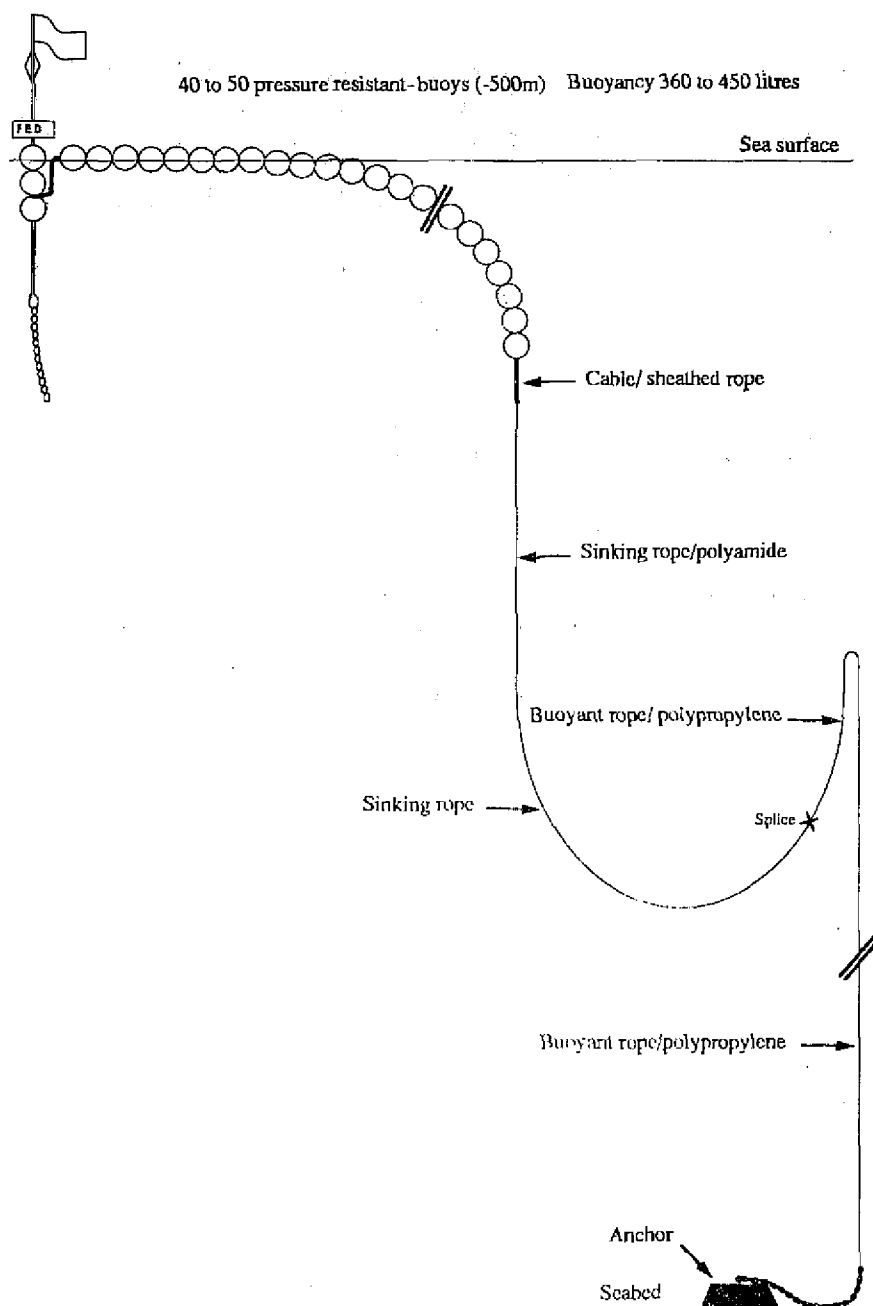


Construction detail of the mast/raft section for new FAD raft design as used in Kiribati

The FAD destined for placement offshore is of a design not previously tried in the Pacific islands. First deployed in the Indian Ocean territories of Seychelles, the Comores and Reunion, it uses a string of pressure-resistant floats as the FAD raft. The concept behind

this design is that under the force of strong currents or storm-waves, the pressure-floats will be progressively forced under water and thus avoid much of the mooring stress caused by the action of waves and strong surface currents on standard rafts. Ex-

tended survival rates are reported for FADs rigged with this raft in the Indian Ocean and the DSFD Project will monitor this present trial closely to determine the design's success in the Pacific.



Overall design of the pressure-float raft FAD; the combination of an inverse catenary curve mooring and a raft which submerges in strong current may result in extended survival times.

## ■ TWENTY-THIRD REGIONAL TECHNICAL MEETING ON FISHERIES

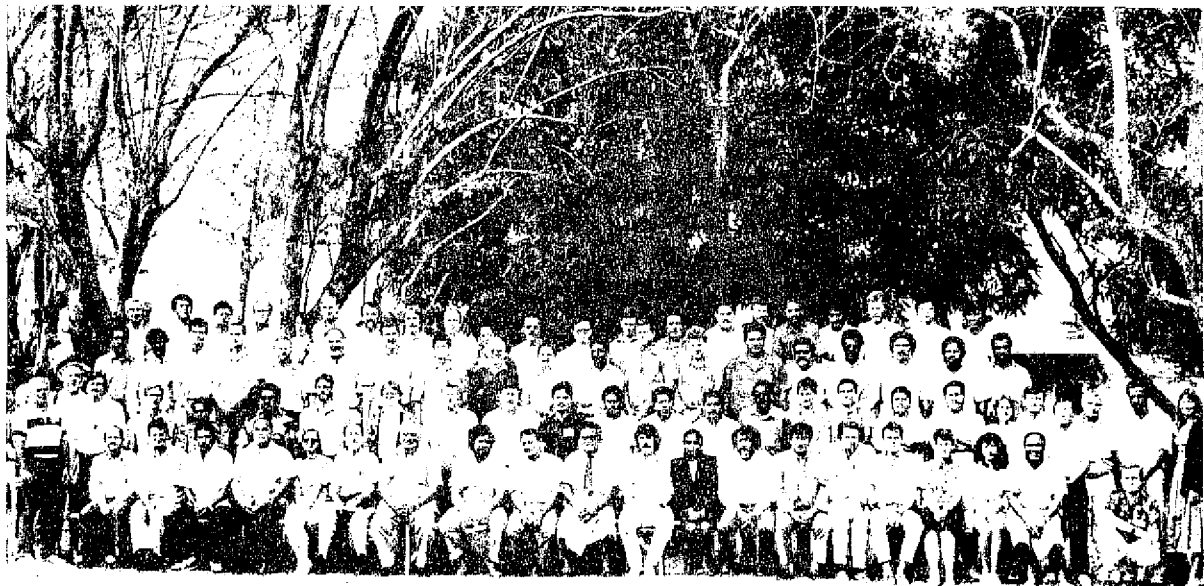
The Twenty-third Regional Technical Meeting on Fisheries (RTMF), held in Noumea from 5 to 9 August 1991, was attended by 66 delegates from 24 SPC member countries and 17 international or other organisations. The meeting was chaired by Dr Tim Adams, the representative of Fiji. Mr Philippe Siu, the representative of French Polynesia, was appointed Vice-Chairman and Chairman of the Drafting Committee.

The purpose of the meeting, as always, was to present the work of SPC's fisheries programmes for regional review, to provide an update on the major issues facing fisheries development in the Pacific, and to enable the region's fisheries managers to exchange information and ideas.

The meeting was opened by the Secretary-General, who warmly thanked the former SPC

Fisheries Co-ordinator, Mr Bernard Smith, for the work done during his period of service and also congratulated Mr Julian Dashwood, his successor on his appointment.

This year, for the first time, an open-day display was organised. This allowed a more direct presentation of programme activities and gave participants a chance for detailed discussions with the staff concerned.



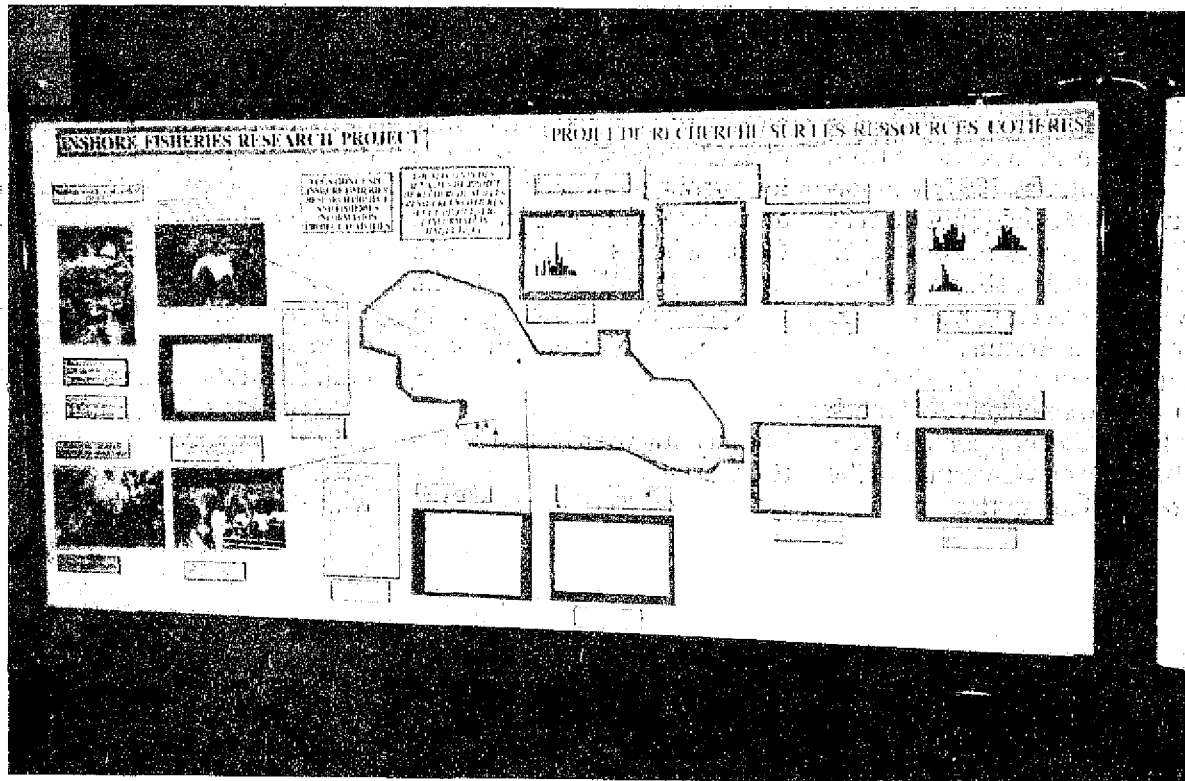
Participants in the Twenty-third Regional Technical Meeting on Fisheries

The first item on the agenda was a general overview of SPC fisheries programmes, describing the activities of each of the programmes' component projects over the past year.

The Tuna and Billfish Research Project was described. The importance to the region of the resource studied by this programme was underlined. The results of the Regional

Tuna Tagging Project (RTTP), which is to be extended to mid-1992, were presented. Total number of fish tagged and release (to date — August 1991) is about 90,000, including 25,000 yellowfin, more than 60,000 skipjack and about 1,200 bigeye tuna. The Albacore Research Project was also detailed, with particular interest in effort focused on determining the structure of albacore stocks. The

Fisheries Statistics Project was reviewed and its principal activities, such as maintaining the Regional Tuna Fisheries Database, publication of the SPC *Regional Tuna Bulletin*, assistance to member governments with fishery statistics systems and statistical support for other fisheries projects, were outlined.



The Inshore Fisheries Research Project display

An important agenda item was the report of the Fourth Standing Committee on Tuna and Billfish (SCTB). The RTMF recommended that a detailed operational plan for 1992—1996 be developed by the Tuna and Billfish Assessment Programme and distributed in advance of the Fifth SCTB for evaluation. The meeting then turned its attention to the SPAR/Third South Pacific Albacore Consultation report and the report of the Yellowfin Research Group.

Activities undertaken by the Deep Sea Fisheries Development Project, including preparation of a FAD handbook and a vertical longline fishing video, were described. The Inshore Fisheries Research Project was reviewed, with particular emphasis on the Workshop on Trochus Resource Assessment, Development and Management. One of the recommendations resulting from this was that SPC should assist Pacific

Island countries to make use of remote sensing and image processing in survey work on trochus and other marine resources.

The main components of the Fisheries Information Project were outlined, including the future update of the *Fisheries Directory of the South Pacific Region*. Information matters were continued with presentation of a progress report on the Pacific Island Marine Resources Information System Steering Committee.

Activities of the Fish Handling and Processing Project described to the meeting included a trial tuna processing and marketing project. A report was given on a study tour to Latin America, whose main purpose was to explore areas of post-harvest fisheries technology and expertise and to evaluate the potential for utilising this expertise in the Pacific Islands.

The Meeting was informed of the Regional Fisheries Training Project's plans for the future, which include post-harvest fisheries training, production and distribution of a revised *Directory of Training Opportunities*, and possibly, a distance course on report writing.

The meeting then considered the report of the SPC/ICOD Human Resource Development Study. Human resource development remains a crucial but often overlooked element in the management and long-term development of fisheries within the region. To assist member countries to make more effective use of human resources, the study assessed the future personnel needs of all island fisheries administrations, in terms of qualifications, skills, levels of competence and numbers of people, within the existing economic constraints of each country and its fisheries division.

Recommendations based on this information will assist countries, agencies and educational institutions to develop approaches and training appropriate for their particular needs.

Each year, a one-day workshop is held on an issue of topical interest in Pacific Island fisheries development. The subject of this year's workshop was 'People, Society, and Pacific Islands Fisheries Development and Management'.

Workshop participants emphasised the great diversity of traditional fisheries management practices and associated knowledge across the Pacific islands, and concluded that most SPC member countries would benefit from comparative studies of these practices and this knowledge. Participants raised the growing problems of reconciling customary law and western law. They agreed on the need for a survey of available information on the various approaches taken by traditional cultures (within and outside the SPC region) to the integration of western laws and traditional customs. Some larger Pacific Island nations contain many customary marine tenure systems about which little is known, and the structures and operations of such systems vary greatly within these countries. Rapid surveys of these systems are needed to determine which would benefit most from further detailed studies to ensure that they continue to function effectively.

Community-based customary marine tenure and associated traditional management systems are facing a number of widespread modern pressures. The workshop strongly sup-

ported research on ways in which traditional marine resource management systems respond to such pressures as major demographic changes, commercialisation of marine resources, aquaculture and marine resource enhancement, other coastal developments (including tourism), government marine resource management and enforcement programmes, and to the wider issues of integrated rural development and gender-specific roles in fisheries.

Presentation of different working papers dealt with such topics as aquaculture and marine resource enhancement (including quarantine protocols for the transfer of biological material from aquaculture facilities), the SPC/SPADP reef reseeding project, trochus reseeding experiment, enhancement of spiny lobster populations through habitat modifications, and the forthcoming Fifth International Conference on Artificial Habitats for Fisheries.

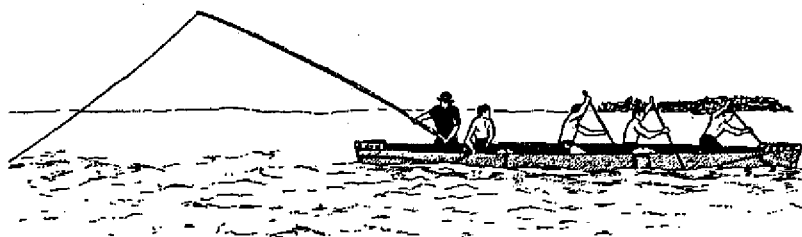
The meeting also considered the development of Pacific island pearl oyster resources and issues relating to safety at sea in Pacific Island fisheries.

The meeting concluded with presentations of the work done by other organisations involved in fisheries development in the region. These were the Forum Fisheries Agency (FFA), the

FAO/UNDP Regional Fishery Support Programme, the International Center for Living Aquatic Resources Management (ICLARM), the United States Agency for International Development (USAID), the South Pacific Aquaculture Development Programme, the International Centre for Ocean Development, the University of the South Pacific, the Western Pacific Fisheries Consultative Committee/Trans Pacific Fisheries Consultative Committee (WPFCC/TPFCC), the Overseas Fishery Cooperation Foundation (OFCF), the Australian Centre for International Agricultural Research (ACIAR) and the Institut français de recherche scientifique pour le développement en coopération (ORSTOM).

The need to review the frequency of the RTMF was raised and a working paper on this subject will be submitted to the next RTMF.

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



## ■ INSHORE FISHERIES RESEARCH PROJECT

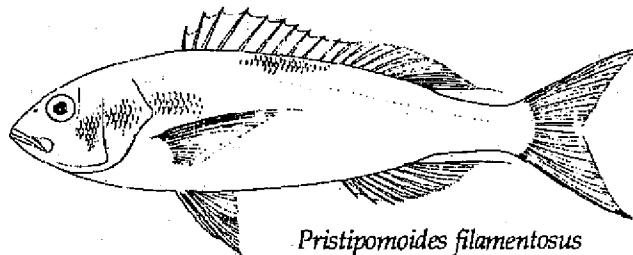
### Analysis of deep slope fisheries data from outer banks and seamounts of the Federated States of Micronesia

During August and September, Inshore Fisheries Scientist Paul Dalzell assisted the Micronesian Maritime Authority (MMA) with the analysis of catch and length frequency data generated from survey fishing on the outer banks and seamounts within the EEZ of the Federated States of Micronesia (FSM). The survey was conducted under the auspices of the FSM National Fisheries Corporation and the Overseas Fisheries Cooperation Foundation (OFCF) of Japan. The aim of the survey was to determine whether stocks

of deep water eteline snappers<sup>1</sup> are present on these banks, and whether there are sufficient quantities to support commercial fishing. Fishing operations were conducted from the *Asashio Maru No. 8*, a 59 gt Japanese longliner which was based at Moen Island in Chuuk lagoon. A total of 29 fishing trips was made by the *Asashio Maru* between September 1989 and February 1991. Most fishing trips lasted ten days and

there were normally two fishing trips per month.

Fishing was carried out mainly with bottom set longlines and handlines. Longlines were set in waters of depths  $\geq 100$  m whilst handline fishing, using electric reels and handreels, was conducted in shallower water, between 40 and 80 m in depth.



*Pristipomoides filamentosus*

Under the terms of the survey licence issued by MMA, the OFCF vessel was obliged to submit to the MMA office a daily record of fishing operations, including catch, fishing effort and species composition. Further, MMA placed an observer on the vessel to record length and weight data from the catches. During the two-week assignment, the monthly catch, fishing effort and catch per unit of effort (CPUE) for

longlining were summarised from the data. The catch composition by family and species was extracted from the data and the ten most important species in the catch identified. A summary of fishing effort in terms of days fished was compiled for each location for future work. Length data collected from longline catches were also condensed and summarised.

It was not possible to present a complete analysis of the survey data in the time available. However, a report of the work accomplished in the two

weeks at Pohnpei was drafted before the end of the assignment. Work that remains to be completed includes further analysis of length frequency data, generation of length-weight coefficients for dominant species in the catch, and examination of the catch data by location to see if there is any evidence of localised depletion of stocks and changes in species composition.



### Length frequency analysis of commercially-targeted coral reef fishes in Palau

During a previous assignment on behalf of Palau's Marine Resources Division (MRD) Senior Inshore Fisheries Scientist Garry Preston outlined a research and monitoring plan to help MRD obtain better management-related information from Palau's reef fisheries. Part

of the work plan was a collection of length frequency data on the commercially important reef species landed at Koror. This follow-on assignment in September was to provide assistance to MRD staff in the analysis of length frequency collected during the first year

from this research. A specific objective was to suggest possible minimum size limits for important species in the commercial catch.

Sufficient length frequency data for eight species (*Siganus lineatus*, *Siganus canaliculatus*,

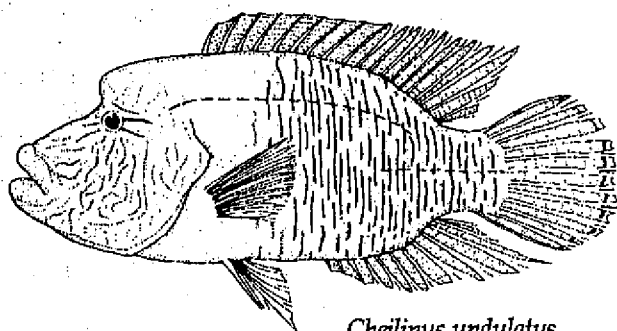
<sup>1</sup> Eteline snappers refers here to fishes of the family Lutjanidae, sub-family Etelinae. The Etelinae or eteline snappers typically inhabit deeper waters beyond the reef slope in depths between 80 and 400 m.



*Lethrinus ramak*, *Hipposcarus longiceps*, *Naso lituratus*, *Naso unicornis*, *Lutjanus gibbus* and *Siganus argenteus*) were available for analysis using the ELEFAN suite of programmes, designed to generate life history and related parameters from length data. All but one of these eight species (*Siganus argenteus*) were amongst the top ten commercial fishes landed into Koror. Two other species were also included in the analysis, the large parrot fish *Bolbometopon muricatum*, and the Napoleon wrasse, *Cheilinus undulatus*. Although few data were available for these species, the parrot fish is amongst the top ten commercial species landed at Palau, whilst the wrasse is a fish traditionally important in Palauan society. Both species have been reported by Palauan fishermen to be decreasing in abundance.

During the period of this assignment the opportunity was taken to summarise and archive all relevant length frequency

data collected for reef fish on Palau. This included data not only from the present initiative but from earlier work in the 1980s. Further, the commercial landings statistics from 1976 to 1990 were summarised and presented in graphic form to show long-term trends. Since



*Cheilinus undulatus*

commercial catches are a fraction of the total production, an estimate of subsistence reef fish production was made based on empirical data. Growth and mortality parameters were used to compute contemporary estimates of the exploitation rates (ratio of natural mortality to fishing mortality) and these were discussed with respect to current harvest estimates and yields from Palau's reefs.

Simple yield per recruit analysis (YPRA) was used to determine the optimum minimum capture lengths for the ten species examined in this study. The principal conclusions from this study were that most of the species examined were moderately to optimally exploited, with an average size at first capture at or above the lengths predicted by YPRA. The most obvious exception was the Napoleon wrasse. This species will take baited hooks and the majority of the catch are juveniles taken by this gear. Adult wrasse and the large parrotfish are

both vulnerable to spear fishing at night, particularly when SCUBA gear is used.

It was not possible to include groupers in this analysis as few length measurements were collected on the dominant species. Concern has been expressed about declines in grouper abundance due to the fishing of annual spawning aggregations.



## ■ WOMEN-IN-FISHERIES PROJECT

Workshop on fish processing and marketing held in Kavieng, Papua New Guinea

In response to the interest demonstrated by PNG in enhancing the role of women in fisheries, the International Centre for Ocean Development (ICOD) funded a Women in Fisheries Support Project in March 1991 under the auspices of the Department of Fisheries and Marine Resources. One component of this project is the training of women in the area of fish handling and processing.

On 3 September 1991, sixteen women from the New Guinea

Island (NGI) Region congregated at the National Fisheries College in Kavieng to attend a two-week workshop on Fish Processing and Marketing. The workshop was jointly organised by the PNG Department of Fisheries and Marine Resources, Department of Home Affairs and Youth, and SPC.

The general objective of the workshop was to assist women from the NGI region by enhancing their skills and knowledge in the area of fisheries.

More specifically, the purpose of the workshop was to train women participants in the techniques of small-scale fish processing and marketing and to encourage participants to develop and establish small-scale fisheries income generating projects. Topics such as chilling, smoking, salting, beche-de-mer processing, and marketing were covered during the two weeks.

Each afternoon was spent by the participants putting their

newly acquired knowledge from morning lectures and demonstrations into practice. The highlight of these afternoon sessions was the actual consumption of products such as fish jerky (marinated dried fish), smoked fish, fish burgers, fish cakes and balls and fish crackers. From the comments made by the participants and the quick disappearance of the fish products, it was apparent that the resource people had been successful in teaching the women different ways of preparing fish.

On Friday 13 September, a closing dinner and presentation

were held to mark the end of a successful two weeks. Before presenting the certificates to the women, a number of guest personnel were asked to make a few comments. One common theme of the comments was the need of such workshops for women and for ongoing assistance and training. As the Vice-President of the National Council of Women said, 'We can't stop here. We must go on and ensure that the other women in the villages have the opportunity to learn these same skills'.

So although the workshop closed on 13 September, it was

agreed that this was just the beginning in enhancing the role of women in fisheries throughout the New Guinea Island Region. In November, there will be follow-up visits to all four provinces to assist in provincial plans to assess the needs and interests of women.

The Department of Fisheries and Marine Resources has without question demonstrated its commitment to enhancing the role of women in fisheries and will continue to promote women in fisheries throughout the coastal regions of Papua New Guinea.



## ■ TUNA AND BILLFISH ASSESSMENT PROGRAMME

### Regional Tuna Tagging Project (RTTP)

The *Te Tautai* began 1991 field activities in Papua New Guinea in February, continuing operations in Indonesia in March, in the Philippines and in Palau in April (see SPC Fisheries Newsletter #57).

The *Te Tautai* departed Koror, Palau, on 2 May 1991, after baiting in Kobasang Harbour for two nights, and steamed south to Helen Reef, fishing along the east coasts of the main islands of Urukthapel, Peleliu and Angaur, and around the small islands of Sonsorol, Banna and Pulo Anna en route.

Numerous schools of tuna were encountered during this trip, particularly between Sonsorol and Banna Islands, but tag releases were limited to 633 skipjack and 102 yellowfin because of the large quantities of naturally occurring bait (ocean anchovy *Stolephorus punctifer*) on which the tuna were often feeding.

After a productive baiting-night at Helen Reef on 5 May, the vessel searched to the east for

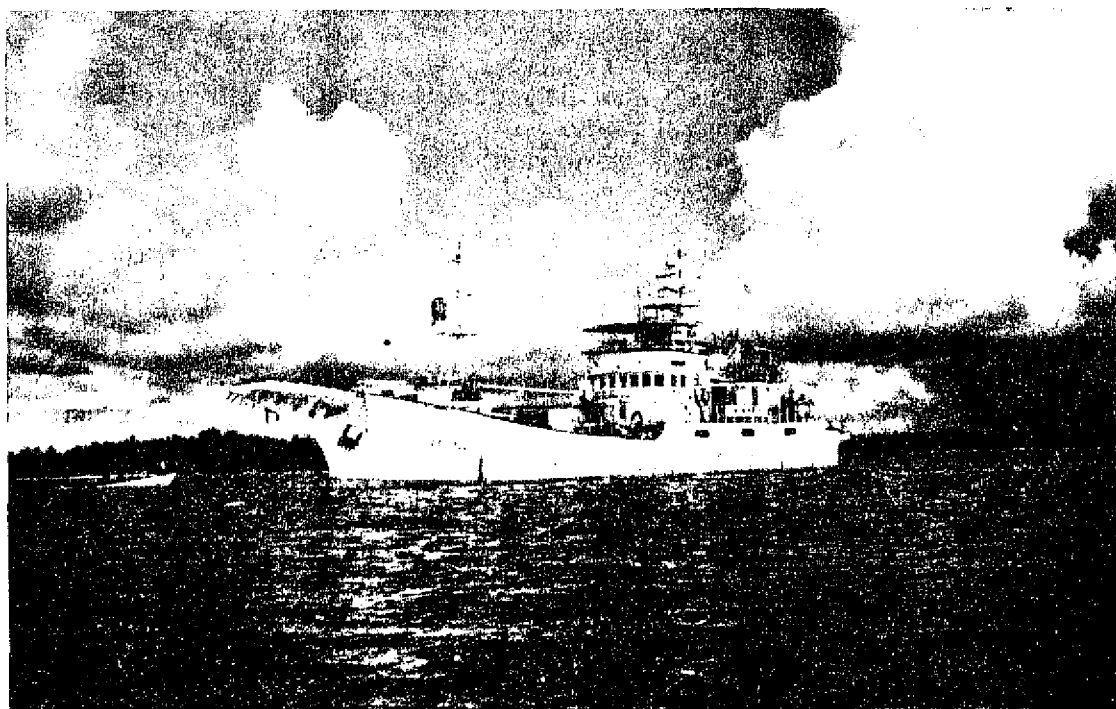
six days before reaching the Hermit Islands in Papua New Guinea. During this long-range trip 837 skipjack were tagged, with the majority of releases occurring near the border between Irian Jaya and PNG, and near the Ninigo Islands of PNG.

The vessel operated out of the Hermit Islands, and briefly out of Manus Island, for the next seven days. Large skipjack schools were encountered around the Hermits, often in association with an extensive current line of floating logs and debris, and 3,621 skipjack and 2 yellowfin were tagged. Four of the tagged skipjack were recovered on the vessel within minutes of their being released.

A one-day excursion to a seamount to the south of the Hermits produced a further 79 re-

leases (29 yellowfin and 50 skipjack) but had to be cut short because of high baitfish mortality.

On 18 May, the *Te Tautai* left the Hermits and began a long-range trip to Chuuk in the Federated States of Micronesia. Poor sightings and rough sea conditions were features of this five-day trip across the Equator. Seamounts to the south-west of Chuuk were visited on 21 May en route to Chuuk but few fish were encountered and none were tagged. The vessel operated around Chuuk for the remaining days of May, catching sufficient quantities of bait in the lagoon for day trips. Twenty-seven yellowfin and 178 skipjack were tagged during this time.



The tagging vessel *Te Tautai*

The month's operations ended on 29 May with a two-day full moon in Moen, Chuuk.

The *Te Tautai* fished to the north and east of the Chuuk Islands and west to Hitchfield Bank and the Namonuito Islands during the first five days of June, tagging a total of 186 skipjack. The vessel departed Chuuk on 6 June, after baiting in the lagoon for two nights, and steamed south to Papua New Guinea, arriving at the Ysabel Pass baiting ground in New Hanover three days later. Thirty skipjack were tagged to the north of Ysabel Pass on the last day of this transit. A further 224 skipjack and 3 yellowfin were tagged close to Kavieng, immediately before a brief port call.

The following three days were spent searching to the north and east of New Ireland, particularly near the Tabar, Lihir and Nuguria Islands. Numerous logs were encountered between the Tabar and Lihir Islands, but in almost all instances were devoid of tuna. Twenty-eight yellowfin and 462 skipjack were tagged during this period, with all the yellowfin being caught from a school close to Simberi Island in the Tabar group.

The vessel's bait supply was replenished in the lagoon of the Nuguria Islands on 13 June. The vessel then searched towards the Kilinailau (or Carteret) Islands and amongst a network of anchored Philippine FADs to the south and east of these islands. Only six of 28 FADs in existence in 1990 were located by the *Te Tautai*, including one that was drifting free with a frayed anchor rope. These FADs yielded 45 yellowfin and 334 skipjack releases. No tuna were caught over the next two days while searching from the Mortlock (or Tauu) Islands west

to the Nukumanu (or Tasman) Islands.

After successful baiting in the Nukumanu lagoon on 17 June, the *Te Tautai* searched north-eastwards. Over the next four days 732 skipjack and 4 yellowfin were tagged in the easternmost part of the PNG zone and in international waters to the north of the zone. On 22 June, the vessel entered FSM waters en route to Pohnpei. Sixty-six skipjack and three yellowfin were tagged during the day, completely exhausting the bait supply on board.

The month's operations, and first five months of this year's charter, ended when the *Te Tautai* arrived in Pohnpei on 23 June. During the last days of June the vessel underwent maintenance and repair work to ensure that all would be running smoothly for the remaining charter period.

The *Te Tautai* searched south-west from Pohnpei on 4th July after filling all bait tanks in Pohnpei Harbour. Several schools of skipjack and yellowfin were located between the Etal and Namoluk Islands in the Nomoi Island group but biting response was poor, resulting in only 68 yellowfin and 26 skipjack releases.

A productive area of skipjack schools associated with drifting logs was then found south-west of the Nomoi Islands and four logs were fished from 7 to 13 July. These logs were marked with radio transmitting buoys and flag markers, allowing the *Te Tautai* to fish them repeatedly during the week. The logs drifted south-east during this period while the vessel found excellent baiting in the lagoon of Satawan Island. A total of 504 yellowfin, 3,581 skipjack and 29 bigeye were tagged in associa-

tion with the four logs and a new RTTP record of 2,057 releases for a single day was set on 10 July.

The ship then worked south and made 280 releases on a log that had been marked by a Japanese purse seiner working close to Nukuoro. Farther south, a fleet of U.S. purse seiners was located fishing on skipjack schools and 169 skipjack were tagged close to the vessels.

Two days were spent around Kapingamarangi, but baiting was poor and the vessel headed north-east toward Kosrae on 19 July. U.S. seiners were located fishing on log associated skipjack, yellowfin and bigeye schools and 239 more releases were made close to the fleet (116 yellowfin, 56 skipjack, 67 bigeye). The transit to Kosrae was uneventful except for the discovery of a large school of skipjack south-west of Kosrae, where 430 releases were made.

Baiting in Kosrae was unproductive and eliminated any opportunity to tag fish for the remaining days spent in the waters of the Federated States of Micronesia. Tuna schools were sighted around Kosrae and while steaming to Majuro for a scheduled two-day break near the end of the month. During the last two days of July, the *Te Tautai* fished in the Marshall Islands and tagged 9 yellowfin and 468 skipjack. For August, the vessel planned to operate in the Marshall Islands for one to two weeks, and then shift south to Kiribati and Tuvalu.

The *Te Tautai* arrived in Majuro from Kosrae in late July, and remained in the Marshall Islands zone until 9 August. The vessel conducted a thorough survey of the central and



#### Baiting around Kapingaramangi

southern Ratak Chain, baiting and fishing around Major, Arno, Maloelap, Wotje, Ailuk, Likiep, Erikub, Jemo, Mili and Keats Bank. Baiting was only marginally sufficient for daily fishing operations, with most atolls supplying limited quantities of sprats and silversides.

Yellowfin schools were scarce during the Marshall Islands cruise, but schools of large skipjack were found in several locations. The best fishing and tagging was found close to Wotje and Erikub Atolls, resulting in 926 releases in the zone (8 yellowfin, 918 skipjack). The second and third weeks of August were spent in Kiribati

waters, where the Project tagged and released 612 yellowfin, 2,867 skipjack and 1 bigeye tuna. Most of the releases were centred on Abemama and Aranuka atolls, fishing on mixed schools of skipjack and yellowfin. Abeinama supplied ample baitfish during this period in the form of large sardines.

The pole-and-line vessel, *Nei Kaneati*, from Te Mautari Ltd was also operating in this area. This vessel is conducting a Kiribati tagging project in conjunction with the RTTP, and two experimental officers from the RTTP spent time on the ship working with a biologist from

the Kiribati Fisheries Division. The *Nei Kaneati* tagged and released over 2,000 tuna in August, with a high percentage of yellowfin in the catch.

Several schools of skipjack were located in the southern Kiribati zone, close to the international border between Kiribati and Tuvalu. A further 1,085 skipjack were tagged from these schools using cultured milkfish that had been purchased from Tarawa as chum. The *Te Tautai* arrived in Funafuti, Tuvalu on 24 August and the crew enjoyed a well deserved break after eight months away from the home port.



#### Fourth Meeting of the Standing Committee on Tuna and Billfish, 17—19 June 1991

The fourth meeting of the Standing Committee on Tuna and Billfish was held in Port Vila, Vanuatu, from 17 to 19 June 1991.

An overview of the status of Western Pacific tuna fisheries during 1990 was presented, followed by a summary of the flow of tuna products to canneries and other markets from

the Western Pacific. The investigation of product flow initially stemmed from the need to identify potential sources of tag returns from the Regional Tuna Tagging Project, but the inves-

tigation also gave useful information for validating catches reported in logbooks and interpreting trends in the fisheries.

A progress report on the activities of the Tuna and Billfish Assessment Programme (TBAP) was given.

Participants from the Philippines and Indonesia reported on recent developments concerning tuna research in their countries. The participant from Australia informed the meeting about a collaborative tagging project to be undertaken with TBAP in the Coral Sea in October–November 1991. The participant from Japan advised that an initial request to the Fisheries Agency of Japan for the release of high seas catch and effort data to the Standing Committee for research purposes had been unsuccessful; however, the recent provision by the United States to SPC of high seas data for purse seiners had opened the matter for re-examination. The arrangements for a second three-month collaborative study between SPC and the National Research Institute for Far Seas Fisheries of Japan had not progressed; non-availability of data, and the workload of the scientists involved previously, had led to postponement of the development of a new proposal. The participant from the United States reported that the secondment of a senior scientist from the National Marine Fisheries Service to TBAP would probably commence in September 1991.

The representative of the Western Pacific Regional Fisheries Management Council highlighted recent changes to United States legislation, bringing tuna under 200 mile zone control. In the Pacific

Ocean, responsibility for the development of management plans for tuna fisheries rests with the Council. The representative noted that the Council's management jurisdiction and the SPC's research jurisdiction overlap significantly, and underscored the need for close liaison.

The SPC Chief Fisheries Scientist expressed his appreciation of the support given by Pacific Island countries and territories to the work of TBAP. They had co-operated closely with the RTTP and fostered the return of tags. Their co-operation had also ensured that catch and catch composition monitoring would proceed in landing ports (Noumea, Pago Pago, Papeete and Pohnpei) and that the coverage would soon be extended to new ports (Chuuk, Palau and Yap).

The representative of the Food and Agriculture Organization advised that, subject to securing sufficient funds, FAO planned to redirect the activities of the Indo-Pacific Tuna Programme from data collection and processing to include assistance to coastal developing countries in data analysis and stock assessment. He highlighted an ongoing need for collaboration with SPC to ensure that the work of the two organisations is complementary. The representative of FAO discussed the forthcoming Expert Consultation on Interactions of Pacific Tuna Fisheries and confirmed that it would be held in Noumea, New Caledonia, from 3 to 11 December 1991.

The meeting then addressed TBAP's Five-Year Strategic Plan, which was called for in a recommendation made by the third meeting of the Standing Committee, held in Noumea,

New Caledonia, in June 1990, and subsequently adopted by the Regional Technical Meeting on Fisheries and the Thirtieth South Pacific Conference. The Chief Fisheries Scientist introduced a draft of the Strategic Plan by pointing out that the existing mission statement was used as the starting point for the draft and modified to reflect present and anticipated developments. In particular, consideration was given to trends in fisheries, possible management initiatives (e.g. the possible development of international arrangements that would allow development and implementation of species-specific management plans for tropical tuna in the Western Pacific), and the expectation that it would be desirable for TBAP to provide ongoing advice on fisheries management. After a lengthy discussion of the mission statement and objectives contained in the draft Strategic Plan, a new draft was prepared to make clear the philosophy of TBAP and to provide objectives that could be used in the evaluation of existing and proposed new activities. The draft Strategic Plan was presented to the 23rd Regional Technical Meeting on Fisheries.

Participants attended from 19 countries and territories (American Samoa, Australia, Federated States of Micronesia, Fiji, France, French Polynesia, Indonesia, Japan, Marshall Islands, New Caledonia, New Zealand, Palau, Papua New Guinea, the Philippines, Solomon Islands, Tonga, Tuvalu, the United States of America and Vanuatu). The Forum Fisheries Agency, the Food and Agriculture Organization of the United Nations and the Western Pacific Regional Fisheries Management Council were also represented.

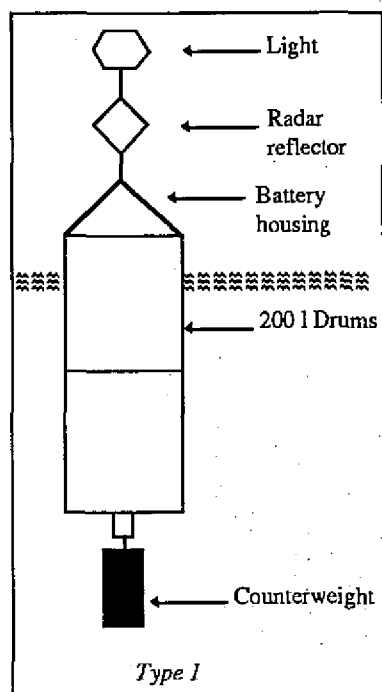
## NEW SOUTH WALES FISH AGGREGATING DEVICES

John Matthews (Fishing Industry Research & Development Council) investigated the feasibility of deploying fish aggregating devices (FADs) for pelagic fish at various locations off the New South Wales coast, studying their effectiveness in attracting important commercial and recreational fishes.

Three basic designs were evolved to try and cope with the conditions off the coast, which included strong southerly sets of up to four knots, gale-force winds from all directions, ship strikes, and vandalism.

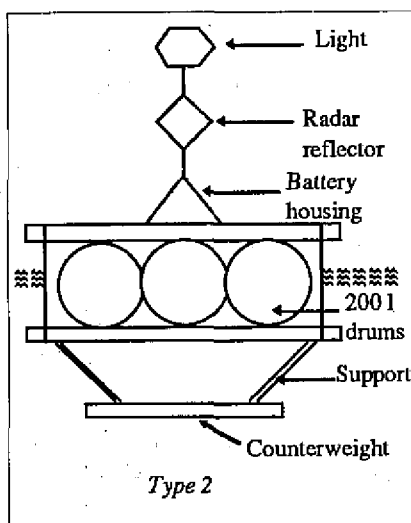
Type 1 consisted of a spar buoy fabricated from two 200-litre galvanised steel drums welded end to end with a massive external counterweight, a conical steel battery housing, radar reflector and light.

Only one FAD of this model was deployed; it floated too low in the water and was too difficult to locate, so the next one was modified by strapping



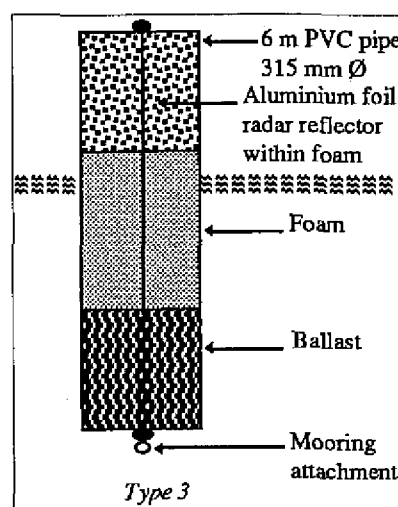
PVC buoyancy tubes around the upper drum. This increased buoyancy satisfactorily, but the tubes were too easily damaged by ship strikes or small vessels coming alongside to moor.

Type 2 was, in hindsight, a retrograde step. It was essentially a raft made of three 200-litre steel drums bolted together side by side in a hardwood frame with a large external counterweight below, and the same battery, radar, and light unit that was fitted to Type 1 bolted on top.



Altogether five units of this type were deployed before the design was abandoned. Although raft-type FADs had proved successful overseas, particularly in Hawaii, the design, while conspicuous, was overly complicated, consisting of too many parts, and was insufficiently robust to withstand the harsh conditions to which it was subjected.

Type 3 was a revival of a simple spar buoy design that John Matthews had used earlier successfully to mark a submerged artificial reef off Narrabeen Beach. It consisted of a six-metre length of 315 mm diameter PVC sewer pipe,



capped top and bottom with discs cut from 18 mm thick PVC sheet glued to rings cut from the pipe. An 18 mm diameter steel rod was passed through the centre of the end caps and formed into an eye at one end and threaded to take a nut at the other.

The lower section was ballasted internally and the remainder of the pipe was filled with closed cell foam and radar reflecting material. Ten Type 3 and 3a FADS (Type 3a simply had the fish attractor suspended from a separate chain) were deployed off Sydney. Apart from their low resistance to wave action, and their simplicity and ease of construction, they were easily launched from quite small vessels, by securing them athwartships across the stern or by towing them.

The longest a Type 1 spar buoy survived at sea was nearly five months off Jervis Bay. Type 2, by contrast, managed a maximum of only 2.5 months. Type 3 buoys got off to a bad start when a pair placed in tandem was cut adrift after only two weeks. However five others survived between five and six months.

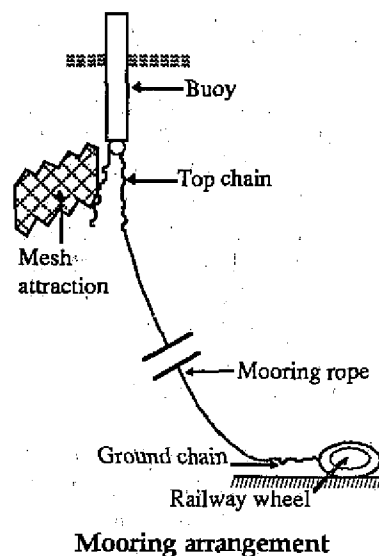
The buoy itself attracted fish, but supplementary attractors were suspended below each buoy. These at first consisted of sheets, flags, and cones of fish or prawn netting, but were later replaced by welded 45 mm cross-strip plastic webbing, of the type used as safety fencing around road constructions.

The mooring lines were changed from plastic coated galvanised wire with eyes swaged at each end to 28 mm soft laid polyethylene rope. Ten metres of chain were secured top and bottom with a swivel at the top and the length-to-depth ratio reduced from 1.5:1 to 1.15:1. The 500 kg concrete block anchor was replaced by an old railway wagon wheel

weighing 450 kg. These could be slung off the stern or quarter and cut free on launching. They proved superior to the blocks because of their ease of handling, greater density and strength.

Dolphin fish were caught off Sydney and Port Stephens during summer and autumn, when species caught near the FADs included yellowfin tuna, striped tuna, marlin, wahoo, and whaler and tiger shark; while off Coffs Harbour dolphin fish were attracted in large numbers.

The report concluded that dolphin fish, which makes excellent eating, seems to be the most promising target species for



anyone fishing around FADs off the NSW coast.

(Source: *Professional Fisherman*)



## ■ FRENCH POLYNESIA'S CORAL REEFS THREATENED

French Polynesia's coral reefs are threatened, Professor Bernard Salvat, Director of the Environment Centre on Moorea Island, has warned. He said coral was being affected by a phenomenon of whitening due to the coral colonies' rejection of symbiotic seaweed indispensable for their survival. He sug-

gested that the coral was probably rejecting the seaweed because of stress caused by above-average water temperatures.

If the stress continues, the declining coral colonies will all die within several weeks. The death of the coral could cause most

animal life in the lagoons to disappear. This would have a disastrous impact on the Territory, where fish and shellfish are major sources of food and pearl cultivation and tourism are the main industries.

(Source: *The South Sea Digest*)





## ■ WOMEN PLAY AN IMPORTANT ROLE IN FIJI'S FISHING INDUSTRY

Taking active part in many agricultural activities as well as seeing to their daily chores, young women have contributed greatly toward increasing family incomes by engaging themselves in many fishing activities in Fiji.

Fishing, especially for molluscs and crustaceans (**kai**, **kaikoso**, prawns, lobsters) is an outstanding example of their involvement. **Kai** (freshwater clams) are almost exclusively gathered by women.

While the majority harvest **kai**, others get involved in activities often carried out by young men, such as *beche-de-mer* processing, smoking, drying and grading. Catching of salt-water bivalves (**kaikoso**), mangrove crabs (**qari**) by using traps and netting or spearing for prawns and other marine resources are also activities mainly carried out by these women.

In addition, much of the processing and marketing effort of the fishing community is the domain of women. Their activities include smoking the fish, mending nets, extracting trochus meat, cleaning, smoking and grading *beche-de-mer* for sale and patiently sitting in markets to sell the catch.

Many women's fishing groups have a large number of members who are in the youth age group. The Toga Women's Fishing Group in Rewa has more than thirty members from three villages (Navatuyaba, Muana and Vunisei), of whom 15 are young women. The group specialises in harvesting freshwater **kai**, catching some 30 t per year valued at F\$20,000.

The people of Koro Island are one of the biggest consumers and market for the group. **Kai** are also sold to middlemen who usually turn up at the village every week. Harvesting freshwater **kai** requires no sophisticated equipment. The women spend most of their time staying in shallow waters diving for **kai**.

A women's fishing group in Uruone and Vanuabalavu has 18 members, of whom 10 are in the youth age group. Net fishing is their main traditional fishing method.

Seashells are also harvested by these women and sold to markets in the Suva area. The group has now acquired a punt to increase its fishing activities.

One of the youth members who attended the Rural Training Programme for fisherwomen organised by the Fisheries Division at Lami is now sharing

her knowledge and teaching the other members of the group how to maintain outboard motors and other basic engineering. The group is also actively involved in community work, making charcoal stoves for the village women and contributing cash towards the church.

Many young women are also involved in the fish processing industry.

The seaweed industry has also attracted many young women to start seaweed farming as a possible income-generating venture. Seaweed farming is a simple operation, but requires constant attention and sound management techniques for greater returns.

Women's involvement in small-scale fisheries appears likely to grow. The recent introduction of a training programme by the Fisheries Division has had a positive effect and has led



women not just to continue with small-scale fisheries, but to divert towards larger-scale activities.

The three-week training programme, organised by the Division and funded by the United Nations Development Programme, provides fisherwomen with knowledge on the use of various types of fishing

gear, law enforcement, fish preservation, handling and marketing, seaweed farming and other fisheries-related activities.

So far four training programmes have been organised, each of three weeks duration, in 1986, 1987 and 1988. Follow-up training was organised for participants from 1986 during 1987.

By the end of 1990 the fisheries sector had an estimated subsistence involvement of more than 20,000, of whom the majority were women. Most of this involvement was with molluscs and crustaceans.

(Source: *Fiji Times*)



## ■ BLUEFIN TUNA FARM FOR AUSTRALIA

A research project to farm bluefin tuna has been set up at Boston Bay, Port Lincoln, to the west of the South Australian capital, Adelaide.

The tripartite agreement between the Japanese Overseas Fishery Cooperation Foundation, Australian tuna boat owners and the Government of South Australia means that the bluefin tuna industry could be worth up to US\$ 150 million within seven years.

The three-year project to farm small tuna will also go a long way to prevent the fish stock disappearing from Australian waters. It aims to reverse the recent tuna industry's decline which has been attributed to reductions in quotas for fishermen.

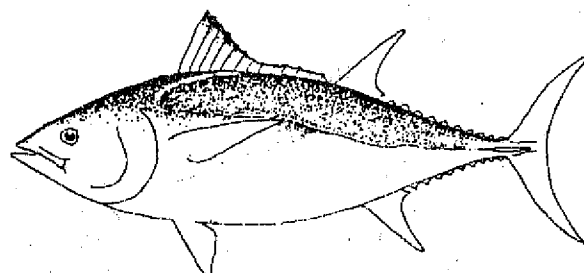
Small southern bluefin will be caught by pole-and-line and will be kept in net enclosures installed in waters off Port Lincoln. At the present time, 800—900 fish are being reared in the enclosures. A sample batch of 12 fish (average weight: 18 kg) has been airshipped and sold in Tokyo and Kyoto.

Bluefin tuna is highly prized in Japan, where it is a key element in the high-price sashimi market. The tuna has to be fresh, of

high quality and readily available. More than 93 per cent of Australian tuna is already exported to Japan, where demand is increasing.

Through the aquaculture project, South Australia expects to increase its bluefin tuna industry, maintain the quality of stock and provide a ready supply of the product.

(Source: *World Fishing and FFA News Digest*)



## ■ FISHERIES CO-ORDINATOR COMMENCES

ACIAR's new Fisheries Research Program Coordinator is Mr Barney Smith. Barney

comes to ACIAR with 20 years experience in fisheries biology and resource management, obtained working in government fisheries research in Papua New Guinea and at the South Pacific Commission (SPC) in Noumea, New Caledonia. His most recent appointment was as SPC Fisheries Co-ordinator, with respon-

sibility for all SPC fisheries activities in the South Pacific, at a time of great growth and policy change for fisheries in the region.

(Source: *ACIAR Newsletter*)



## ■ MONEY CAN BE MADE FROM SHARKS

According to a manual produced for fishermen by the FAO/UNDP Regional Fishery Support Programme, shark fins are one of the most expensive fish products in the world; a set of four or five fins from one shark could fetch US\$ 60 or more.

Practically all the demand is Chinese. In Hong Kong and Singapore, the two hearts of the trade, workshops process fins to remove skin and flesh until the cartilage is left to look like a fan or a feather with all the strands standing up. Because finished fins look attractive, they are sometimes packed in expensive boxes or put together

like a flower display. The cost of these sets is very high.

Much of the shark coming from the South Pacific region is caught by Japanese, Korean and Taiwanese fishermen. Pacific Islanders don't usually catch the big ocean-going sharks that yield bigger valuable fins. But the manual suggests that shark-fin processing is a profitable sideline for them too if done properly. An attraction is that fins don't need to be iced, frozen or rushed to market like fresh fish — a great plus for outer island fishermen whose links with main town buyers are irregular.

Graham Southwick, a Suva shark fin exporter, mentioned that, although Hong Kong was the biggest buyer of dried fins, most of the fins handled there were re-exported to San Francisco.

(Source: *Islands Business Pacific*)



## ■ FORTHCOMING MEETINGS

### FAO/DANIDA Workshop on Tropical Fisheries Stock Assessment

Up to 25 participants from around the region have been invited to attend this workshop at the University of the South Pacific from 11 November to 6 December. With the intention of providing a broad-based introduction to tropical stock assessment methodology, FAO/

DANIDA tutors have conducted more than 35 similar workshops worldwide based on the LFSA (Length-based Fish Stock Assessment) and ELEFAN (Electronic Length Frequency ANALysis) computer data processing packages. For the Suva Workshop they will

introduce the new FIFET programme and associated training manuals. Enquiries about the workshop should be directed to the FAO/UNDP Regional Fishery Support Programme, Suva, Fiji.

(Source: R. Gillett, FAO/UNDP)

### FAO Expert Consultation on Interactions on Pacific Tuna Fisheries

As recommended by the 1988 and 1990 SPC Regional Technical Meetings on Fisheries, FAO will host the first Consultation at SPC from 3 to 11 December. The Consultation's

ultimate objective is to enhance capacity to address tuna fisheries interaction problems. The meeting is being co-ordinated by the FAO/UNDP Regional Fishery Support Programme

and countries with a desire to attend or a special interest in the subject should contact this office.

(Source: R. Gillett, FAO/UNDP)

### Seminar on mud crab culture and trade in the Bay of Bengal

The Bay of Bengal Programme (BOBP) is a multi-agency regional fisheries programme which covers seven countries

around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Programme

plays a catalytic and consultative role: it develops, demonstrates and promotes new techniques, technologies or

ideas to help improve the conditions of small-scale fisherfolk communities in member countries.

The capture, culture and trade of mud crabs, *Scylla serrata*, is of increasing importance in the Bay of Bengal region. As most of these activities are undertaken by the artisanal fishery sector and there is a growing trade in mud crabs, BOBP is

convening a regional seminar in Surat Thani, Thailand, from 5 to 8 November 1991, to discuss this subject of widespread interest.

Topics to be discussed at the seminar, include:

- Species and racial identification;
- Natural resources, their exploitation and management;

- Seed supply, both natural and hatchery production;
- Feeds;
- Culture and fattening;
- Technology transfer, extension and training;
- Trade, investment, credit and economics.

(Source: Bay of Bengal Programme)



**Aquaculture in tropical areas.** Edited by S. Shokita, K. Kakazu, A. Tomori and T. Toma. English edition prepared by M. Yamaguchi.

This book, originally released in Japanese only, has just been published in English and contains much useful information for Pacific Island fishery workers. The focus of the book is Japan's Ryukyu archipelago, whose islands and coral reefs stretch over a 1,000 km distance between Kyushu and the Republic of China (Taiwan). A number of successful aquaculture and marine ranching practices have already been developed in the area, despite the relatively short history of these research efforts.

The book brings together information that has been contributed by scientists at the Kagoshima and Okinawa Fisheries Experimental Stations, and at the University of the Ryukyus, but which was previously scattered in a wide variety of mainly Japanese-language reports.

Many of the species covered are found in the tropical Pacific Islands, and include the following: seaweeds (*Monostroma*, *Caulerpa*, *Gracilaria*, *Hypnea* and *Eucheuma*); fishes (spangled emperor *Lethrinus nebulosus*, rabbitfishes *Siganus* spp, tilapias, groupers, and milkfish *Chanos chanos*); crustaceans (spiny lobsters, mangrove crabs and coconut crabs); molluscs (black-lip pearl oyster, the giant clam *Tridacna crocea*, green mussels (*Perna* spp), trochus and green snail); and other organisms, including sea cucumbers and sea urchins.

For many of the key Pacific species, some of which are under threat from over-exploitation in some areas, mass seed production techniques are not yet available. This means that the feasibility of aquaculture or large-scale stock enhancement

through release programmes cannot be studied.

These species groups include sea cucumbers, lobsters, deep-water snappers and coconut crabs. As a result, the chapters on these species are short, but nevertheless synthesise available information on feeding habits, reproductive biology, larval and juvenile development, and other aspects of the animals' basic life history.

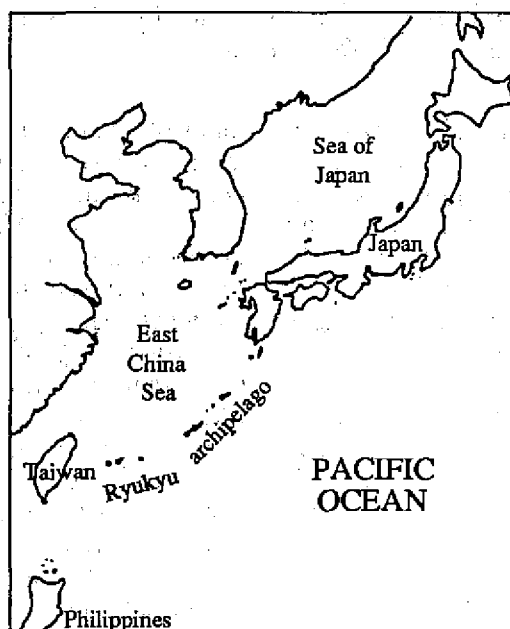
The aim of the Japanese-language edition is to serve as a reference book for high-school teachers and university students dealing with fisheries. The English-language version is equally useful for both trainers and trainees at this level.

In addition, it acts as a valuable information resource for fishery development workers search-



ing for concise life-history information on commercially exploited Pacific Island marine species. This applies especially to many of the invertebrates, which may be important to subsistence rather than commercial fisheries, and on which information is often hard to locate.

This book is available at a cost of 12,000 Yen (about US\$94) from Midori-Shobo Publishers, Ikebukuro Sky Building, 2-14 Ikebukuro, Toshima-ku, Tokyo 171, Japan. (Sales Department fax #: 81-3-3590-4441).



### Managing small-scale fisheries in Oceania: unusual constraints and opportunities.

In: *Economics of fishery management in the Pacific Islands region. Proceedings of an international conference held at Hobart, Tasmania, Australia, 20—22 March 1989.* Australian Centre for International Agricultural Research. ACIAR Proceedings Series (1989). N° 26, 85—93.

Pacific Island nearshore fisheries present the Western economist with unusual conditions, some of which can undermine economically sound fisheries development. For example, it is virtually impossible in many cases to obtain at reasonable cost the information on catch, effort and stocks needed for sound management. In addition, social barriers to capitalis-

tic behaviour are widespread. Occupational pluralism is the norm. But there are also unusual opportunities for the fisheries manager in the form of an indigenous framework for marine resource management and an undervalued but sometimes very rich indigenous knowledge base. The record of development projects in Oceania is bad in terms of both

economic gains and social and environmental consequences. In future, economists must be as concerned with the nature, direction and implications of social and environmental changes brought about by development projects in the region as with their contributions to economic growth.



### Appraising inshore fishery resources in Pacific Island countries.

In: *Economics of fishery management in the Pacific Islands region. Proceedings of an international conference held at Hobart, Tasmania, Australia, 20—22 March 1989.* Australian Centre for International Agricultural Research. ACIAR Proceedings Series (1989). N° 26, 78—84.

The inshore fishery resources of Pacific Island countries are outlined and methods of their appraisal are discussed. The decision whether or not to proceed with the development of a particular fishery is usually based on data collected during a necessarily short field survey. It is therefore imperative to maximise the information obtained by collecting data over a broad area which includes not

only biological aspects of the stock, but marketing and economic viability under conditions of limited shore-based infrastructures for processing and marketing. In many cases in the past, surveys have been restricted to addressing biological aspects of a potential fishery. Crucial biological parameters are the expected catch rates (catch per unit of effort) and the level of exploitation at

which catches are sustainable. Economic and marketing appraisals both require price and cost information even though assumptions must be made regarding potential operational size. A structured approach to collecting such minimal information is presented. Basic analyses of these data allow a more meaningful appraisal of fisheries potential.



# TUVALU PLANS FISHERIES DEVELOPMENT

With a national fisheries development plan now in place, the tiny Polynesian nation of Tuvalu is making sound progress towards development of its fisheries resources.

With a total land area of only 24 km<sup>2</sup>, and a population of just over 9,000, the atoll nation of Tuvalu (formerly the Ellice Islands of the British Gilbert and Ellice Islands Colony) is one of the smallest and most remote independent countries in the world. Tuvaluans are by tradition fishermen and people of the sea and, with such a tiny land area, the ocean is the country's only significant natural resource. Successive economic development plans since the country gained independence in 1978 have therefore placed high priority on efforts to develop the fisheries sector as a basis for economic development.

## **The national fisheries development plan**

While considerable effort and aid funding have been put into fisheries development over the past ten years, progress overall has fallen short of expectations. For this reason Tuvalu Fisheries Division and the Tuvalu Government commercial fishing corporation, Naficot, have over the past year collaborated in drawing up a national fisheries development plan. The intention of the plan is to set out clear and realistic objectives and strategies for development and to provide for better co-ordination of effort. Following

by Tim Gentle,  
Principal Fisheries Officer  
Tuvalu Fisheries Division

a recent in-depth review of the fisheries sector, the plan has now been officially adopted by Government.

The national fisheries development plan gives priority to appropriate development at the village level to ensure an improved and consistent supply of seafood protein for the people of Tuvalu. At the same time the plan puts major emphasis on the planned and progressive development of a sustainable small-scale seafood export industry. Finally, under the plan, Tuvalu will continue to make efforts to maximise returns from foreign fishing vessels fishing in the country's exclusive economic zone.

## **Existing fisheries**

Except for the Japanese aid pole-and-line tuna vessel *Te Tautai*, fisheries in Tuvalu are entirely at the subsistence and artisanal level. Subsistence fishing is carried out from canoes in the lagoons or in nearshore waters. Artisanal fishermen operate from 14-foot outboard trolling skiffs mainly targeting tuna offshore. There are approximately one hundred of these skiffs operating at the main island of Funafuti. Total landings (both subsistence and artisanal) in Funafuti are estimated at about 150 t per year.

Landings for the whole country are estimated at about 450 t.

There are no exports of fish at present and fish sold are purely for the local market. In recent years, sale of fish has developed in the outer islands and there are now trolling skiffs operating in these islands to supply this demand.

The country's only distant water fishing vessel, *Te Tautai*, cannot operate economically in Tuvalu waters because of poor local supplies of live bait. However the vessel has fished for two seasons in Solomon Islands waters, bringing substantial revenue for the country. The vessel is currently on charter to the South Pacific Commission Tuna and Billfish Assessment Programme's EEC-funded yellowfin tagging project. This two-year project will yield a handsome contribution to the country's economy.

Licence fees from foreign fishing vessels operating in the Tuvalu EEZ make a further substantial contribution to the economy. During 1991 this is expected to amount to nearly 0.6 million dollars. Tuvalu currently has licensing arrangements with Japan, South Korea and Taiwan and, under the multilateral tuna treaty, with the United States.

## **Planned developments**

### *Village level fisheries*

Under the fisheries development plan, efforts to develop fishing at the village level will focus on promoting the use of appropriate technology to increase fuel efficiency and enhance self-sufficiency.

One key project already underway aims at promoting improved low-cost small plywood fishing craft for village level use. The project is under the control of FAO Master Boatbuilder Michael Savins and funded jointly by the FAO Regional Fishery Support Programme and AIDAB.

During the last ten years there have been several attempts to introduce improved small-scale fishing craft to Tuvalu. All these attempts were unsuccessful because the vessels were unsuitable for local conditions. In this new project, all vessels have been specifically designed for Tuvalu conditions by FAO naval architect Øyvind Gulbrandsen, who is an acknowledged expert in the design of artisanal fishing craft for developing countries. All the designs will incorporate sail for improved fuel economy and safety (very few sailing craft are used at present for fishing in Tuvalu and fishermen have become to a large extent dependent on outboards).

Four new designs are being built and tested locally:

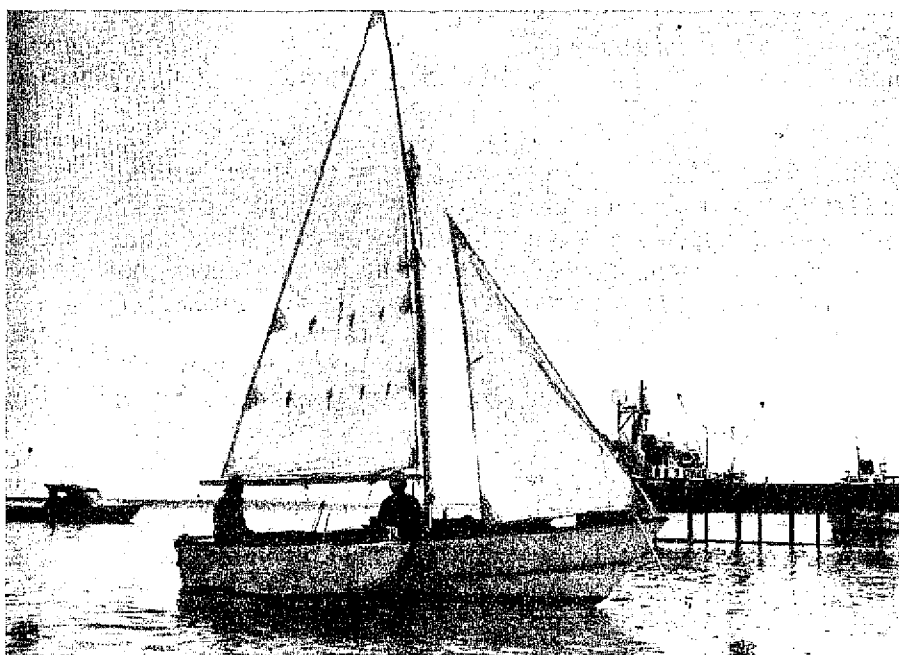
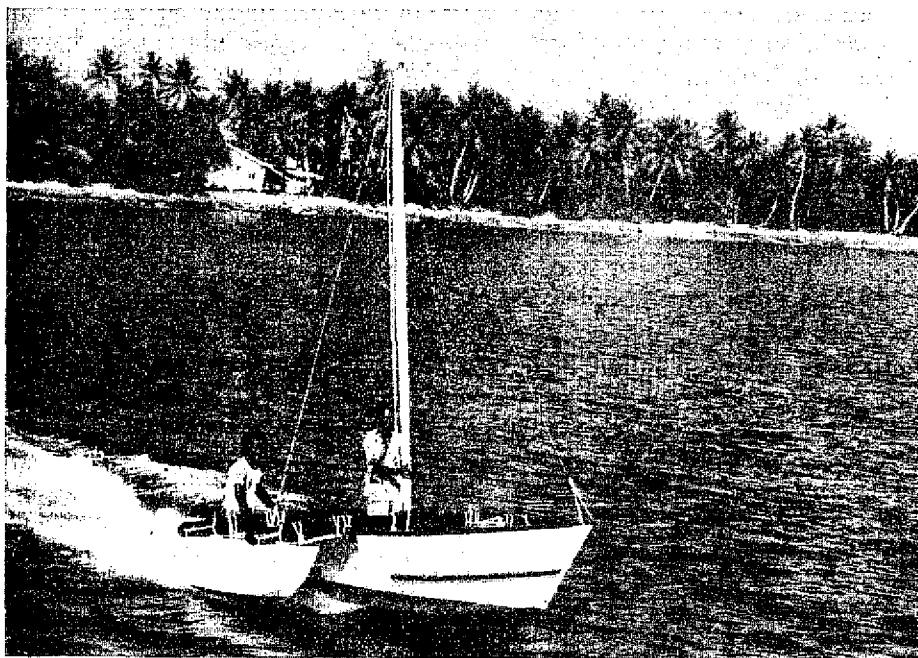
— An improved design of motor-sailing outrigger canoe, light enough yet strong enough to be launched through surf where necessary. The canoe has been especially designed for use in some of the outer is-

lands of Tuvalu which lack proper reef passes and where shortages of fish occur during bad weather conditions, since existing craft cannot easily be launched or beached under strong surf conditions;

— Two improved models of trolling skiff, both of which will incorporate sail for safety and improved fuel economy. Both

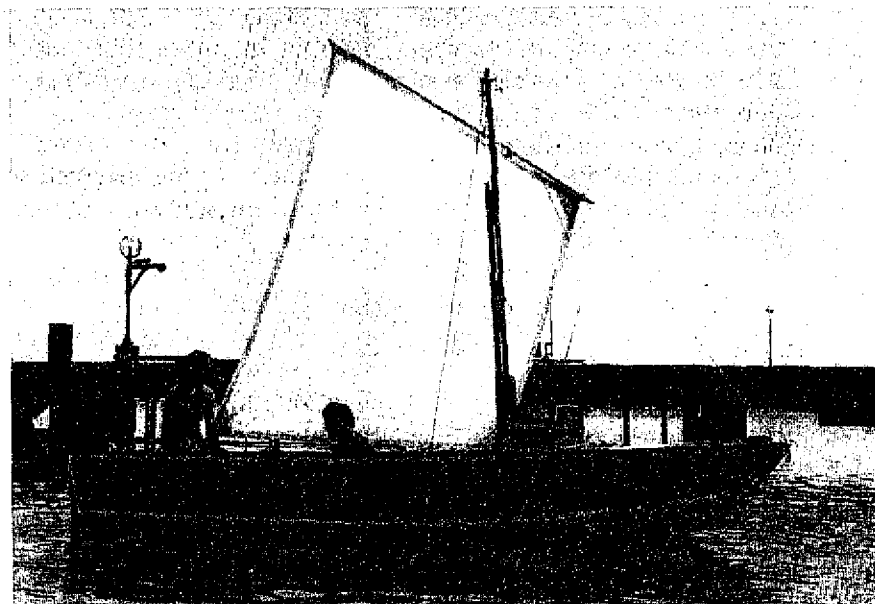
are designed to be more seakindly in heavy seas than the trolling skiffs presently in use;

— An improved marine ply paddling canoe for lagoon fishing. Such a craft is needed because few traditional-style canoes are now being made, since local supplies of timber suitable for canoe building are now virtually exhausted.



Improved designs of motor-sailing outrigger canoe used in Tuvalu





Trolling skiff with the emergency sail rig set up

All the vessels are to be demonstrated extensively to local fishermen and any suggestions the fishermen have for possible design improvements or modifications will be incorporated before the new vessels go into production at the Government boatbuilding yard. Local fishermen have already shown keen interest in the new boats and the Prime Minister himself has put in an order for the one of the new motor-sailing skiffs.

In addition to these new-design vessels, the Fisheries Division will also use aid funds to make available FAO emergency sail rigs for use on the existing fleet of trolling skiffs. These emergency sail rigs will be made available free of charge to skiff owners and can be used to bring a skiff safely home in case of outboard breakdown. Outboard engine breakdown is at present the major reason for fishermen becoming lost at sea. In other initiatives aimed at assisting fishers at the village level, the Fisheries Division is actively continuing to develop

its extension service to provide training to local fishermen, covering both technical areas (outboard maintenance and use of innovative small-scale fishing methods including deep bottom fishing, improved trolling methods, vertical longlining) and non-technical areas (safety at sea, small business management, record keeping).

The Division is continuing to put emphasis on improving the village fisheries database to provide essential information for planning and management purposes. Information from the database is already being used to provide advice to the Business Development Advisory Bureau (BUDAB) on loans for village fishermen.

Deployment of fish aggregation devices (FADs) around all the islands will also continue, using the Japanese-aid fisheries development/extension vessel *Manau*. FADs have now proven to be virtually indispensable to the artisanal fishery. Future developments will in-

clude design improvements, following SPC recommendations, and attachment of navigation lights on FAD floats to make location of FADs easier and hence allow fishermen to fish the devices in the productive pre-dawn hours. Under the plan Fisheries Division will continue to provide training to younger fishermen in traditional fishing methods and marine lore.

Traditionally much of this information was considered to be secret and was closely guarded by certain

families. Traditional masterfishermen (*tautai*) passed their knowledge on only to selected young kinsmen. Because of social change, and particularly because young men now have less opportunity to go fishing with older relatives owing to compulsory Western-style schooling, much of this traditional knowledge is no longer being passed on and is in danger of being lost with the passing of the older generation. To counter this trend, Fisheries Division Masterfisherman Captain Loto Pasifika is providing practical training of this type (for example how to locate an atoll lagoon from a distance by the reflection on clouds; traditional methods of catching *tafauli* or black trevally, a much-prized food fish).

The Fisheries Division is also liaising with the Education Department on including fishing knowledge and skills in the Tuvalu school curriculum, with the aim of encouraging young people's interest in fishing as well as making them aware of

possible employment opportunities in the fishing industry. It is hoped to introduce a programme in Tuvalu schools modelled on the successful fisheries curriculum which has been developed in the Maldive Islands.

#### Small-scale export industry

Development of export fisheries is under the control of Naficot. There are a number of constraints to the development of an export fishery in Tuvalu, including difficulty of transport of product to overseas markets, motivation and organisation of fishermen and the need to ensure consistent quantity and quality. Development of an export fishery will require concerted efforts to train fishermen and shore-based staff in appropriate handling techniques and work habits. A fisherman licensing or registration scheme is to be introduced in Funafuti as a means of promoting the development of a core of professional fishermen.

Under the new management of ASAS General Manager Dick Lee, the UK—Australian aid fish market/processing centre is now running at a profit for the first time since it was built in 1987. To facilitate production of export quality products, the centre will shortly be upgraded by incorporating an air conditioned processing module to allow processing of fish in a controlled hygienic environment.

High priority under the fisheries development plan is given to development of a small-scale offshore fishery for deep sea snappers on the offshore seamounts in the Tuvalu EEZ. This fishery is to be developed under the USAID regional Pacific Is-

lands Marine Resources Project. Phase I of this project will comprise assessment of the sustainable yield and development potential of the resource. In Phase II, consideration will be given to building locally a number of suitable offshore fishing craft to exploit this resource (these vessels will probably be motor-sailing multi-hulls in the 35 — 40 ft range).

The Fisheries Division is at present arranging for a chart of all seamounts in the Tuvalu EEZ to be prepared, using satellite remote sensing data. A programme of trial fishing will then be carried out with USAID funding.

If stocks are sufficient, the intention is to develop the fishery through a joint-venture relationship with a Fiji-based company already established in the business. Options for transporting the catch are via Air Marshalls (this airline has already made a firm offer to air-freight up to 1.5 t of fish a week to Fiji), via the vessel of the Fijian fishing company or, snap-frozen, via Forum Line container ship. Catch would be sold to the Fijian company, who would then despatch it to overseas markets.

In addition to offshore snapper fishing, the development plan makes specific provision for outer islands development. The plan notes that it would be extremely difficult to operate a successful fish collection service to the outer islands to collect fresh or frozen fish, because of logistics and cost. The emphasis in the plan therefore is on production of dried fish on the outer islands as a cottage industry. An AIDAB-sponsored project is already underway to meet this objective. Under this project, community fishing

centres will be established as a pilot project on two of the outer islands in order to produce quality dried savoury fish (tuna jerky). The project is being developed by the Fisheries Division's Extension Section, with advice from an Australian monitoring agent, APTA.

Lastly, Fisheries Division and Naficot are working together to utilise effectively the fleet of five fisheries training launches donated under Japanese aid in 1988. Unfortunately the vessels are poorly suited to local conditions and it is proving very difficult to operate them on an economic basis. Options being considered for the vessels are catching yellowfin tuna for processing by Naficot as a value-added product for export (smoked fish, tuna jerky) and carrying out trial fishing for sharks for the shark fin trade and, at a later stage, for the production of shark skin for the shark leather trade. Over the last six months an SPC masterfisherman, Mr Tuainetai Rata, has been demonstrating the use of vertical longlining gear from the vessels to target yellowfin.



*Maximising returns from foreign fishing vessels*

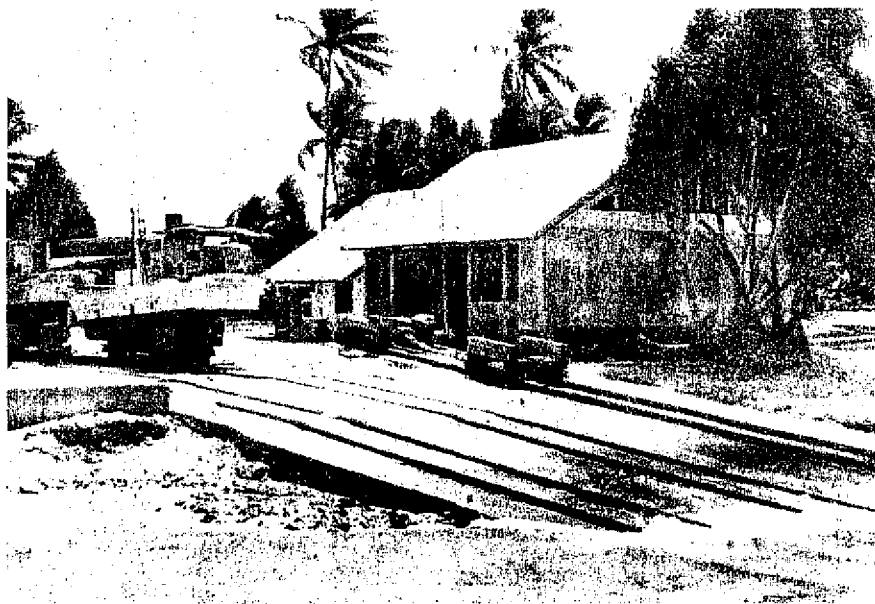
Tuvalu is in a difficult position in trying to police its very large EEZ effectively. At present the country is in a weak negotiating position with distant water fishing nations, since these nations frequently claim that, while they fish in the zones of neighbouring countries, they rarely if ever fish in Tuvalu waters and that they are therefore only prepared to pay a minimal access fee. With its limited surveillance capacity, Tuvalu cannot counter effectively this argument at present. Tuvalu cannot afford to operate a dedicated fisheries patrol vessel or a national operations centre. Under the development

plan, therefore, Tuvalu will continue to participate actively through FFA in regional initiatives aimed at improving surveillance and maximising returns from foreign fishing vessels (e.g. the proposed high frequency radio network to exchange intelligence on vessel movements, use of satellite transponders to track vessels). At the same time, Tuvalu will make every effort to make more effective use of existing surveillance assets by maintaining closer liaison with civil aircraft and merchant ships, and, in particular by providing better information to surveillance flights operated by RNZAF and RAAF. A database on seasonal movements of vessels in the area will be developed with

FFA assistance to improve flight planning of these surveillance flights.

**Conclusions**

Fisheries development in a tiny, remote country such as Tuvalu presents many problems. The first priority must be to develop a fisheries development plan with clear and realistic objectives appropriate to the needs of the country and with clearly stated strategies to achieve these objectives. Having adopted such a plan, Tuvalu now has a sound basis for the rational development of its living marine resources.



Tuvalu Fisheries slipway

# DEVELOPMENT OF THE INTRODUCED GREEN SNAIL POPULATION IN FRENCH POLYNESIA

## Introduction

In the late 1950s, the production of mother-of-pearl from the black-lipped pearl oyster *Pinctada margaritifera* was in sharp decline in French Polynesia. It was therefore decided to introduce other pearl shell varieties to offset this shortage.

The proximity of the western Indo-Pacific region, very rich in nacreous molluscs and with a coral environment comparable to that of French Polynesia, prompted the authorities of the day to seek a commercial species within that region. The trochus *Trochus niloticus* was thus introduced from Vanuatu in 1957 (Yen, 1985). This first introduction was a total success and the experiment was repeated in 1966 with *Turbo marmoratus*, also from Vanuatu.

The giant green turban shell, *Turbo marmoratus* Linné 1758, is a nacreous gastropod mollusc of the order Archaeo-gastropods, belonging to the family Turbinidae. More commonly known as the 'green snail', this large shellfish, which may weigh over 3 kg, has a green to brownish-green shell lined with mother-of-pearl, making it at a highly-prized raw material in the mother-of-pearl industry and the handicrafts trade.

Contrary to the trochus, which has been successfully introduced to a number of Pacific countries (Gillett, 1986; Yama-

by Stephen Yen,  
Etablissement pour la  
valorisation des activités  
aquacoles et maritimes  
(EVAAM)  
Papeete, Tahiti  
French Polynesia

guchi, 1987), the green snail's adaptation to the waters of French Polynesia would appear to be the first known successful introduction of this species (Yamaguchi & Kikutani, 1989).

This 23-year experiment has so far not been documented elsewhere. This study is a report on the introduction of this shellfish to French Polynesia and an attempt to appraise the size of the present population and its consequences for the fishery. From a purely biological standpoint, the operation can be termed a success, and from the 'commercial' standpoint also, since green snail poaching (harvesting is as yet illegal), is regularly reported around the island of Tahiti.

## Introduction of the green snail to the island of Tahiti

### Transport from Vanuatu to Tahiti

In March 1967, 300 'adult' green snails weighing over 1 kg were collected in the New Hebrides (now Vanuatu) on the island of Efate. The available information does not state the exact place of collection.

These animals were loaded aboard the *Tahitien* bound for Papeete. During the journey, the molluscs were kept alive in a metal tank (an empty metal drum) filled with sea water, renewed by intermittent pumping.

At the end of the 12-day journey, 42 green snails arrived alive but very weak in Papeete on 9 April 1967. They were immediately transported to the intended introduction site.

### Establishment on Tautira reef

#### *Transferring the animals to the site*

The imported specimens were transported to Tautira, the chosen site, on their day of arrival. Because of the long distance between Papeete and the site, they first travelled by road in tanks filled with aerated sea water and were then carried out to the reef by boat.

#### *Site description*

The chosen site lies on the south-east coast of the peninsula, at the end of the island, in Tautira district (Figure 1). It is close to the site used for trochus introduction 10 years previously, and was chosen for the following reasons:

- relative remoteness from highly-urbanised areas, reducing the risk of poaching;
- exposure to the prevailing east winds, creating an environment of strong current and high oxygenation, favourable to this species;
- extreme south-easterly position, exposed to the prevailing winds, favourable for larval migration along the coast, parallel to the winds.

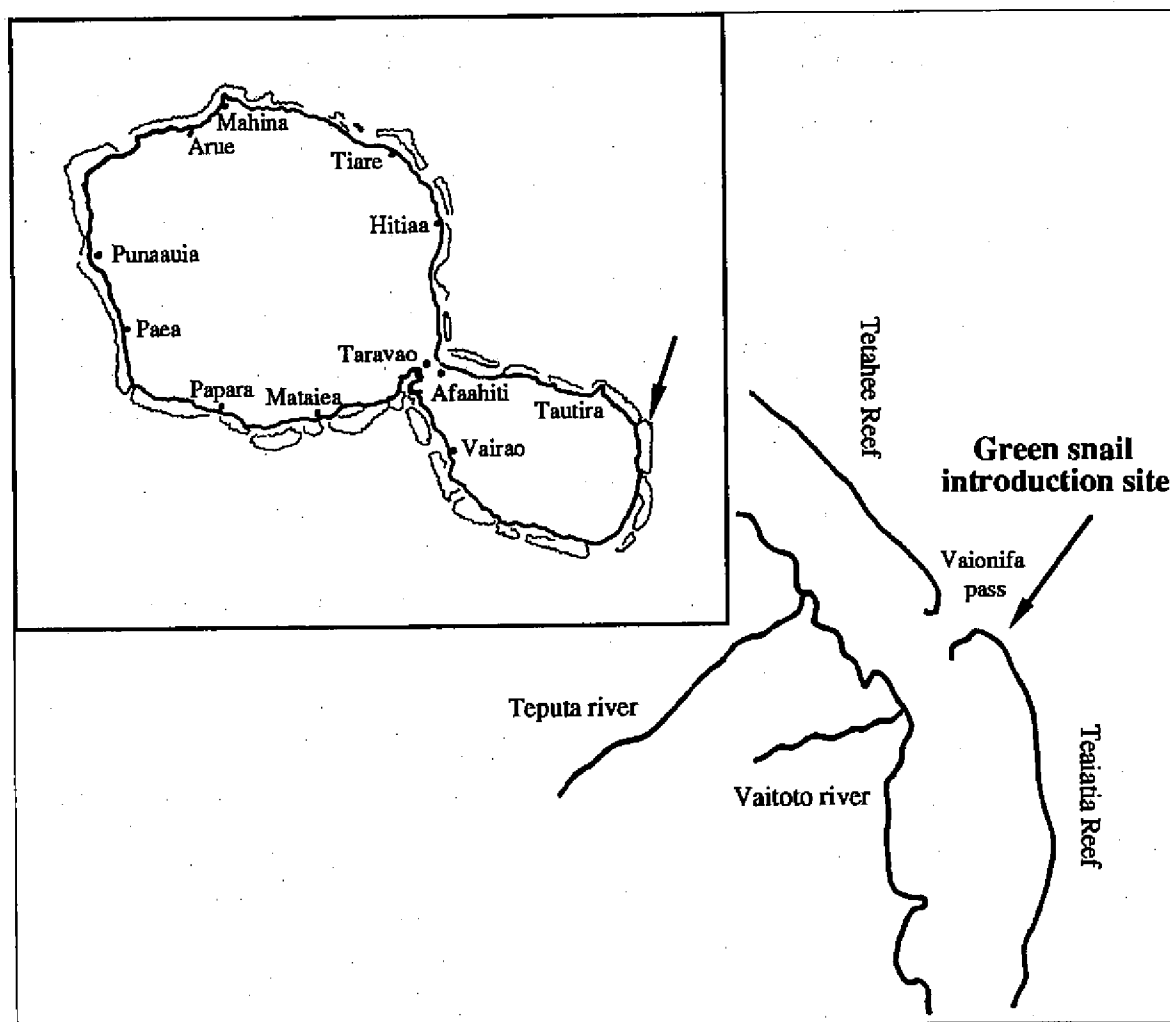


Figure 1: Map of the island of Tahiti and 1967 green snail introduction site

The specimens were placed on the outer slope of Teaiatia barrier reef, approximately 100m from the Vaionifa passage, on

bottoms ranging from 7 to 8m in depth (see Figure 1). No description of this site was made at the time of introduction, but

a recent dive enabled the author to sketch the lagoon floor (Figure 2).

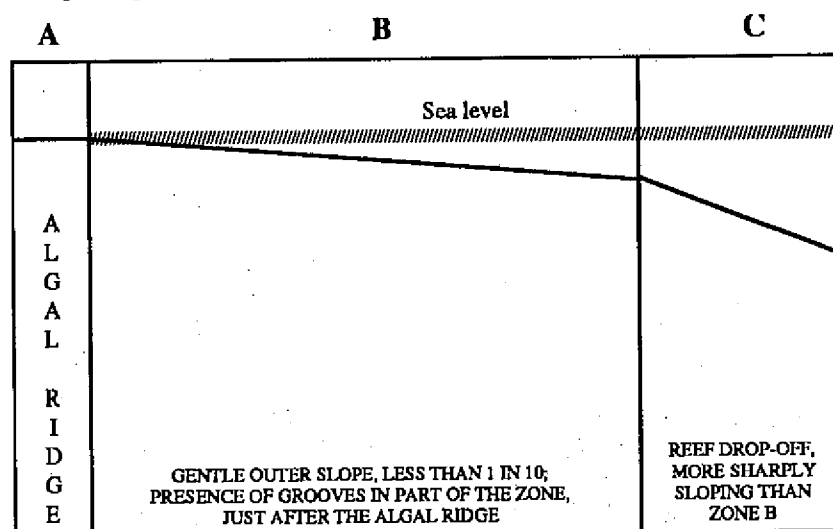


Figure 2: Diagram of the introduction site

The site features the presence of an extensive reef flat (Zone B) approximately 80 to 100 m wide, very gently sloping before the sharper drop-off. A predominance of *Pocillopora* colonies is observed, with some *Acropora* and *Porites* amongst them. The algal vegetation is generally encrusting, except the macrophytes of genus *Turbinaria* which are probably not a source of food for the green snails. The molluscs introduced in 1967 were placed on the reef drop-off. During our recent inspection, most were found scattered over Zone B, not hidden in the fissures and crevices, which are uncommon at this location.

There is no information available about the state of living substrate when the specimens were introduced in 1967, but the geomorphology of the site was certainly the same then as it is now.

## Development of the population around Tahiti

### Initial observations

The results of inspections carried out by the Fisheries Department from 1967 to 1971 are nowhere to be found.

A visual inspection carried out at the introduction site in December 1971 revealed the presence of seven adult green snails at depths of 7–11 m, but no young specimens were found. During the same period, two fishermen reported collecting two juveniles on the outer slope of the barrier reef at Pueu, a district close to Tautira (see Figure 1).

In October 1972, fishermen from Faaone collected two juveniles weighing under 1 kg on

the Faaone fringing reef (Figure 1). They were gathered at night at depths of 0.5–0.8 m.

The harvesting of these young specimens made it possible to confirm that the species had adapted to the reefs of Tahiti and was spreading along the island's east coast.

### 1979 Survey

Between September 1979 and January 1980, 13 years after the introduction, an initial population survey was carried out on all the reefs of Tahiti. However, the information gathered during this operation was not accurate enough to provide an appraisal of the stocks of green snails present around the island. Precious information about the proliferation of these animals at a time when virtually no inter-reef transplanting had been carried out around Tahiti was nevertheless obtained, together with data on the relative stock sizes in each district.

Each dive involved 2–4 divers working outside the barrier reef. The dive times were generally recorded and distances travelled alongside the reef were sometimes registered. Depths were usually noted also. The specimens present were counted as divers progressed along prearranged transects. Some relatively deep dives, between 15 and 25 m, were performed during this inspection to verify whether or not green snails were present at this depth.

Figure 3 shows the relative stock size as it emerged reef by reef during the survey. The information gathered during this study was as follows:

— Presence of green snail along the whole length of the east coast of Tahiti, with a greater density near the introduction site;

— Absence of green snail in almost every west coast location, apart from occurrences in the extreme south-west near the introduction site;

— Green snail presence was recorded at depths of between 1 and 15 m; beyond this no specimen was observed.

In certain areas in the immediate vicinity of the introduction site, as many as 80 green snails were counted in 30 minutes' diving time by four divers. Although this figure may have no real significance where overall stock estimation is concerned, it is comparable to the figure recorded on Aneityum in the New Hebrides in 1961 (13 animals/10 mins/2 divers) where Devambez estimated that the stocks had risen to exploitable levels again.

The spread of the population along the east coast was therefore confirmed by this survey, but it was slow compared to the proliferation of trochus, for which commercial fishing became possible a mere 14 years after its introduction (Yen, 1985).

### Recent observations

No population survey was carried out between 1979 and 1990, but a number of dives have been made in the urban area between Punaauia and Mahina since 1987. They showed that green snails were present on all the reefs within this zone and that stock sizes had diminished from 1987 to 1990. To quote only the example of the Venus

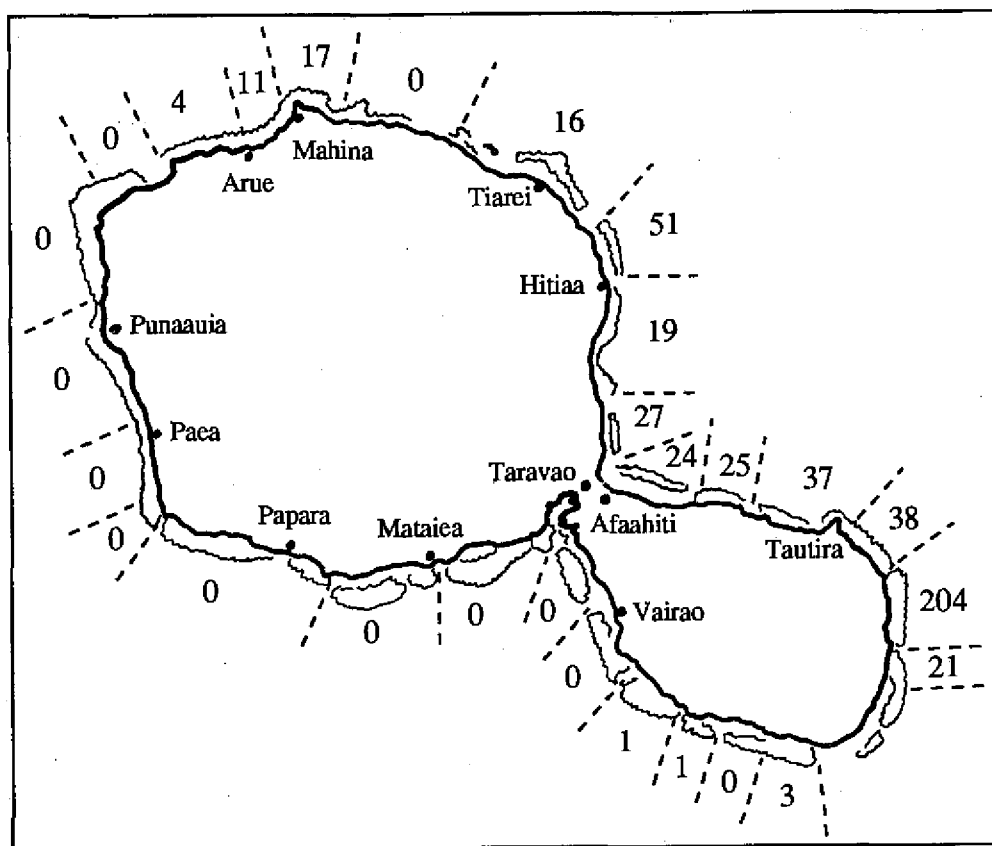


Figure 3: Results of the survey carried out between September 1979 and January 1980. (The figures represent the number of green snails found on each separate reef.)

Point reef at Mahina, 96 specimens were collected and released in a 40-minute dive by two divers in June 1987, whereas in 1990 only 56 were counted in a six-hour dive by two divers (Gauducheau, 1990). The two figures are not directly comparable because the actual fishing effort in the latter case was much more intensive, entailing a much longer diving period for the same surface area surveyed, than in the former case; however, the total area surveyed in 1987 was smaller.

Gauducheau's 1990 study showed how small stocks were in the urban area; they are far from being exploitable under current circumstances. However, no counts have been carried out in other areas, particularly around the peninsula

where stocks would appear adequate to sustain commercial poaching.

### Green snail transplanting in French Polynesia

#### Inter-reef transplanting around Tahiti

In 1976, the first transplant operation from Tautira to one of the Papara reefs was carried out. After the first survey in 1979, other transplantings took place, mostly to reefs off the west coast of Tahiti using specimens from Tautira (see Table 1), so as to encourage the species to colonise along this coast, its spread having occurred naturally along the east coast.

#### Inter-island transplants

Many transplanting operations were carried out between 1980 and 1981 to the Leeward Islands and some of the Tuamotu atolls (Table 1). In 1982, it was the turn of the Gambier Islands to receive transplanted stocks. Other, more recent, introductions have taken place, chiefly in the Tuamotu Archipelago in 1985, 1987 and 1989. None of these introductions have ever really been properly monitored,

but, according to the few observations reported by fishermen, these molluscs appear to adapt better to the reefs of high islands than to atoll reefs.

In November 1981, 12 specimens were sent to the Cook Islands, where they were introduced to the island of Aitutaki (Dashwood, pers. comm.).

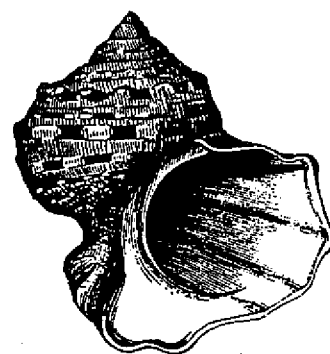


Table 1: Green snail transplants carried out in French Polynesia from 1967 to 1990

Destination		Date of transfer	Place of transplantation	No of specimens		Time in transit	Origin
Group	Island			on depart.	on arrival		
Societies	TAHITI	4/9/67	TAUTIRA: Vaionifa pass, Tahuna	300	42	12 days	VANUATU (Introduction)
	TAHITI	12/22/76	PAPARA: Teavarua pass	13	13		TAUTIRA (Vaionifa)
		8/25/80	PAPEARI: Oneroa point	10	10		Tautira
		8/25/80	TOAHOTU: Temahina	10	10		Tautira
		8/25/80	VAIRAO: Toahotu/Vairao boundary	10	10		Tautira
		9/1/80	PAPEARI: Motu Matuu pass (c/Toahotu)	15	15		Tautira
	MOOREA	9/1/80	PAPEARI: Motu Matuu pass (c/Mataiea)	15	15		Tautira
		Jun-80	AFAREAITU: Maatea		10	x h	Tahiti
		Jun-80	AFAREAITU: Ahi motu		10		Tahiti
		Jun-80	TEAVARO: Vaire pass		10		Tahiti
		Jun-80	TEAHAROA: Terae point (Faauro)		10		Tahiti
		Jun-80	TEAHAROA: Avaroa pass (c/Temae)		10		Tahiti
		Jun-80	PAPETOAL: Tereu pass (c/Haapiti)		10		Tahiti
		Jun-80	HAAPIII: Paroa point		10		Tahiti
		Jun-80	HAAPIII: Taota pass		10		Tahiti
		Jun-80	HAAPIII: Matauvau pass		10		Tahiti
	HUAHINE	10/29/80	APU: Vaioera motu		10		Tahiti
		10/29/80	PAREA: Tau point		10		Tahiti
		10/29/80	MAROE: Muri Maca motu		10		Tahiti
		10/29/80	MAEVA: Oavare motu		10		Tahiti
		10/29/80	FARE: Airstrip		5		Tahiti
	RAIATEA	10/29/80	FIITI: Fare/Fiti boundary		5		Tahiti
		1/21/80	UTUROA: Pufau pass/Tahaa side		49		Tahiti
		10/14/80	UTUROA: Pufau pass/Tahaa side		30		Tahiti
		10/14/80	AVERA: Teava Piti pass		10		Tahiti
		10/14/80	OPOA: Teava Mao pass		10		Tahiti
	TAHAA	10/14/80	FETUNA: Naonao pass		10		Tahiti
		10/14/80	VALAAU: Toamaro pass		10		Tahiti
		10/14/80	TIVA: Paipai pass		10		Tahiti
	BORA BORA	10/14/80	HAAMENE: Toahotu pass		10		Tahiti
		11/26/80	ANAU: Taurere point		10		Tahiti
		11/26/80	VAITAPE: Facing Hotel Bora Bora		10		Tahiti
		11/26/80	VAITAPE: Facing Motu Tapu		10		Tahiti
		11/26/80	FAANUI: Tevairoa Islet		10		Tahiti
	MAUPITI	11/26/80	FAANUI: Facing airstrip		10		Tahiti
		11/6/80	Motu Ahi		8		Tahiti
		11/6/80	Motu Aaira		8		Tahiti
		11/6/80	Alparau point (pass)		8		Tahiti
		11/6/80	Paotini		8		Tahiti
Tuamotus	ARUTUA	6/27/81	Village pass	20	20		Tautira
		9/4/90	Putehue motu	10	10	2 h	Punaauia
		9/4/90	Between Putehue and Agahuru motu	10	10		
	TAKAPOTO	10/16/81	Facing airstrip	5	5	x h	Tahiti
		10/16/81	Okokina	5	5	x h	Tahiti
	MATAIVA	11/27/81	Village pass		6		Papeete
	HIKUBERU	Jun-82	Horo ava	10	10	x h	Tahiti
	RARAKA	Aug-85			6 ?		Mahina
	MAKEMO	8/27/85		70	0	4 days	Mahina
	APATAKI	11/10/87	Haniuru pass (village) outer slope	30	30	2 days	Mahina
		9/7/90		20		x h	Mahina
	NIAU	9/7/90		20		x h	Mahina
Gambiers	GAMBIER	May-82	Taravai pass		3	x day	Tahiti
		May-82	Totegegie		3	x day	Tahiti
		May-82	Mokoto		3	x day	Tahiti
Cook Islands	AITUTAKI	11/27/81	Aitutaki, 150 km north of Rarotonga	12	?		Tahiti



## Socio-economic benefits of the introduction

### Current legislation

In 1977, following the proliferation of the green snails, whose stocks became easier and easier prey for fishermen because of their development, the first official action was taken to protect the species. A permanent ban on fishing, transporting and selling green snails was imposed throughout French Polynesia. In 1988, new regulations on the protection of certain species of marine and fresh water animals, including the green snail, were adopted. Under these new provisions, green snail fishing activities can be organised under the authority of a supervisory panel of officials, scientists and fishermen.

No such official harvest has yet been organised.

### Illegal fishing for human consumption

Subsistence harvesting of this shellfish is at present being reported and revealed all around the coastline of Tahiti. Reports are based on the sometimes large quantities of empty shells found discarded in the water on all the reefs of Tahiti. The flesh is removed immediately and the shell thrown back for fear of reprisals if it is landed. When chopped, the flesh of this species resembles that of *Turbo setosus* as which it is sometimes sold. It is true that the increasing scarcity of *Turbo setosus* on the reefs of Tahiti has been conducive to green snail fishing for consumption.

## Commercial poaching for the shell

In 1990, three illegal green snail shell trading activities were dismantled by the judicial and customs authorities. More than 25 t of empty shells were seized, equivalent to a harvest of approximately 15,000 specimens. A batch weighing 7,685 t was sold at auction for over 20,000,000 CFP francs, i.e. 2,719 francs/kg.

This illicit trading shows how highly prized the green snail's shell has become as a raw material in the mother-of-pearl industry. The prices have accordingly soared, tempting fishermen to ignore the regulations for substantial gain.

## Conclusion

It is now undeniable that *Turbo marmoratus* has successfully adapted to the reefs of French Polynesia. At the moment we cannot really account for the success of the introduction, which simply seems a stroke of good luck, since the animals did not undergo any special preparation before being planted onto Tahiti's reefs. Did the mollusc find an ideal environment for its development or did it adapt to the environment by changing its biological requirements? There is as yet no answer to this question, which deserves further enquiry.

Whatever the case, this transplanting, which would appear to be the first successful one anywhere in the world, gives fresh hope for the production of coveted mother-of-pearl from green snail, which was limited naturally to the western Indo-Pacific region. The impact on local species is, however, un-

known at present and should be investigated more fully in future studies.

Stock estimates for areas around Tahiti are urgently required before the reefs are stripped bare by poachers. Since the natural proliferation of this species is slow, due certainly to the brevity of its larval life (3 to 4 days, according to Yamaguchi in 1988) the intensity of illegal harvesting can rapidly lead to over-fishing.

Reef transplanting would appear to be a good strategy to widen the distribution of this species, but the natural breeding stocks are very vulnerable to fishing and are therefore likely to be endangered in the near future, which could also be a limiting factor for transplanting operations. The production of green snail spat for reef re-seeding could be a feasible solution and should be pursued.

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# THE DEVELOPMENT AND DECLINE OF DEEP REEF SLOPE HANDLINE FISHING IN THE EAST SEPIK PROVINCE, PAPUA NEW GUINEA

The SPC Deep Sea Fisheries Development Project (DSFDP) and its predecessor, the Outer Reef Artisanal Fisheries Project, were established in the 1970s to promote the increased exploitation of the snapper (*Lutjanidae*) and grouper (*Serranidae*) stocks of the deep reef slopes (80—300 m depth) of the Pacific Islands. SPC masterfishermen visited almost all the countries of the region demonstrating fishing techniques and surveying different locations for fishable stocks. At the heart of the deep slope fishing methodology was a wooden hand-reel, adapted from a design conceived in Western Samoa. By the mid 1980s successful deep slope fisheries had been established in Vanuatu, Fiji and Tonga.

Several articles have been written about the success of these fisheries, particularly the fisheries in Tonga and Vanuatu. Less is known, however, about the successful introduction of deep slope fishing in Papua New Guinea. This fishery was, for a three-year period, the major source of fish landed at a commercial fish plant in Wewak, the provincial capital of the East Sepik Province (ESP) on the northern coast of Papua New Guinea. Prior to the inception of the deep slope fishery in 1983, commercial fish landings at the Wewak fish plant were declining. Landings

by  
**Molean Chapau,**  
Dept. of Fisheries & Marine  
Resources, Kavieng  
Papua New Guinea

and

**Paul Dalzell,**  
South Pacific Commission,  
Noumea, New Caledonia

had decreased from 18 t in 1979 to 8 t by 1982.

During 1983 the staff of the Fisheries Laboratory in Wewak began demonstrating deep slope fishing to villagers along the coast and on coastal islands. Total production in this first year was encouraging, with deep slope fishes amounting to 12 t or 54.5 per cent of the total fish landings at the Wewak fish plant. The landings of deep slope fish in 1984 and 1985 were 14.3 t and 20 t respectively. By 1985 there were 34 part-time and full-time fishermen landing deep reef slope fishes into Wewak. An optimistic future was predicted for the fishery, with a possible doubling of the number of fishermen in the fishery and annual landings totalling 40 t by the end of the decade.

This encouraging scenario did not, however, eventuate. Landings of deep slope fish in 1986 declined to about 10 t.

During the following year the drop in production was even more marked and deep slope fish landings totalled less than 5 t. The fishery continued to decline, so that at present few deep slope fish are landed to the Wewak fish plant. Some catches of deep slope fish are landed in Wewak town but go directly to hotels, restaurants and small stores. These landings are the remnants of the fishery that commenced in 1983 and expanded rapidly up to 1985. How could such a productive fishery suffer such a reversal of fortune in such a short time?

When the project staff began demonstrating deep reef slope fishing, the response from different villages around Wewak was not uniformly enthusiastic. The most positive response to this initiative came from a group of villages about 40 km from Wewak and centred on the village of Turubu. The Turubu villagers quickly adopted the Samoan hand reel for use on their 11 m outrigger canoes and contributed to about 75 per cent of the total landings. There were in total 10 full-time fishermen landing deep reef slope fishes to the Wewak plant and all came from the Turubu area. The enthusiasm of the Turubu villagers for deep slope fishing was encouraged by a range of services offered by the project staff and not just the financial returns from fishing. It was this aspect of the fishery that led to the decline in production.

The normal functions of a government fisheries station are to buy fishermen's catches and supply ice to fishermen. These institutions are staffed by public servants and work to public service hours (07.45 to 16.06 hrs) during a five-day week. Project staff realised that this would be

unsuitable for the development of a fishery and hence were always ready to respond to fishermen landing catches outside regulation office hours, particularly at week-ends. In addition, the project offered a range of other services to the fishermen that included sale of subsidised fishing gear, collection of fish from Turubu during periods of inclement weather and organising regular servicing of outboard motors in Wewak. In addition, the project staff offered financial advice and management to the fishermen and advised on the saving and disposal of fishing incomes. The project staff also helped fishermen negotiate loans from banks in Wewak by demonstrating to bank managers the profitability of deep slope fishing.

Essentially, the project staff were acting as a mixture of fisheries agents and fisheries brokers. They took the role of middleman that is common in the small-scale fisheries of South-east Asia. Here fish brokers and buyers have well-developed business and personal relationships with fishermen and, whilst taking a percentage of the catch revenues as a fee, perform a similar supportive role to that described above. Indeed, in some cases the fishermen may need to rely on their respective brokers to keep them solvent during lean periods during the year.

However, it was always envisaged that the role of the Fisheries Research Staff in the development of the fishery would be temporary and that the support and management of deep slope fishing would be transferred to the East Sepik Provincial Government's Fisheries Extension Branch. This duly happened in 1986, allowing project

staff to explore new fishing grounds in the offshore Schouten Islands of the ESP and survey the deeper reef slopes (>200m). Unfortunately, the same commitment to providing services to the fishermen was not evident in the Extension Staff. This discouraged the fishermen, most of whom stopped fishing altogether, whilst a few others continued to fish but to market the catch themselves. A nucleus of four to five fishermen from Turubu still continues to catch deep slope fishes but they are not as productive as before when they were serviced by Fisheries Research staff.

Other factors involved in the decline of the fishery were beyond the control of project staff and were concerned with Provincial politics. However, these factors were peripheral and acted to exacerbate a situation where fishermen were demoralised by the lack of service after maintenance of the project was transferred to Fisheries Extension. Besides discouraging the Turubu fishermen, the major producers in the deep slope fishery, the decline in fishermen services also served to dampen the enthusiasm of the more marginal fishermen from other locations such as the Schouten Islands.

Presently, a small but unknown volume of bottom fish is be-

ing landed in Wewak by a few remaining fishermen from Turubu. They have to cope with all aspects of transport, marketing, etc., unlike in the past when they benefited from the services provided by the project staff. The initial aims of the project were to increase fresh fish supply in the region and to improve the economic performance of village fishermen. The initial success of the project and the subsequent decline are a valuable lesson to fisheries developers, particularly those attached to government agencies.

The deep slope resources of the East Sepik Province and indeed the rest of PNG are considerable. However, to establish a viable fishing industry there has to be the development of a range of services to the fisherman that will help nurture the infant fishery and attract others into fishing. This is only likely to happen where there are close private business relationships between the fishermen and fish buyers and not through a government agency such as an fisheries extension office.

