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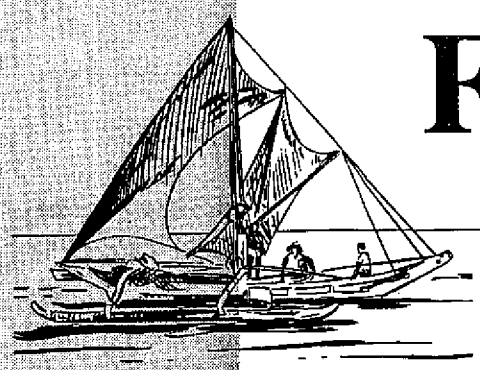

FISHERIES
Newsletter

NUMBER 62
JULY — SEPTEMBER 1992

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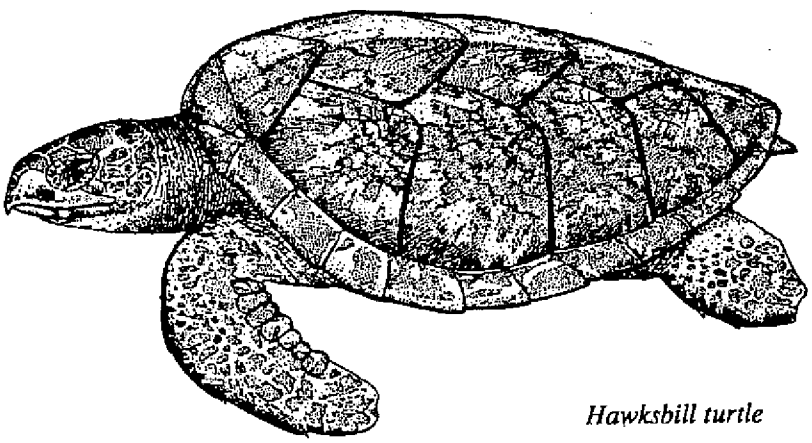


Hawksbill turtle

South Pacific Commission
Prepared by Jean-Paul Gaudechoux, Fisheries Information Officer

TWENTY-FOURTH REGIONAL TECHNICAL MEETING ON FISHERIES

The Twenty-fourth Regional Technical Meeting on Fisheries (RTMF) was held in Noumea from 3 to 7 August 1992, bringing together 60 participants from 23 SPC member countries and 12 international or other organisations.

In accordance with the procedure of rotating the Chairmanship alphabetically between member countries, Mr Steven Yen of French Polynesia was appointed Chairman of the meeting, while Mr Rufo Lujan of Guam was appointed Vice-Chairman and Chairman of the Drafting Committee.

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

A few changes were made to the agenda this year, with mornings being devoted to consideration of programme activities and afternoons to technical discussions on such topics as Pacific tuna fisheries, preliminary results of the Regional Tuna Tagging Project, design and interpretation of fishery statistical programmes, baitfish aggregation devices and fishing techniques.

First on the agenda were an overview of SPC Fisheries Programmes and a report on the activities conducted under the various programmes in the previous year. The future of the Tuna and Billfish Assessment Programme (TBAP) came up for discussion on the first day.

The Chief Fisheries Scientist summarised TBAP activities conducted over the past year, highlighting the work of the Regional Tuna Tagging Project and underlining the rationale and importance of tagging studies for tuna research. He also described the work being done on assessment and modelling of tuna populations in the region, and provided an overview of the Albacore Research Project and the Philippine Tuna Research Project which the TBAP will undertake under the auspices of the Western Pacific Fisheries Consultative Committee (WPFCC), in co-operation with the Philippine Bureau of Fisheries and Aquatic Resources (see SPC *Fisheries Newsletter* no. 61).

Participants expressed their full support for the work of the TBAP, which is being considered by the European Community for five-year funding under Lomé IV, and recommended the adoption of a strategic plan for the programme.

The activities of the Coastal Fisheries Programme were then reviewed and discussed, in particular the Fisheries Information Project. Two new special interest groups have been set up, one on trochus and one on traditional marine resource management and knowledge. Participants emphasised the importance of these special interest groups for the collection and dissemination of information on marine resources in the region.

The Fisheries Development Associate then described the activities of the project and presented the two bibliographies that had been produced, one on the marine resources of the Federated States of Micronesia, the other on the marine resources of the Marshall Islands.

During discussions of the Inshore Fisheries Research Project, participants stressed the

Photo: Marial Dosdane

This year, the Representative of French Polynesia, Stephen Yen, was appointed Chairman of the meeting.

value of this project for the development of national fisheries research capabilities. The main components of the Fish Handling and Processing Project were also reviewed, with special reference to the proposed establishment of the Regional Post-harvest Fisheries Centre (RPFC) on the campus of the University of the South Pacific in Suva. Participants expressed concern about the current lack of funding for this Centre.

The meeting then discussed future plans for the Regional Fisheries Training Project and the practical module of the SPC/Nelson Polytechnic training course which this year was based at the Fisheries Training Centre in Luganville, Santo, Vanuatu. This training module was very successful and the availability of well-equipped boats enabled the trainees to make good use of local marketing facilities.

The meeting considered the activities of the Deep Sea Fisheries Development Project at some length and noted that the United Nations Development Programme had approved funding for the offshore fisheries development sub-project.

Participants were then invited to consider a paper outlining the prospects of collaboration in Pacific Island Pearl Oyster Resource Development. The pearl oyster industry, and shell industries in general, were viewed as being very important to several of the smaller Pacific Island countries.

The Representative of French Polynesia, after pointing out that the black-lip pearl oyster had been pioneered in French Polynesia, confirmed to the meeting that French Polynesia was prepared to participate in pearl oyster surveys, provide assistance for artificial production of spat and re-seeding of oyster beds, help train technicians in pearl oyster farming techniques and farm management, and support a regional research programme. The representative of the Australian Centre for International Agricultural Research (ACIAR) outlined his organisation's recent initiatives in pearl- oyster research, particularly in connection with disease diagnosis, health management and population genetics.

Photo: Martial Dosdane

Members of the SPC Fisheries Programmes, one second after a tea-break was announced

Every year a one-day workshop is held during the RTMF on a topic related to Pacific fisheries development. This year's topic was: 'Fisheries training for the Pacific Islands'.

Existing, new and proposed training opportunities were reviewed and the meeting also acknowledged the importance of the SPC Fisheries Training Directory as a tool for the identification and planning of appropriate training programmes. The Meeting recommended that this Directory be widely disseminated and kept up to date with relevant information.

The meeting reaffirmed its support for the proposed Western Pacific Fisheries Consultative Committee study tour of ASEAN fisheries training and education institutions.

The creation of a course leading to a Certificate in fisheries studies was extensively discussed and participants agreed to postpone this project pending the re-establishment of the Marine Resources Institute in Solomon Islands. In the meantime, SPC should consult its member countries with the aim of further documenting the vocational fisheries-related training requirements of the region as well as the likely future demand for training opportunities at various levels.

Acknowledging the potential for the increased employment of Pacific Island nationals in the industrial fisheries sector, participants also recommended that SPC investigate the feasibility of introducing standardised fishing deckhand certification in the region.

A working paper was then presented on the role and future of the RTMF. The ensuing discussion culminated in a recommendation that the RTMF be held on a biennial basis henceforth, with the provision that extraordinary meetings be convened to deal with issues of major concerns to the region, when they arose.

During the last few hours of the meeting, participants listened to statements by other organisations involved in fisheries development in the region, namely the United Nations Development Programme, the Forum Fisheries Agency, the South Pacific Regional Aquaculture Development Programme (SPADP), the New Zealand School of Fisheries, the Western Pacific Fisheries Consultative Committee, and the Australian Centre for International Agriculture Research (ACIAR).

This year's meeting was interesting and productive, touching on a wide variety of topics and defining guidelines that SPC should follow for fisheries development. As always, a number of issues were thrashed out outside the meeting room and all participants had the opportunity to establish or renew personal contacts with representatives of other countries and organisations.

(Contributor: J.P. Gaudechoux)

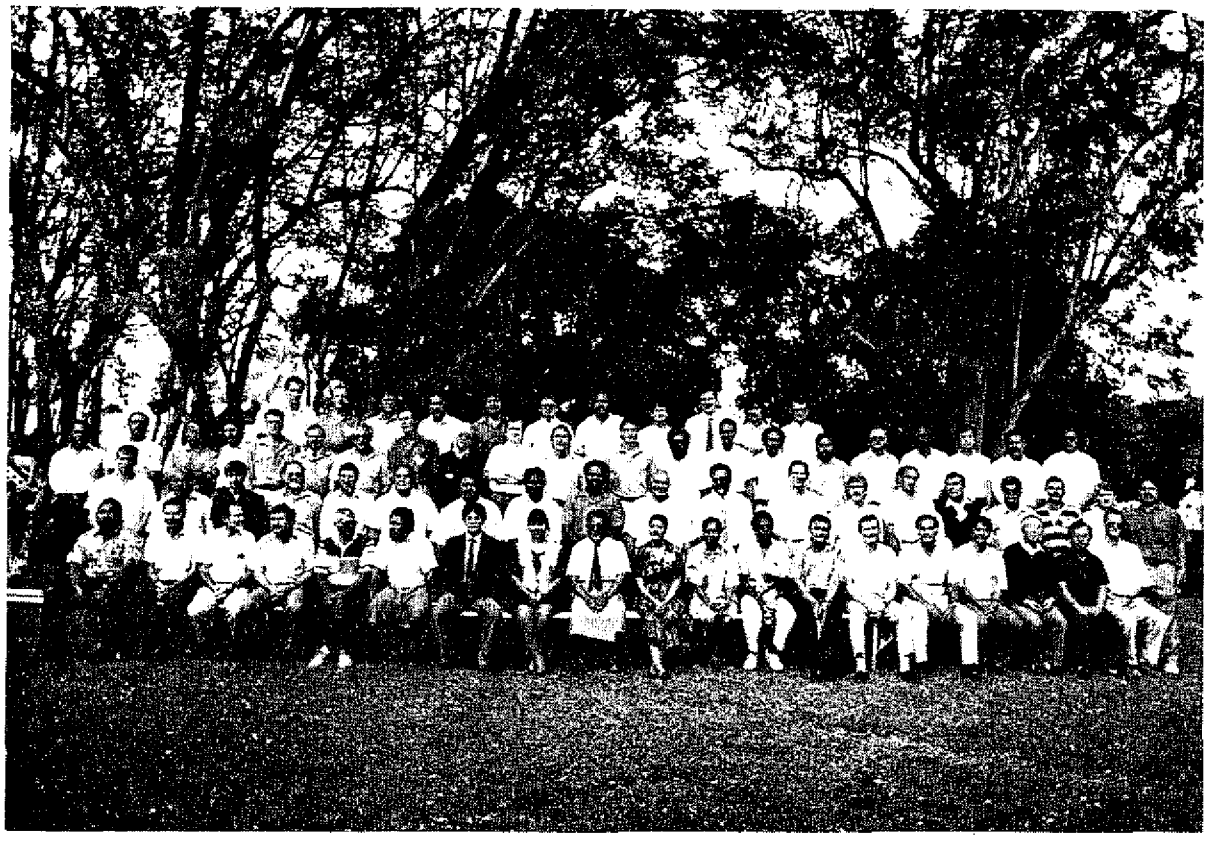


Photo: Martial Dosdane

Participants in the Twenty-fourth Regional Technical Meeting on Fisheries

FIFTH PIMRIS MEETING SUCCESSFUL

The fifth Pacific Islands Marine Resources Information System (PIMRIS) Steering Committee Meeting was held in Noumea at SPC Headquarters from 30 to 31 July 1992, just before the Twenty-fourth Regional Technical Meeting on Fisheries (RTMF).

Continuation of PIMRIS activities was of major concern to participants, since ICOD funding for the Coordination Unit will cease in June 1993. In light of this, the meeting recommended that the regional co-operating agencies involved in

PIMRIS — SPC, FFA, USP and SOPAC — continue their participation in PIMRIS and, if possible, formalise this participation through the mechanism of an inter-agency agreement with other PIMRIS participants. Participants also agreed that the PIMRIS Coordination Unit would seek funding for and organise a review of its own activities and those of other regional agencies involved in marine resources information, to facilitate future planning and the identification of funding.

Overwhelming support for PIMRIS to continue its present activities was given by fisheries representatives at the 24th RTMF, to which the PIMRIS report was presented.

Since the establishment of the PIMRIS network, various information activities have been undertaken by the participating regional agencies, two of the major initiatives being the development of the MOANA database, and the assistance given to national centres in the organisation of their information resources.

Nine countries have been assisted so far in the organisation of their fisheries information collections and libraries. CDS-ISIS database software has been installed at most of the sites in these countries and in many cases follow-up visits have been made. In-country work has been undertaken by the Outreach Programme of the Coordination Unit at USP library, by FFA, and by SOPAC.

The MOANA database was officially launched during the PIMRIS meeting this year and Version One was available for searching in the SPC library. MOANA contains over 9,000 bibliographic records relating to living and non-living marine resources in the Pacific region. It will be sent to the national centres in due course.

(Contributor: R. Cassidy, SPC Librarian)

Photo: Martial Doucane

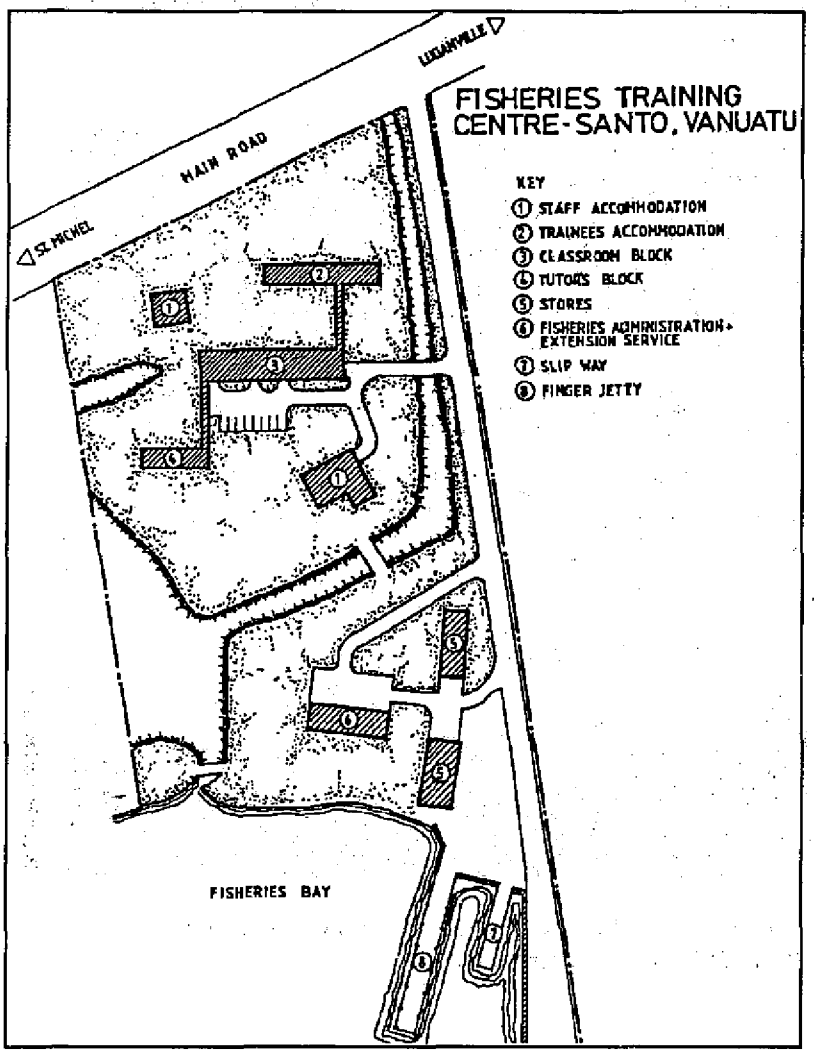
Participants in the Fifth Pacific Islands Marine Resources Information System (PIMRIS) Steering Committee

REGIONAL FISHERIES TRAINING PROJECT

Vanuatu hosts 1992 Nelson Course Practical Module

Thanks to a generous offer from the Government of Vanuatu, the Fisheries Training Centre (see plan below) in Luganville, Espiritu Santo, was made available to SPC as a venue for this year's Nelson Course Practical Module. The 12 course participants, fresh from four months at the Nelson Polytechnic New Zealand School of Fishing, arrived in Vanuatu on 1 June for five weeks of practical fishing experience, ready to put into practice their newly acquired skills in seamanship, navigation and fishing technology.

Under the guidance of SPC's Fisheries Training Advisers Hugh Walton and Michel Blanc, Masterfisherman Paxton Wellington, Nelson tutor John Moore, Centre Manager Simon Meava, and local tutor Joulie Latana, the group spent the first few days familiarising themselves with the Fisheries Centre and its training vessels, preparing fishing gear for the course. The impressive facilities of the Training Centre provided a 'one-stop shop' for the practical module, with accommodation, classroom, workshop, fish handling and operational facilities housed on the same site as the Fisheries Division's Extension Centre. Located on a sheltered stretch of waterfront with ample wharf and mooring space for the three training vessels, the Fisheries complex was constructed with financial support from the European Community and opened in 1990 (see SPC *Fisheries Newsletter* # 56).



Prior to the commencement of the course, the Training Centre's staff had been hard at work preparing the training vessels and catching bait. SPC Masterfisherman Paxton Wellington, on FAD deployment operations in Santo, had given many hours of his time to join forces with the Fisheries Boatyard to recondition the training vessel *Etelis*, a 33 ft VAN 1 design, fitting a new Yamaha diesel engine, rebuilding the wheelhouse, and upgrading the hydraulics. As part of the FAD deployment work the *Etelis* was also fitted with a GPS navigation system and dual frequency echosounder. The other vessels provided for the course trainees were the 28 ft FAO-designed *Tabwemasana*, fitted with four hand-reels for bottom fishing, and the FAO-designed KIR-4 canoe *Cuso*, also fitted with hand-reels for trolling and bottom fishing.

With the vessels all in such good shape, it was possible to be ready to fish after only three days of lectures and preparation and there was an air of excitement as trainees were roused from their bunks at 2 am to head for the fishing grounds. The role of tutors in fishing operations was strictly that of observers, with trainees being

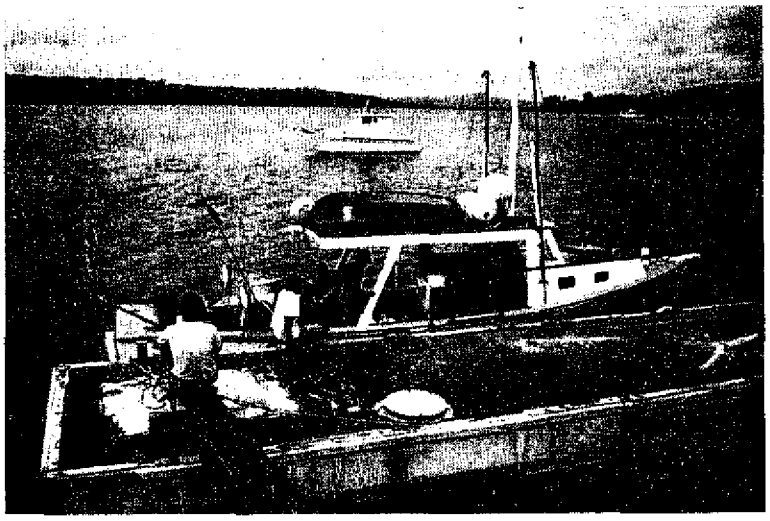


Photo: Hugh Walton

The training vessel *Etelis* prepared for sea

rostered to the various boats on a weekly basis and taking turns as skipper, navigator, engineer and statistician. With trainees at the helm, the *Cuso* and the *Etelis* headed to one of several SPC-deployed FADs, whilst the *Tabwemasana*, utilising the local knowledge of tutor Joulie Latana, embarked for a day of bottom fishing with a small longline and the four reels.

The fishing gods saw fit to provide a day with clear skies, no wind, and a mirror-calm sea, and topped it off some very encouraging catches of both pelagic and demersal fish. Top honours for the day went to the crew of the *Tabwemasana*, with a catch of 274 kg of mixed *Etelis* species. However both *Cuso* and *Etelis* proved the newly deployed FADs to be productive, with good catches of yellowfin, skipjack, and mahimahi. The first day of fishing set the tone for the next three weeks, with all three boats working steadily and the trainees experiencing a range of fishing methods which included vertical and horizontal pelagic longline, demersal trotline (50–100 hook longlines) and handreels, and trolling. Catch highlights included a 2-hour early morning troll at the FAD for 475 kg of yellowfin and a 12 ft tiger shark caught on the pelagic longline.

The Fisheries Training Centre sells all catch from trainee fishing operations to the Santo Fish Market. Fish are delivered to the market after being gilled and gutted in the small processing room at the Centre. An abundance of ice from the four block-ice machines installed at the Centre ensures that fish is well chilled and the majority of the catch is air freighted to Vila for sale through the Natai fish market.

Although the practical module is primarily concerned with training in fishing methods and vessel operation, considerable emphasis was placed on vessel economics and data collection with trainees completing daily catch and economic analysis records. These records were analysed in group sessions at the end of each week to produce profit/loss statements for each vessel. This exercise benefited from some excellent catches and showed the profit potential for all three vessels. The combined catch for the course totalled 3,365 kg of gilled and gutted fish with a sale value of VT 620,000.

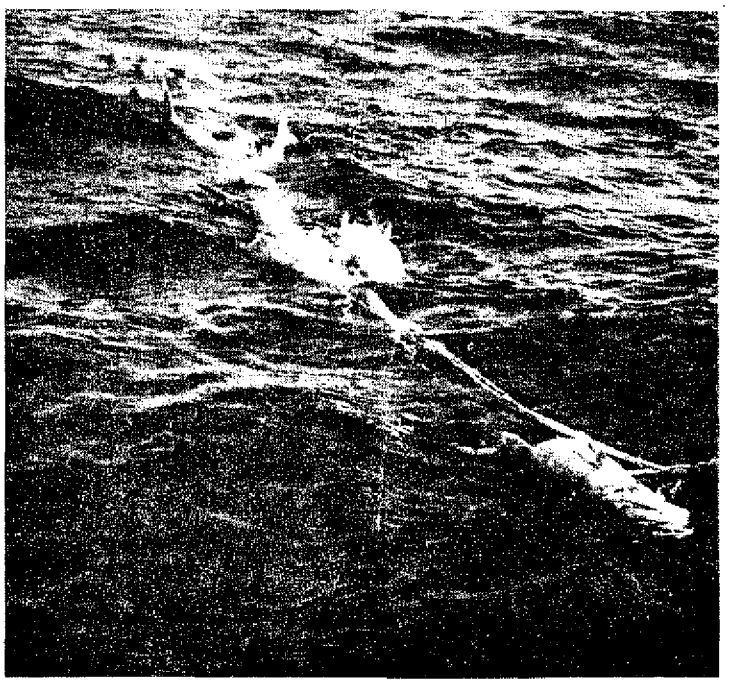


Photo: Hugh Walton

Success with the bottom longline

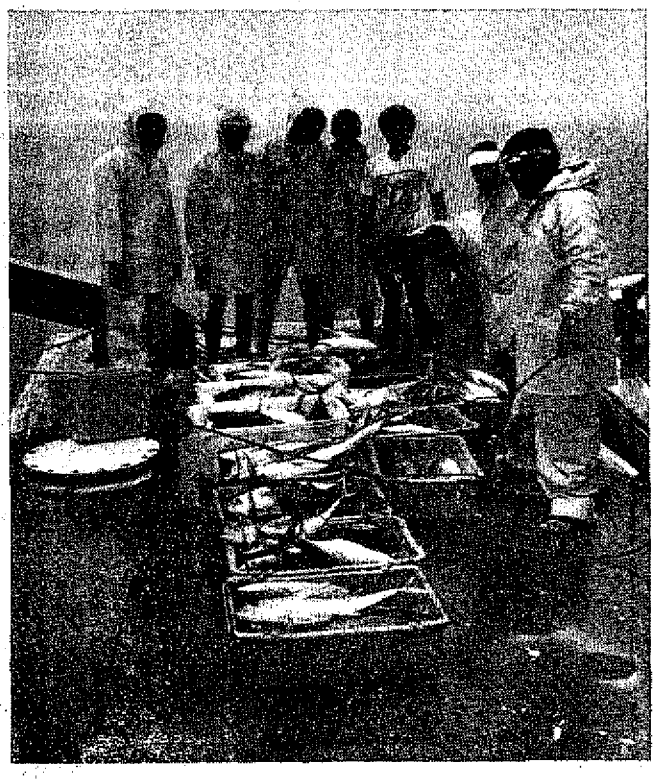


Photo: Hugh Walton

FADtastic... 475 kg from 2 hours of trolling aboard *Etelis*

The trainees responded very well to this exercise, showing considerable interest in the parameters of vessel economics and the collection of data for ascertaining profitability. There was general agreement that the use of a well presented logbook could be a big factor in encouraging fishermen to record catch and operational economics information. It was also acknowledged that such information could be of substantial benefit to fishermen and fisheries statisticians.

The Regional Fisheries Training Project is grateful to the Governments of New Zealand and Australia, the Commonwealth Secretariat, and the Commonwealth Foundation for the financial support of the annual Nelson Course and practical module and the success of the 1992 course.

The Government of Vanuatu has kindly offered to host a second practical module in 1993 and arrangements are already under way for this. Interested potential participants for the 1993 course should make enquiries through their respective Fisheries Divisions.

(Contributor: H. Walton)

Photo: Hugh Walton

1992 Nelson Course Trainees

Back row, left to right: **Glen Alo (Vanuatu), Donald David (Federated States of Micronesia), Allan Debao (Nauru), Terukuai Abee (Kiribati), Katieli Peleti (Tokelau), Maata Kimeri (Kiribati), Lorrie Suarkia (PNG), John Moore (Nelson Tutor), Paxton Wellington (SPC)**

Front row, left to right: **Charles Poithily (New Caledonia), Teremoara Patai (Cook Islands), Sio O'Fanoa (Tonga), Patterson Kame (Solomon Islands), William Aruhane (Solomon Islands)**

INSHORE FISHERIES RESEARCH PROJECT

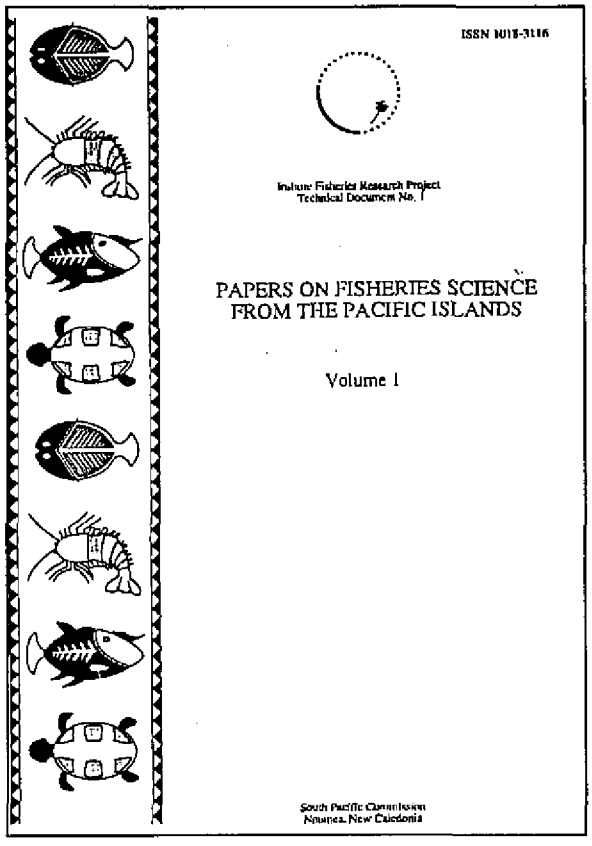
Two technical documents published

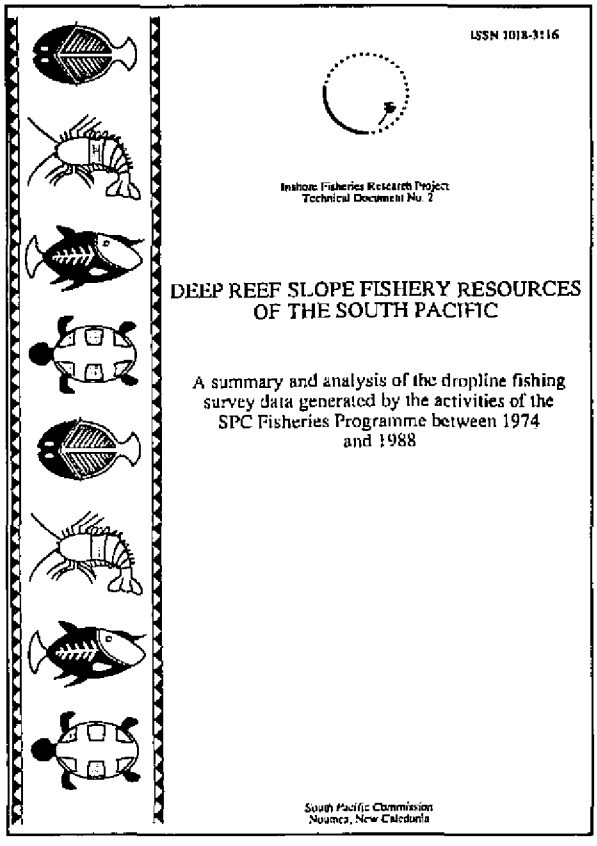
Two technical documents from the SPC Inshore Fisheries Research Project (IFRP) were published in July. The first of these (*Papers on Fisheries Science from the Pacific Islands*, vol. 1) is a selection from the papers presented at the 1988 Inshore Fisheries Research Workshop and is the inaugural volume of a new fisheries technical series designed to provide a publication platform for Pacific Island fisheries scientists. Topics in this first volume include market surveys of reef fish landings in Western Samoa, stock assessment of small pelagic fishes in Kiribati, growth and mortality of spiny lobsters in Tonga and cost-benefit analysis of fish aggregation devices (FADs) in the Cook Islands. Other papers deal with harvesting of corals in Fiji, biology of mullets in Tonga and exploitation of lethrinids or emperors in Fiji. The second volume of this series is already in preparation. It will include papers on deep slope fishing in American Samoa, economics of shellfish production in Vanuatu and growth and mortality of giant clams in Tonga.

The second publication produced by the IFRP is an analysis of all the catch-and-effort and species composition data on deep slope stocks in the South Pacific collected by the master-fishermen employed under the Outer Reef Artisanal Fisheries Project and the Deep Sea Fisheries Development Project between 1974 and 1988.

An initial version of this report was prepared for a USAID/NMFS workshop on stock assessment of deep slope fishes held in Honolulu during 1989. The initial analysis was expanded and includes estimates of standing stocks and potential yields for each of the countries in the South Pacific region. Summaries of the catch-and-effort and species composition data generated by different country visits were entered into a database which was then printed with a map giving details of the areas fished. A synopsis of the findings and yields for each country has been included with these database summaries to provide a reference for fisheries officers and other workers who need ready access to information on deep slope fishery resources.

(Contributor: P. Dalzell)





Coastal fisheries statistics

A technical session on fisheries statistics for coastal fisheries in the South Pacific took place during the Twenty-fourth Regional Technical Meeting on Fisheries. It was chaired by SPC Inshore Fisheries Scientist, Paul Dalzell, who emphasised the importance of reliable statistical data from coastal fisheries in the South Pacific region and the need to improve the quality of reporting of these statistics.

The various national fisheries statistics collection programmes in the region were reviewed. Commercial landings are fairly well covered in most countries (Table 1), but estimates of the subsistence production are usually extrapolated from nutritional data collected by health officers or from agricultural census data collected at infrequent intervals.

Collection of fisheries statistics appears to be difficult to establish and difficult to maintain. Some countries of the region had established coastal fisheries databases but these were discontinued after a few years of operation.

The SPC Nutritionist, Cecily Dignan, spoke on the relationships between fisheries statistical data and nutrition. During her presentation, Ms Dignan reviewed the areas where fisheries and nutritional workers could collaborate with mutual benefit. Information on subsistence catches is important to provide information on nutrition and food availability, whilst dietary data collected during nutrition surveys are useful for empirical estimates of subsistence production. Fisheries production tends not to be included in food and nutrition policy and planning in the Pacific, because of the poor reporting of statistical data on coastal fisheries production and the lack of fisheries representatives on national food and nutritional committees. Ms Dignan stressed the need for fisheries officers to be aware that, at the national level, fisheries statistical data are also useful for professions and organisations other than those in the fisheries sector.

Table 1. Summary of land area, population and nominal fisheries statistics for South Pacific states and territories

Country/ Territory	Land area (sq. km)	Population (no.)	Nominal fish landings (t)	Subsistence catch (t)	Commercial catch (t)
American Samoa	201	33,000	400	300	100
Cook Islands	240	17,200	1,100		
Fiji	18,274	715,375	21,500	15,000	6,500
French Polynesia	4,000	197,000	1,719		
Federated States of Micronesia	700	73,160	1,406	1,003	403
Guam	541	106,000	421	350	71
Kiribati	4,849	68,207	12,300		
Marshall Islands	701	73,160	200		
Nauru	21	8,900	190		
New Caledonia	18,734	164,173	5,160	2,000	3,160
Niue	2,459	2,200	60	48	12
Northern Mariana Islands	478	16,800	229		
Palau	488	16,000	1,050	900	150
Pitcairn	5	53	5	5	
Papua New Guinea	462,840	3,592,900	25,000	23,000	2,000
Solomon Islands	28,370	307,597	8,000	7,900	100
Tokelau	12	1,700	231		
Tonga	780	94,535	270		
Tuvalu	24	8,230	927		
Vanuatu	12,190	142,630	3,200	2,940	260
Wallis & Futuna	153	14,000	1,000		
Western Samoa	2,831	156,349	3,500		
Total	**558,891**	**5,809,169**	**87,868**	**53,446**	**12,756**

The Fisheries Education and Training Officer, Hugh Walton, then addressed the use of fisheries log books as statistical tools. He reviewed several types of log data sheets used by commercial fishermen and the data sheet used by SPC masterfishermen. He then showed some simple log sheets used successfully during the practical module of the SPC/Nelson Polytechnic training course in Vanuatu. It was suggested that such simple log sheets might be used by fishermen if they could perceive that they would benefit by keeping such records. The main incentive for the fisherman was that they provided a personal record of economic performance and would be useful for securing credit and bank loans. Such records would also be useful to fisheries officers collecting statistical data and would remove from them some of the onus of making direct records of catches. Training workshops could be held with fishermen to convince them of the utility of such records and to train them in filling in the data sheets.

Short accounts of fisheries statistical programmes were invited from Fiji and from the US National Marine Fisheries Service (NMFS), which directly assists fisheries statistical data collection in American Samoa, Guam and the Commonwealth of the Northern Marianas.

The Senior Inshore Fisheries Scientist, Dr Tim Adams, spoke on behalf of Fiji where until recently he was acting Director of Fisheries. He emphasised the importance to Fiji's Fisheries Division of the regular collection of fisheries statistics for dealing with issues relating to development, management and marine tenure. Mr Ray Clarke of NMFS discussed the collaborative arrangement by which fisheries statistics are collected in the American-affiliated territories of Guam, the Commonwealth of the Northern Mariana Islands and American Samoa. He described data collection methods and manpower requirements for data collection and reporting.

(Contributor: P. Dalzell)

Aitutaki trochus survey

Following on from the 1991 SPC Trochus Resource Assessment, Development and Management workshop in Vanuatu, and in line with a recommendation from the Twenty-third Regional Technical Meeting on Fisheries, the South Pacific Commission is presently assisting with a 'model' trochus stock assessment in Aitutaki in the Cook Islands.

With funding assistance from the Australian Centre for International Agricultural Research (ACIAR) and the FAO Regional Aquaculture Development Project, several participants from the 1991 workshop are working alongside Aitutaki Fisheries Officers with the technical advice of Warwick Nash of the Tasmanian Sea Fisheries Division and SPC Senior Inshore Fisheries Scientist Tim Adams.

The idea of the survey is to take advantage of the tightly controlled Aitutaki trochus harvest to compare the relative merits of three different stock assessment methods and to learn more about the population structure and stock dynamics of *Trochus niloticus*. The results will provide useful information to all the trochus fisheries of the region.

Trochus was introduced to Aitutaki from Fiji in 1956–1957 and was abundant by the late 1960s. The first harvest was authorised in 1980 and harvesting has taken place on an annual or a biennial basis since then. Harvests are organised cooperatively over the whole island and continue until the quota (set after a survey by Fisheries staff) is filled, usually after around five days.

At the time of writing, the 1992 harvest is still under way. The team spent two weeks on a pre-harvest survey, is presently censusing the harvest and plans to undertake a one-week post-harvest survey. The stock assessment methods being compared are strip-transects, mark-recapture and change-in-ratio methods. These will be described more fully, along with results, in a later issue of this newsletter.

Whatever the results, they will be extremely interesting to all Pacific Island fisheries scientists who are charged with assessing stocks of invertebrates. The team has over 11,000 length-frequency measurements and marked around 5,000 shells in the size-range 8–11 cm. During the harvest, they have taken another 5,000 length-frequency measurements and monitored around 34,000 harvested shells for the marks placed on the shells during the pre-harvest survey.

(Contributor: T. Adams)

DEEP SEA FISHERIES DEVELOPMENT PROJECT

Regional trials with a new FAD raft type

During a workshop on fish aggregation devices (FADs) held in conjunction with SPC's Twenty-second Regional Technical Meeting on Fisheries in 1990, a member of the French delegation gave an account of an innovative FAD raft type in use in the Indian Ocean. This raft, first deployed in Mauritius and later in the Comores and Reunion, is made up of a string of pressure-resistant floats which, it was suggested, may submerge without damage under the effect of strong current or storm conditions and thus avoid much of the stress that the traditional solid floating FAD structure undergoes. Given the reported long survival times for FADs rigged in this way, workshop participants expressed interest in exploring their potential value in the Pacific.

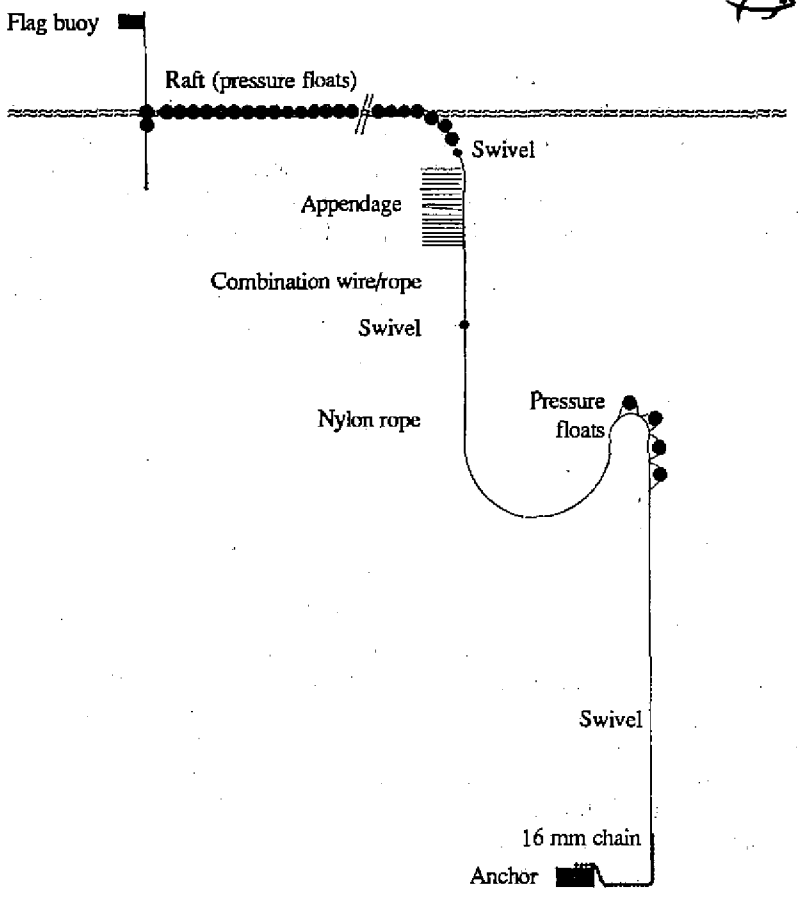
Initial examination by SPC's Deep Sea Fisheries Development Project (DSFDP) staff and others of the technical data on the use of this raft type suggested that by adding a catenary curve mooring system, which was not done in the Indian Ocean, a FAD with important advantages over the usual type might be developed.

Since that time a number of such rafts have been deployed by Pacific Island countries, some with the technical assistance of SPC's DSFDP and one by New Caledonia's territorial fisheries authority, the *Service des affaires maritimes et de la marine marchande*. A report on these deployments was given during the Twenty-fourth Regional Technical Meeting on Fisheries held recently in Noumea.

Each of the FADs deployed has incorporated a string of 30–50 Japanese-made plastic floats rated to withstand submersion to 300 m. The floats have been strung on a variety of materials including nylon rope, combination wire rope and stainless steel cable, in each case with a sheathing of plastic pipe to prevent chafe. Sections cut from discarded automobile tyres or rubber conveyor belting have been used as spacers between individual floats for the same reason. Cost of the new rafts has averaged around US$ 1,500.

As of August, three of these FADs had been deployed in the region, two in Vanuatu and one New Caledonia. As the oldest of these has been in the water for only four months it is too early yet to assess the long-term life and effectiveness of the new raft type, but they have aggregated fish very successfully. The new rafts will be closely monitored and it is expected that several other countries will soon begin their own trials with this innovation. Information on the sources of supply for pressure-floats and details of rigging methods can be obtained from SPC's Fisheries Development Officer.

(Contributor: P. Cusack)



An Indian Ocean-style FAD raft deployed by the DSFDP in Vanuatu. The mooring was made up only of nylon rope and therefore required the attachment of extra pressure-resistant floats to the mooring line to lift the lower hardware clear of the bottom.

FISHERIES INFORMATION PROJECT

Special Interest Group Information Bulletins

As part of the Beche-de-mer Special Interest Group (SIG) activities, the Fisheries Information Project has just released the fourth issue of the *Beche-de-mer Information Bulletin*.

Since the last issue of the *Bulletin*, many new members have joined the SIG. It is hoped that the new members will contribute to the content of future issues by keeping the Group informed of the evolution of fishing and marketing activities in their countries and new developments in research.

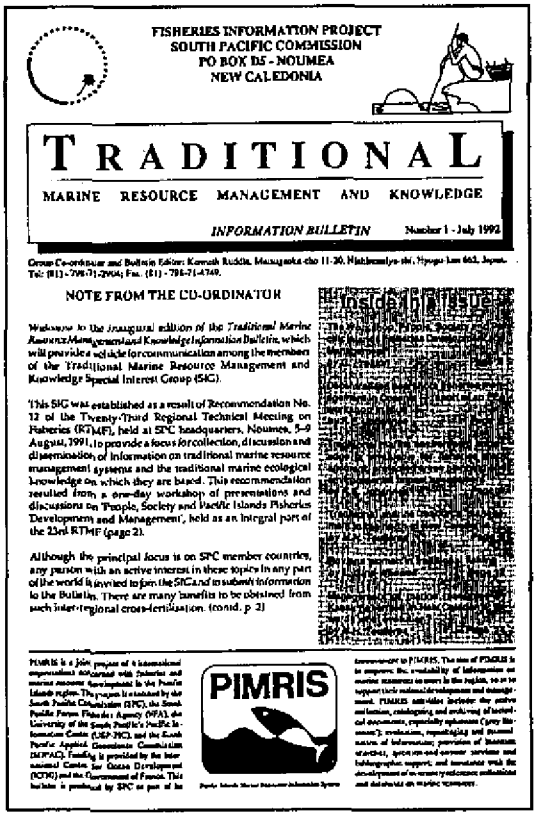
The latest issue includes information on beche-de-mer production in Indonesia and a summary of a Japanese handbook on *Stichopus japonicus*. The first results of an internal tag retention experiment on beche-de-mer in Papua New Guinea are also presented.

The Fisheries Information Project has also just released the second issue of the *Ciguatera Information Bulletin*. This issue includes articles on ciguatera research at the Queensland University of Technology, ciguatera fish poisoning and reef disturbance in South Tarawa, Kiribati and the treatment of ciguatera by using mannitol. A brief report on the Fourth International Conference on ciguatera fish poisoning is also presented.

Two new SIGs were established as a result of a recommendation by the Twenty-third Regional Technical Meeting on Fisheries, held in Noumea from 5 to 9 August 1991. One SIG concerns trochus, and the other, Traditional Marine Resource Management and Knowledge.

The two first issues of the corresponding *Information Bulletins* have now been published (see front pages below).

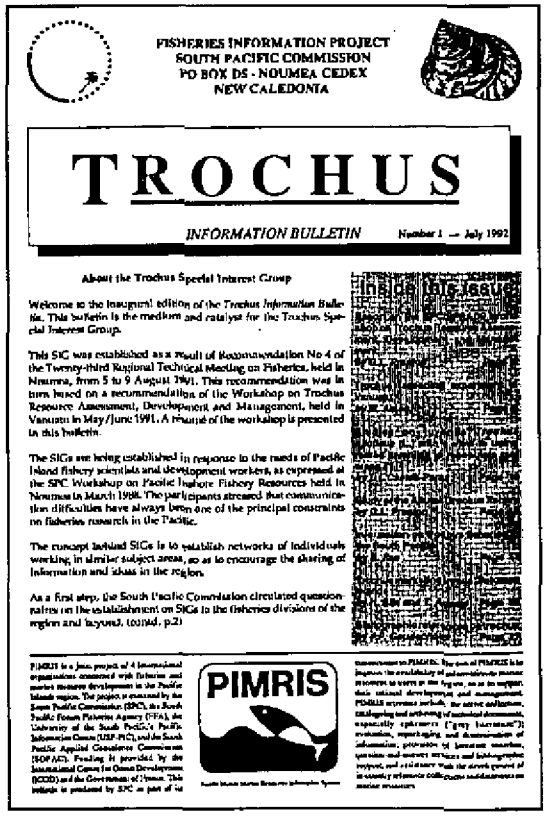
The *Trochus Information Bulletin* includes information on a trochus reseeding experiment in Vanuatu, a study of the Aitutaki trochus fishery, and a report on the SPC/SPRADP Workshop on Trochus Resource Assessment, Development and Management. A paper on trochus fisheries in the South Pacific is also presented and give a good overview of catch statistics for this fishery.


FISHERIES INFORMATION PROJECT
SOUTH PACIFIC COMMISSION
PO BOX D5 - NOUMEA
NEW CALEDONIA

TRADITIONAL
MARINE RESOURCE MANAGEMENT AND KNOWLEDGE
INFORMATION BULLETIN Number 1 - July 1992

NOTE FROM THE CO-ORDINATOR

PIMRIS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NEW CALEDONIA

TROCHUS
INFORMATION BULLETIN Number 1 — July 1992

About the Trochus Special Interest Group

PIMRIS

The *Traditional Marine Resource Management and Knowledge Information Bulletin* includes an article on traditional management of marine resources in the north of New Caledonia and an article on Roviana (Solomon Islands) women in traditional fishing. Two workshop reports are also presented:

— the 'People, society and Pacific Island fisheries development and management' workshop, held during the Twenty-third Regional Technical Meeting on Fisheries, Noumea, New Caledonia August 1991;

— the 'Decentralised nearshore fisheries management in Oceania' workshop, held during the Sixth Technical Sub-Committee of the Forum Fisheries Committee, Niue, April 1992.

There has been an increase in awareness and demand for SPC's information services in the fisheries sector during 1992. The Fisheries Information Project will continue its present activity and will make efforts to gradually increase the number of SIGs. The establishment of two more SIGs, on fisheries education and training, and fish aggregation devices, is planned.

(Contributor: J.P. Gaudechoux)

MARINE RESOURCES BIBLIOGRAPHIES OF THE FEDERATED STATES OF MICRONESIA AND THE MARSHALL ISLANDS

SPC published two marine resources bibliographies in June as a result of a bibliographic survey in Micronesia (SPC *Fisheries Newsletter* #59).

During the survey of both published and unpublished material in Honolulu, Majuro, Pohnpei, Guam, Yap, Tokyo and Suva from 29 September to 13 November 1991, the author (Masanami Izumi) received great assistance from many people in government and fisheries-related offices, institutions, international organisations and libraries.

Marine resources bibliography of the Federated States of Micronesia

Special attention was paid to research and experimental reports written in Japanese by research scientists of the Palao Tropical Biological Station and the Japanese Government

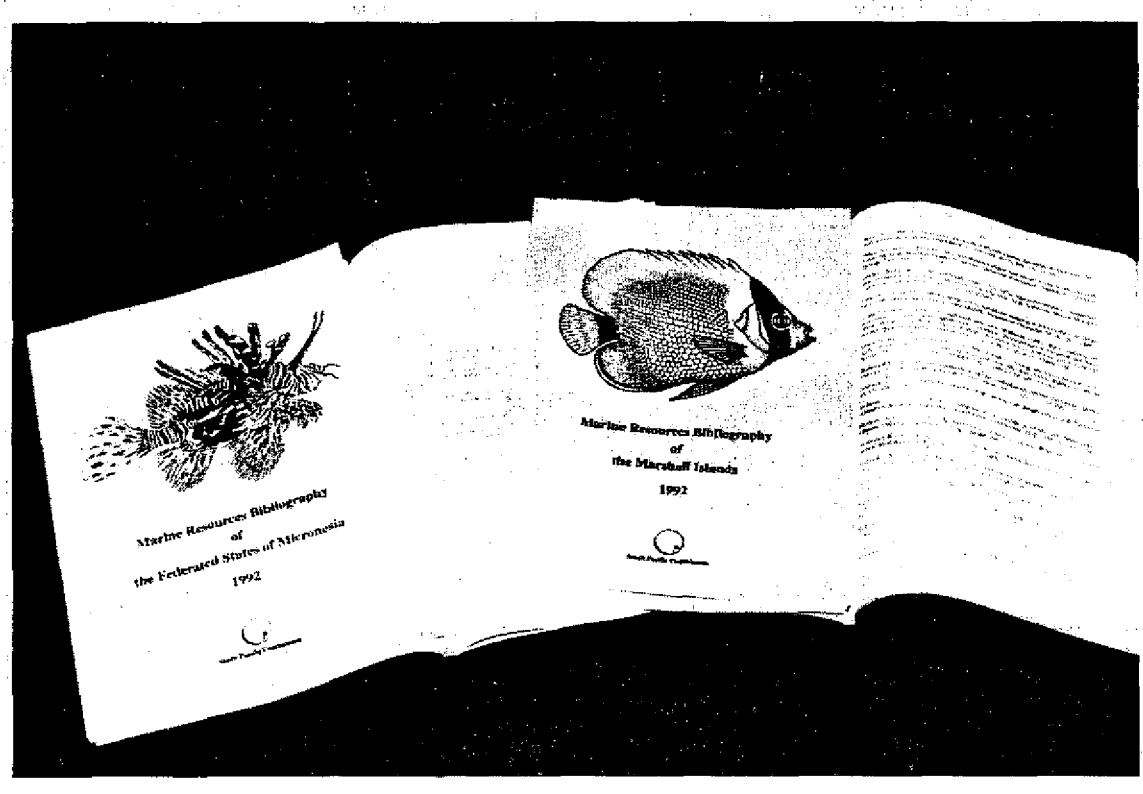


Photo: Martial Dosdane

South Seas Bureau's Fisheries Experiment Station in the 1930s during the Japanese-mandated era. The bibliography contains 167 pages and 1,283 references.

Marine resources bibliography of the Marshall Islands

Special attention was paid to research and experimental reports on marine resources and environment in Eniwetok and Bikini Atolls, Marshall Islands. The bibliography contains 119 pages and 786 references.

The information gathered was entered into a Pro-Cite library database. The publications were distributed to the region in July 1992. The author hopes that the publications will be useful to fisheries officers, research scientists, government policy makers, development consultants and fishermen who are involved in fisheries development activities in Micronesia and other areas. He is indebted to the authors listed in the above bibliographies for their tremendous research work.

In 1988, Mr Izumi published a *Marine resources bibliography of Palau* (243 pages) for the FAO/UNDP Regional Fishery Support Programme in Suva, Fiji. Izumi and his team are planning to compile a similar marine resources bibliography for Guam, in co-operation with the Government, later this year.

(Contributor: M. Izumi)

DEEP BOTTOM FISHING GOES RURAL

SPC is currently involved with the Government of Kiribati in a joint Integrated Rural Development Project on the peninsula of North Tarawa.

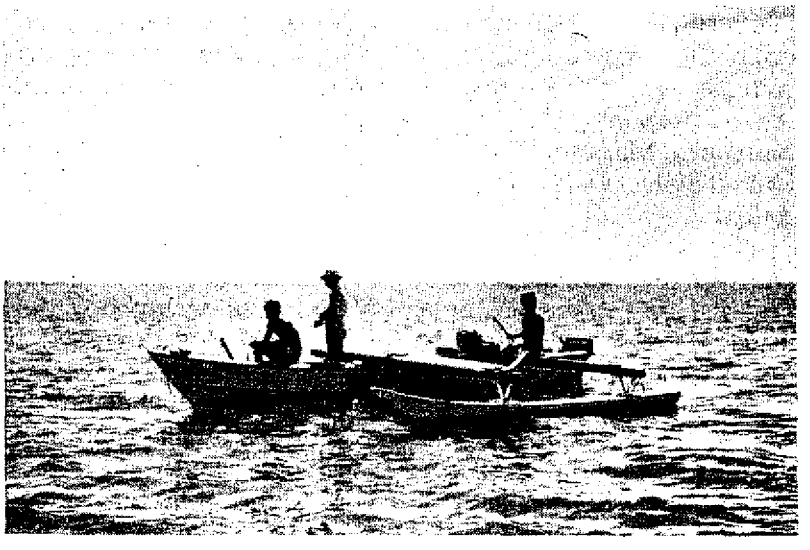
In accordance with a Memorandum of Understanding governing the delivery of services by SPC, the Government of Kiribati and the North Tarawa people, the main emphasis of the project is to assist the people to control more of their development horizon. In the theoretical realms of rural development, concern with the promotion of human dignity has now emerged as a key criterion of development, outdating the strategies of the seventies which aimed for increases in gross national product. 'Working with the people' as opposed to 'working for them' has become a hallmark of the new wave of development effort that is gradually gaining recognition and momentum in the Pacific region.

The sea is not only the largest resource of atoll-dwellers, but the basis of their livelihood. The people of North Tarawa identified the major constraints restricting their development in this sphere as lack of deep bottom fishing skills and the need for more awareness of market opportunities.

As a result, the Department of Fisheries and the SPC Fisheries Programme have developed with the people a series of training programmes to assist them in tapping their marine resources. In addition, market studies investigating the viability of establishing formal market outlets with urban Tarawa will also be commissioned.

In June this year the Kiribati Fisheries Division conducted a two-week training session in deep bottom fishing on North Tarawa. The North Tarawa Council used the following criteria to select the trainees:

— their boats must be engaged in fishing activities 75 per cent of the time;



Fishermen on the lagoon side of Abaoroko, North Tarawa

— the owner must have the ability to pay for any fishing gear issued during the training that he wishes to keep; and

— the boats must be seaworthy and mechanically operational.

The training comprised onshore sessions and practical training at sea, with three officers from the Fisheries Division presenting lectures and taking groups of fishermen out to sea.

At sea the trainees were shown how to determine anchoring and fishing depths, use hand-reels, anchor and retrieve the anchor.

Most importantly of all they were instructed in the finer details of using hand reels and techniques and tricks for untangling lines during fishing expeditions. During the practical sessions, a total catch of 190.9 kg of deep bottom fish was landed. Naturally the owners of the canoes took home what they caught.

The fishermen who participated thoroughly enjoyed the sessions and came away from the training with added skills to assist them in their daily efforts to provide food for their families.

(Contributor: V. Wichman, Economist)

TUNA AND BILLFISH ASSESSMENT PROGRAMME

Fifth meeting of the Standing Committee on Tuna and Billfish

The fifth meeting of the Standing Committee on Tuna and Billfish was held in Honolulu, Hawaii, from 18 to 19 June 1992. Participants included fisheries scientists from American Samoa, Australia, Federated States of Micronesia, Fiji, French Polynesia, Indonesia, Japan, Marshall Islands, New Zealand, Palau, Philippines, Solomon Islands, Taiwan and the United States. The South Pacific Commission, the South Pacific Forum Fisheries Agency and the Western Pacific Regional Fisheries Management Council (whose members include American Samoa, Guam, the Northern Marianas and the United States) were also represented.

During a review of the status of tuna fisheries in the SPC area, it was noted that during 1991 tuna catches in the region exceeded one million tonnes for the first time. The total catch of the four main commercial species (albacore, bigeye, skipjack and yellowfin) in 1991 in the Western Pacific (including the domestic fisheries of the Philippines and eastern Indonesia) was approximately 1.4 million tonnes. Trends in nominal CPUE, while open to further investigation, did not indicate any immediate cause for alarm. Decreases in yellowfin CPUE in the Japanese longline and pole-and-line fisheries in 1990 had not been sustained. A small amount of logbook data held at SPC indicated that Taiwanese longline CPUE for albacore increased during 1990. The economic outlook is for declining profitability, due to increased catches, continuing over-supply, increasing costs of production and increased output from Asian canneries.

During consideration of the work programme of SPC's Tuna and Billfish Assessment Programme (TBAP), the quality of purse seine logbook data held at SPC was discussed. In an attempt to examine quantitatively the levels of non-reporting and under-reporting by the major distant-water fleets, it was found that for Korean purse-seiners, greater non-reporting of catches than that which could be expected due to high seas activities (which are not required to be reported under most access agreements) was occurring. Significant under-reporting was found to occur for most Taiwanese purse seiners and some Korean purse seiners.

The results of preliminary skipjack and yellowfin assessments conducted by SPC, based on tagging data, were presented. It was found that fishing mortality in both species was currently relatively low, approximately 15 per cent of the total mortality rate. This implied some capacity for the stocks to accommodate increased catches. It was estimated that a doubling of the catches of both species would reduce equilibrium stock sizes by only 11—20 per cent for skipjack and 5—24 per cent for yellowfin. It was noted that there is still no compelling evidence to indicate any significant interaction between the surface fishery and the longline fishery for yellowfin tuna, and that this is consistent with the low fishing mortality rate estimated for yellowfin in the preliminary assessment.

The results of other ongoing research projects conducted by SPC were also presented, including the development of indices of yellowfin abundance from purse seine catch rates, a study of purse seine and longline by-catch, and an attempt to quantify the effect of fish aggregation devices (FADs) on tuna movements, which was part of a study on interactions between pole-and-line and purse seine fisheries in Solomon Islands, based on tagging data.

An overview of the proposed work plan of the TBAP for 1992/93 was presented, including projects covering statistics and monitoring, biological research, assessment and modelling, reporting and liaison, and albacore research. The meeting recognised the importance of the TBAP's statistics and monitoring activities. Noting that funding commitments are currently made on an annual basis, it recommended that efforts be made to secure commitments on a longer-term basis for this high priority activity.

Reports were presented by representatives of the Western Pacific Regional Fisheries Management Council, the University of Hawaii and the Australian Institute of Marine Science. The meeting was advised that the Fifth South-East Asian Tuna Conference will be held by the Indo-Pacific Tuna Programme from 1 to 4 September 1992 in General Santos City, Philippines.

(Contributor: TBAP staff)

Second meeting of the Western Pacific Yellowfin Research Group

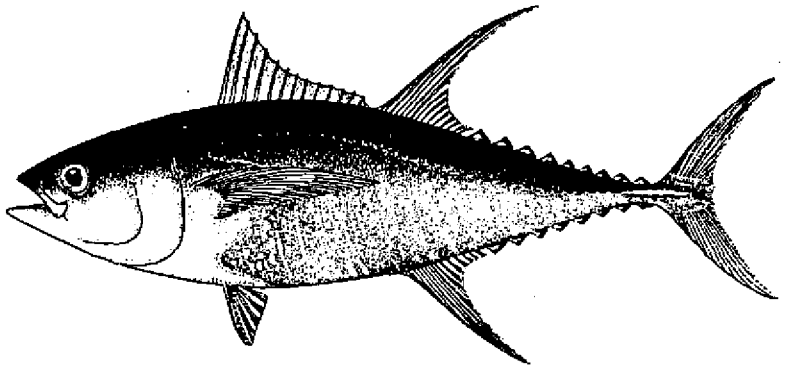
The second meeting of the Western Pacific Yellowfin Research (WPYR) group was held immediately following the fifth meeting of the Standing Committee on Tuna and Billfish, from 20 to 24 June 1992. The participants who attended the meeting of the Standing Committee also attended the WPYR meeting.

At its first meeting held in Port Vila in June 1991, the group identified the main research questions that should be addressed. The second meeting was organised with the intention of developing a comprehensive database for conducting stock assessment. Several months prior to the workshop, data correspondents provided catch, effort and length-frequency data that could be used to construct a time series of yellowfin tuna catches by size for 1970—1990. The data correspondents represented most nations with major yellowfin tuna fisheries in the Western Pacific, including Australia, Fiji, Indonesia, Japan, New Caledonia, New Zealand, the Philippines, the Republic of China, the Republic of Korea and the United States of America. Data were provided by the South Pacific Commission on behalf of Palau, Papua New Guinea, Solomon Islands and Tonga.

A catch-by-size database was constructed during the meeting. Extensive substitutions to raise the length-frequency data to represent the total catch were required for all gear types. Because of this, the meeting agreed that the catch-by-size database would not be appropriate for conducting virtual population analyses. Nevertheless, the attempt to construct the database was considered a useful exercise to identify the availability of data and their limitations.

The meeting reviewed several areas of yellowfin research, including the use of purse seine and longline CPUE to construct indices of abundance, stock structure, age and growth, reproductive biology and mortality rates.

(Contributor: TBAP staff)



CORAL BLEACHING

In a previous issue of the *SPC Fisheries Newsletter*, we reported concern about coral bleaching in French Polynesia (*Fisheries Newsletter* no. 58).

An article by Francis Rougerie in issue no. 35 of *ORSTOM Actualités* reviews the latest research work on this kind of reef damage.

This occurrence was first observed in March 1991 by ORSTOM diver/oceanographers, who found areas of coral bleaching. A sudden and unexpected malfunction of the coral ecosystem would appear to be the cause of this natural disaster, which is likely to affect all South Pacific atolls.

According to ORSTOM's scientists, bleaching is due to a large-scale discharge of the micro-algae (Zooxanthellae) which live within the tissues of coral polyps at a density of 1 to 10 million per cm^2.

These symbiotic Zooxanthellae (two living organisms are called symbiotic when they form a lasting and mutually profitable association) are fundamental to the primary production of coral reefs and their slow and regular release by healthy coral may be considered as the start of the reef food chain, from the small zoo-planktonic organisms which eat them to the largest fish.

A survey carried out in May 1991 revealed that all the barrier reefs of the Society Islands were affected by bleaching, as were all the nearby atolls. Bleaching and fluorescent colouring first appeared on the top of the reef to ocean side and then gained in depth (to 40 m) and encroached inwards into the lagoons and on to their coral outcrops.

These coral colonies had therefore suffered stress, which had caused significant coral mortality. Ninety per cent of *Acropora* colonies were affected by this damage and 50 per cent had died, covered in stringy algae. An August 1991 estimate put overall mortality at 10–15 per cent for coral colonies in the 0–12 m depth band.

The rapid and simultaneous appearance of bleaching on 500 km of barrier reef would imply that this is a regional rather than a local event, which may be attributable to a change in the state of the ocean.

ORSTOM has been regularly monitoring ocean temperature and salinity since 1978 and initial analysis of these data has yielded a first possible cause, an abnormal 1 to 1.5°C increase in ocean temperature from January 1991.

Another important factor was whether or not this event had occurred in previous years in French Polynesia or other tropical areas sustaining coral reefs. It would appear to be a recent phenomenon: the first cases of coral bleaching in the Caribbean date back only to 1975 and coincided with abnormally high ocean temperatures (29° C and over).

These warm-water phases derive from a global-scale hydro-climatic anomaly known as ENSO (El Nino Southern Oscillation), when the emergence of the warm El Nino current along the Peruvian and Chilean coasts is associated with a barometric pressure field abnormality between French Polynesia and Indonesia.

It would, however, appear that one or more other factors need to be associated with the unusually warm water in order to explain the current event. Of these probable factors, ultraviolet radiation heads the list.

The ozone shield which protects the earth from the sun's rays is diminishing because of the freon gas molecules released by domestic aerosols. Assessments published in *Nature*, the science magazine, show that the proportion of UV radiation getting through to the earth's surface and the ocean may well have increased by 8–10 per cent.

ORSTOM's scientists have developed a new approach to try and test the cause-and-effect relationship between ocean temperature anomalies and bleaching. This method is based on the notion of geothermal endo-upwelling. The reef's internal heat convection results from the temperature difference between the water lying in the gaps, cracks and cavities of a porous environment, the coral limestone in this case, and the ocean water.

This temperature and therefore density difference gives the water lying in reef interstices positive buoyancy, which has a tendency to cancel itself out if the ocean temperature gets close to the trapped water temperature.

When this happens, the endo-upwelling declines, the nutrient supply falls away and the under-nourished micro-algae are

condemned to die and be expelled by the coral which is 'under stress'.

This approach however needs to be tested; core samples from the barrier reef should provide further information in the near future and possibly yield better knowledge of the functioning of the reef.

(Source: *ORSTOM Actualités*)

INTERNATIONAL SYMPOSIUM ON SEA SAFETY

The Second International Symposium on Safety and Working Conditions Aboard Fishing Vessels will be held from 15 to 17 September 1992 in the Centro de Formacion Occupational Maritima de Bamio (Villagarcia de Arosa, Gallicia, Spain).

This symposium will be jointly organised by the Commission of the European Communities, El Instituto Social de la Marina (ISM, Spain), the Université de Bretagne Occidentale (Sea fishing safety and working conditions laboratory, University Technology Institute, Lorient, France) and the University of Quebec (Technomar, Rimouski, Canada).

The preliminary programme schedules four themes.

Theme 1: Analysis of occupational accidents on fishing vessels

Topics of working papers to be presented will include:

— On the frequency response function of human dynamic responses to the motions of fishing vessel;

— Musculo-skeletal load due to ship motions of fishing vessels, in combination with work on board;

— Safe design construction and operation of small fishing vessels;

— Risk during abandoning a ship in distress;

— Safety deficiency analysis approach to fishing vessel safety.

Theme 2: New technologies, technology transfer and improvements to safety and working conditions

Working papers will include:

— Stability determination of fishing vessels rolling in real seas;

— Integrated quality to improve the onboard safety, fresh fish handling in marine environment;

— Noise reduction aboard fishing vessels — How far do we reach with existing technology;

— Contribution of the technology to the working safety on board fishing vessels.

Theme 3: Fishing policies and payment systems: effects on fisherman's safety and working conditions

Theme 4: Training schemes and awareness training for fishermen

During the two last sessions, the working papers which will be presented are only available in French and/or in Spanish.

(Source: European Community)

AUSTRALIAN MARKETING EXPERT INTRODUCES SEAFOOD MARKETS IN JAPAN

Dr Steve Williams, Deputy Director (Research), Australian International Business Centre, University of Queensland, reported on 'Understanding Japanese seafood markets' in the February, March and April 1992 issues of *Australian Fisheries*.

The first article published, subtitled 'History and tradition', deals with History and tradition, Regional preferences and consumption, and Change and implications for exporters.

The topics of the second article, subtitled: 'Structure and function', are: Approach, Functions of central wholesale markets, Market differences, Changes in the markets, Distribution pathways for seafood, Other changes in distribution, Current problems and development, and Future trends.

Part 3, 'Recent changes in seafood consumption and purchasing behaviour', covers Health, Convenience, Lifestyle, Environment, Novelty, Changes in consumption, Changes in seafood purchasing, Some implications for exporters, and Current market position.

The lives of the Japanese and their ichthyophagous culture are indissolubly connected with

each other. Through his attention to the traditional point of view, Dr Williams became attuned to the living customs of the Japanese, and produced a refreshingly different type of article introducing his thoughts on seafood markets in Japan.

During his research in Japan, he was at the Tokyo (Tsukiji) Fish Market daily from midnight to dawn to observe market workers, fish arriving, auctions, etc. He vigorously carried out surveys and collection of information from people at the market and in the fishing industry. The articles, intelligently arranged, will be of value to many readers interested in seafood marketing.

Although the articles are aimed at Australian fishermen, it is recommended that people in the South Pacific region concerned with fisheries read them. Let's get in touch with the ichthyophagous culture of Japan!

In addition, Williams' other publications, listed below, provide useful references.

Williams, S. C. (1986). *Marketing tuna in Japan*. Queensland Fishing Industry Training Council Inc., Brisbane.

Williams, S. C. (1988). *Marketing chilled fish in Japan*. Queensland Department of Primary Industries Information Series, Brisbane.

Williams, S. C. (1990). *Towards market research in fisheries management*. Discussion Paper Series, Australian International Business Centre, University of Queensland.

Williams, S. C. (1991). *Recent changes in Japanese markets for Australian shrimp: implications for exporters*. Discussion Paper Series. Australian International Centre, University of Queensland.

Williams, S.C. (1991). *Prospects for promotion of wild shrimp in Japan: implications for Australian exporters*. Management Paper, Graduate School of Management, University of Queensland, no. 4.

(Source: *Australian Fisheries*/ M. Izumi)

Photo: Martial Dosdane

SUCCESSFUL BOAT LANDING PROJECT FOR AVATELE VILLAGE, NIUE

The potential for fisheries development on Niue is constrained by the island's rugged geophysical coastline, with craggy coral outcrops and steep cliffs limiting access to the sea. Consequently, generations of Niuean fishermen have made their way to the sea by climbing up and down inhospitable sea tracks with wooden canoes slung over their shoulder. With the advent of aluminium dinghies on the island in the 1970s, improvements in sea access were necessary since dinghy launching facilities were limited to only one derrick at Alofi wharf and a rocky beach at the village of Avatele.

The Niue Government recognised that improved sea access around the island would have direct benefits for the island's fishermen and for the development of its fisheries. One of the few areas having potential for sea access improvement was Avatele.

The coastal features of Avatele comprise a sea track, a rocky beach and a basin bounded by a fringing reef with a narrow channel entrance leading to the sea. Since the 1970s, the beach had been used as a launching site for aluminium dinghies, but dinghy hulls became damaged after repeated dragging over the rough stones. These combined factors presented the opportunity for a fisheries development project to enhance the natural reef features of Avatele beach for boat launching and landing. This opportunity was jointly recognised by the Niue Government and Godfred Shuma, Port Harbour Engineer with a UNDP/ESCAP project on Regional Co-operation in Shipping, Ports and Inland Waterways.

A UNDP/ESCAP project for the Avatele Boat Landing Facility was conceived with the engineering expertise of Mr Shuma. The project, which was implemented by the Niue Department of Public Works, was to:

— construct a 45 m by 6 m concrete boat ramp beside the beach, with a sloping, flood-lit, tar-sealed road to the village;

— blast and widen the reef channel entrance;

— cast *in situ* multiple breakwater blocks to provide wave protection near the ramp;

— construct a gabion box retaining wall along the sea track;

— beautify and landscape the beach with makatea sand;

— protect the foreshore with coral rocks;

— construct public toilets and showers; and

— provide car parking and boat storage areas.

Reef blasting expert Peter Asher collaborated in the project and provided practical training to local personnel in underwater drilling, blasting and dredging. This training has assisted Niue in the subsequent development of a similar sea track and boat landing facility at Namukulu village.

The Avatele boat landing project was well designed and well executed, with work beginning in February 1985 and finishing in November 1985. The successful completion of the project has been attributed to good co-operation and communication amongst Mr Shuma, Mr Asher, the Niue Government and local labourers. Furthermore, the active participation by the people of Avatele during working bees led to the accelerated completion of the access track.

The boat landing is presently fully utilised by canoes, aluminium dinghies and occasionally by the Fisheries Division Alia catamaran for servicing its fish aggregation devices. The number of aluminium dinghies in Avatele which regularly use the landing has increased from 6 to 14 since project completion, while the number of canoes based at the landing has increased from 9 to 20. Since the boat landing has also increased the potential number of fishing days from Avatele, the project has increased the availability of fish in the village community. The ramp has become a popular picnic and swimming area for Niueans and tourists, providing such recreational facilities as a sandy beach and an extended swimming area.

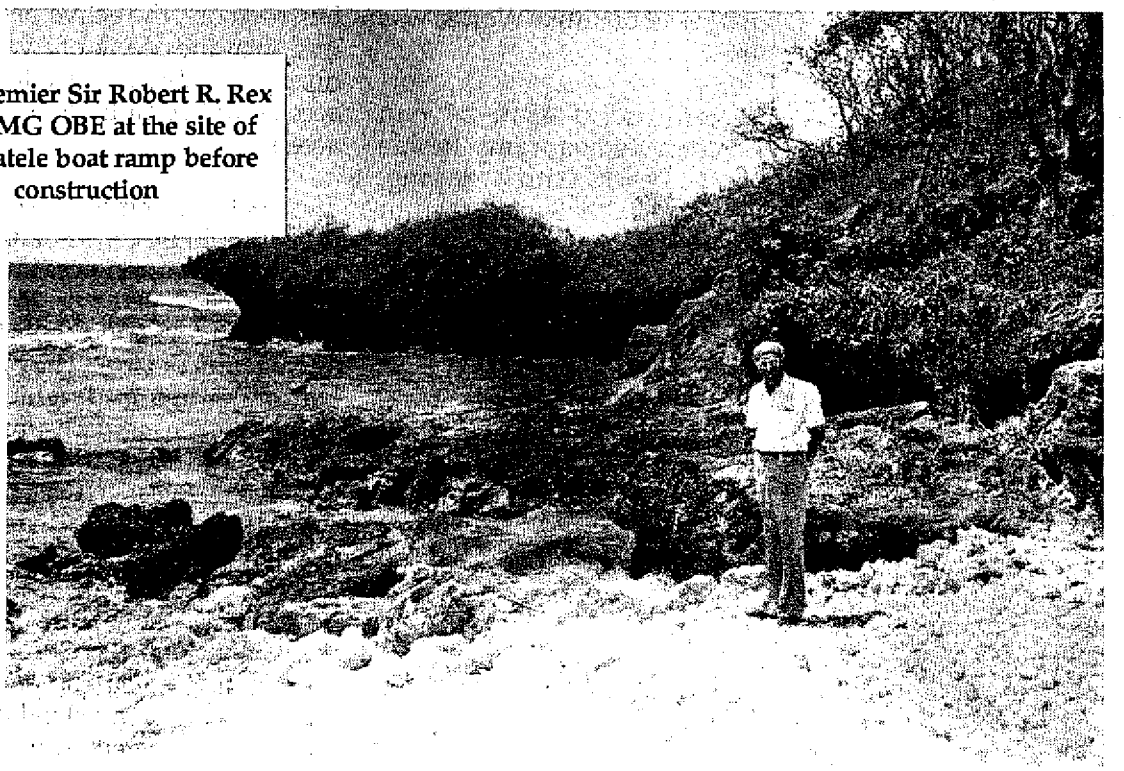
Since the completion of the boat landing in 1985, the tar-sealed road has suffered wave damage by Cyclone Ofa in 1990, but the concrete ramp was left intact. During 1992, the Niue Government plans to extend the concrete ramp landward by an additional 40 m to reduce the likelihood of further damage to the access road.

To ensure the ongoing care and maintenance of the boat landing, the Niue Government has entered into a formal Memorandum of Understanding with the Avatele Village Council.

This defines obligations of the pertinent parties and confers responsibility for care and maintenance of the landing on the Village Council.

The UNDP/ESCAP Avatele Boat Landing Facility is recognised as a useful fisheries development project because it involved the village community during project implementation, it conferred responsibility for the landing on the Village Council and it continues to provide community benefits.

(Source: S. Coffen-Smout, Fisheries Development Officer, Niue)



Niue Premier Sir Robert R. Rex KBE CMG OBE at the site of the Avatele boat ramp before construction

Photo: Scott Coffen-Smout

Avatele channel and basin on the left, with breakwater blocks, access ramp and sea track after project completion

Photo: Scott Coffen-Smout

ACIAR/CSIRO TUNA BAITFISH RESEARCH PROJECT

The ACIAR/CSIRO Tuna Baitfish Research Project (BRP) began in November 1986. It involved collaboration between CSIRO Division of Fisheries in Cleveland and the Fisheries Divisions in Solomon Islands and Maldives with funding from the Australian Centre for International Agricultural Research (ACIAR). The work was extended to include Kiribati during 1988. A new project was started in 1990 that continued the work in Kiribati and Solomon Islands and involved Fiji for the first time.

The first project addressed problems of trophic interactions between the baitfishery and the subsistence reef fish fishery. It also undertook detailed analyses of baitfish fisheries biology and ecology in each country to enable the participating countries to develop appropriate management strategies. The results of these studies were presented at a workshop sponsored by ACIAR on tuna baitfish and held in Honiara, Solomon Islands in December 1989. The proceedings of the workshop were published as ACIAR Proceedings No. 30.

Field research on baitfish in Kiribati finished in February 1991. It geared towards attempting to assess the potential yield of the baitfishery and to understand the factors that contributed to the wide fluctuations in baitfish abundance. These results will be published soon as ACIAR working paper No. 36. Project scientist Mr Nick Rawlinson also made observations on the commercial pole-and-line tuna fishery during his time in Kiribati. His suggestions on technical improvements to the fishery have been included in the report. It is hoped that they will improve the viability of the industry.

More recently, most project activities have been directed towards Fiji, where the question of possible trophic interactions between the baitfishery and subsistence reef fish fisherles is also a problem. This was one of the main topics covered in the recent annual co-ordination meeting of project staff held in Suva on 16—17 June 1992. At the meeting, Fiji staff explained the system of custom reef ownership and how bait-fishing by commercial pole-and-line vessels was perceived to have a negative impact on reef fish resources. Custom reef owners are demanding compensation for the baitfish taken and the Fiji government is anxiously awaiting the outcome of the Baitfish Research Project's studies of reef fish diets before establishing an appropriate level of compensation.

As part of this study, staff in Fiji are conducting extensive social surveys of villagers in areas where there has been high baitfishing effort. These surveys include interviews of villagers to help assess the level of subsistence fishing activity and the type of fishing people. From previous work in Solomon Islands, staff will be able to use these data to determine the most important fish groups in the subsistence catches. This information will be important for comparison when the major baitfish predators are identified.

Other work in Fiji discussed at the meeting included on-going studies examining baitfish potential in areas of the country where available baitgrounds are not being used. If the project finds adequate supplies of baitfish in these areas, it will enable the industry to spread its baitfishing effort and hopefully to exploit tuna resources in new areas. Initial results have been good, with pole-and-line vessels starting to baitfish in baitgrounds north-west of the main island, Viti Levu, where project staff recorded high catch rates.

On-going work in Solomon Islands discussed at the co-ordination meeting has involved re-examining length-frequency data collected during the earlier field work (1987—1989). These analyses have revealed that it is extremely difficult to estimate growth accurately from modal progression in length-frequency samples of these multiple-spawning tropical fishes, because small juveniles are usually absent from the catches. A scientific paper identifying the problems with this type of analysis is currently being prepared. The project has produced a total of 37 publications and reports, any of which are available from CSIRO upon request.

(Source: D. Milton, CSIRO, Australia)

ACIAR
AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

CSIRO
AUSTRALIA

FAO REGIONAL FISHERY SUPPORT PROJECT TO CLOSE

After 17 years of serving the Fisheries Departments of the region, the FAO Regional Fishery Support Project (RFSP) closed its doors at the end of August 1992. This followed a decision by the funding agency, the United Nations Development Programme (UNDP), to try to channel its regional fisheries development funding through 'indigenous' organisations as of 1992, when the 5th UNDP development cycle began.

Over the years, RFSP managers have enjoyed close collaboration with fisheries officers of the region, and their assistance and support has come in many forms, from small boat design to trochus introductions. The project was initially run by Harry Sperling, who was succeeded by Keith Meecham in the mid-1980s, and then, more recently, Bob Gillett, who initially worked as Keith's deputy. Project staff and consultants are well known in the region and have included such luminaries as Masanami Izumi, Michel de San, Oyvind Gulbrandsen, Mike McCoy, Mose Pelasio, Nick Trachet, Hugh Walton and Mike Savins. In recent years, the project office in Suva became an essential port of call for fisheries officers travelling through Suva, as well as an invaluable source of information due to the excellent specialised fisheries library that had been built up over the years. It was almost impossible to drop in on the office without making valuable new contacts or renewing old ones.

Like many others in the region, SPC staff have valued the support of the RFSP and its staff, and will be sorry to see it close. We wish the project staff — Bob, Mere, Maria and Mili — all the best for the future.

(Contributor: G. Preston)

BACKSTOPPING OF FAO REGIONAL AQUACULTURE DEVELOPMENT PROJECT

The Regional Aquaculture Development Project (RADP), run by Mr Hideyuki Tanaka, is to close on 31 August. A second phase of the project, funded like the first phase by a Japanese Government grant to FAO, is expected to become operational in about May 1993. In the interim period, the United Nations Development Programme (UNDP) has agreed to provide bridging funding of US$ 50,000 to enable certain identified priority activities to be completed during the 8-month gap in which there will be no project staff in place.

UNDP has requested that SPC assume responsibility for providing the 'backstopping' service, which means that the Commission's Fisheries Programme will have to assume the extra workload of completing these ongoing or unfinished activities. The recently held Twenty-fourth SPC Regional Technical Meeting on Fisheries discussed the matter at length and ultimately authorised the Commission to undertake this role. During the meeting, the representative of the Forum Fisheries Agency expressed FFA's willingness to assist in the matter and thus lighten the load. This assistance is much appreciated by the Commission, and the two agencies are presently engaged in discussions as to how best to deal with each of the 20 or so outstanding items. In the next couple of weeks the Commission will be formally contacting each FAO member country to seek clarification on the status of each outstanding project, and to agree on the assistance required from SPC or FFA.

(Contributor: G. Preston)

A CATCH MONITORING PROGRAMME FOR NAURU'S COASTAL FISHERIES

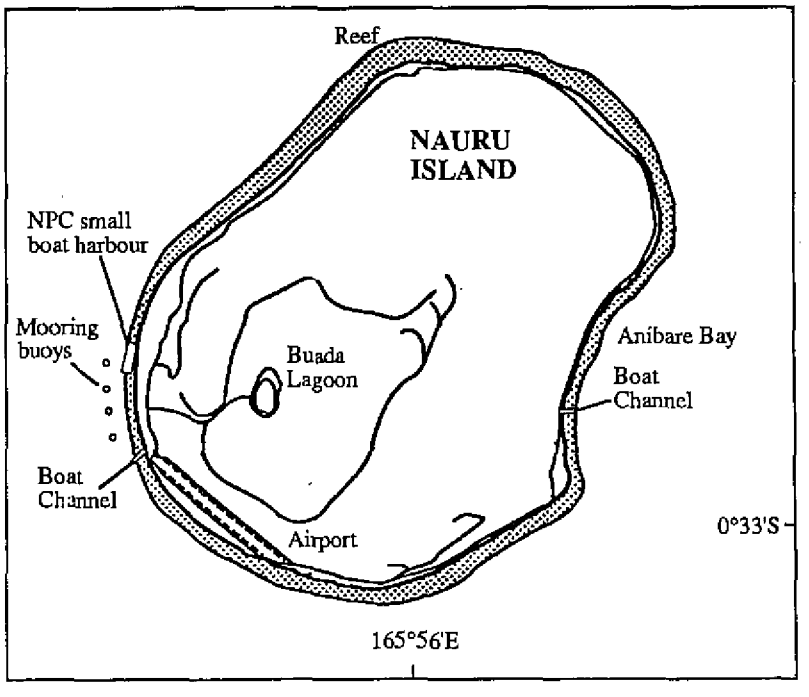
by P. Dalzell
South Pacific Commission
Noumea, New Caledonia

Introduction

Despite the wealth generated by the mining of phosphate-bearing rock, and the well stocked stores around the island, much of Nauru's food comes from the sea. Nauruans employ a variety of fishing methods to capture both reef-associated species and large pelagics from the open sea. Invertebrates such as molluscs, crayfish and octopus are taken from the narrow fringing reef around the island and there is also a tradition of capturing milkfish fry from the sea and transferring them to a small brackish lake in the interior (Buada Lagoon) to grow to a harvestable size.

Although fish and seafood are an integral part of the Nauruan diet, little is known about the amount of fishing activity on Nauru and the size of the annual catch. Further, there has been increasing concern about the volume of landings on Nauru, particularly from the reef zone. Information suggests that certain reef fish species are becoming scarce and the average size of the fish caught is decreasing.

The Government of Nauru asked the SPC Fisheries Programme to assist in establishing a system for monitoring catches on Nauru, in order to determine the amount and types of fish caught by different fishing methods and eventually to estimate the total harvest of fish on Nauru. The information collected from such a programme would assist the Government to manage coastal fisheries resources on Nauru.



Map of Nauru

During July 1992, I spent two weeks on Nauru and established a catch monitoring programme with the Department of Island Development and Industry. I worked closely with a Nauruan fisheries officer, Alan Debao, who will ultimately take charge of the monitoring programme. Trials with catch data sheets were conducted to determine the most effective methods of recording catches and fishing activity. By the end of the second week a methodology had evolved that required regular observations of numbers of people and boats engaged in fishing, details of catches from different fishing methods and an inventory of fishing vessels and gears.

Coastal fishing on Nauru

Enough information was gathered to make some preliminary observations on fishing on Nauru. Most coastal fishing around Nauru is conducted from small (4 to 5 m) outboard powered skiffs or canoes. The skiffs are launched from two man-made boat channels which give access to the sea through the narrow fringing reef. Fish is caught both for subsistence and commercial purposes.

The main fishing activities carried out from the powered skiffs are trolling for pelagic fish such as tuna and bottom fishing for snappers and groupers. Trolling equipment ranges from simple plastic reels to expensive game-fishing rods and reels. A variety of lures is used, including flying fish when they can be caught. During 1991 three fish aggregation devices

(FADs) were deployed around Nauru by the Department of Island Development and Industry, with assistance from the South Pacific Commission, to improve fishing for pelagic fishes.

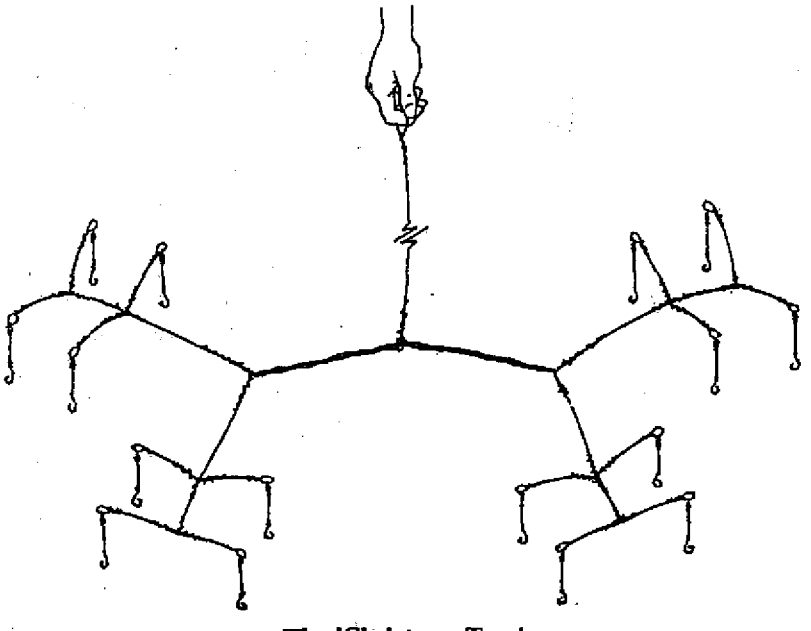
Bottom fishing from both skiffs and canoes is carried out with simple handlines and with a device known as a 'Christmas Tree', which is a T-shaped or cruciform wire framework to which are attached between 16 and 32 hooks (see Petit-Skinner, 1981, for detailed description of this and other traditional fishing methods on Nauru). The most favoured bait for bottom fishing is skipjack tuna and imported milkfish bought from local stores. Catches from the Nauruan skiffs are mainly for recreational and subsistence purposes. Traditionally, much of the catch is given away to friends and family, although large catches may be sold for extra income and a few Nauruans fish regularly for catches that are sold to local stores.

The large numbers of Nauru Phosphate Corporation (NPC) employees from Tuvalu and Kiribati are also enthusiastic fishermen, for both subsistence and commercial purposes. They build and fish from their own canoes as well as using small (3.5 to 4.5 m) outboard-powered skiffs launched at the NPC small boat harbour. The principal fishing-ground for the canoe fishermen is close to the large deep-water mooring buoys used by carrier vessels loading phosphate. The mooring buoy system acts as a very effective fish aggregator and regular catches of rainbow runner (*Elegatis bipinnulatus*), yellowfin tuna (*Thunnus albacares*) and wahoo (*Acanthocybium solandri*) are taken there by mid-water handlining. A description of this fishery is given by Cusack (1987). The powered skiffs are used by the Tuvaluan and Kiribati workers for trolling and bottom fishing around the island. The catches made by these other Pacific Islanders are used mainly to supplement their incomes and are sold on the road-side above the area where the canoes are launched.

Nauruans also fish on the reef flat with cast nets and seine nets. Cast nets are usually thrown over schools of fish in the surge zone at the reef edge. The target species are surgeon fish (*Acanthurus* spp.), drummers (*Kyphosus* spp.) and mullet (*Valamugil seheli* and *Liza vaigiensis*). Seine nets are deployed in an arc on the reef flat and fish are driven into the net by a number of men splashing the water and walking towards the net. The catches from seine nets are similar to those from cast netting. Most catches from cast netting and beach seining are for subsistence consumption.

Reef fish are also caught by spear fishermen using SCUBA gear to fish between the surface and 60 m depth. Catches from SCUBA fishing comprise small snappers, groupers, squirrel fish, jacks and surgeon fish.

Catches from troll fishing trips with powered skiffs were dominated by skipjack tuna, which formed nearly 90 per cent of total landings. Yellowfin tuna accounted for about 8 per cent of the remaining catch and the balance was comprised of rainbow runner, barracuda, longtom (Belonidae), shark and sailfish (Istiophoridae). Catch rates ranged from 0 to 8.6 fish/line hr and 0 to 34.3 kg/line hr, with means of 1.6 fish/line hr and 7.2 kg/line hr. During the period of this survey, fish were caught from schools on the open sea and not from the FADs, which were reported by fishermen to be temporarily unproductive. Earlier in the year, however, the FADs were aggregating fish and were providing good fishing for skipjack, yellowfin, mahi-mahi (*Coryphaena hippurus*) and rainbow runners.



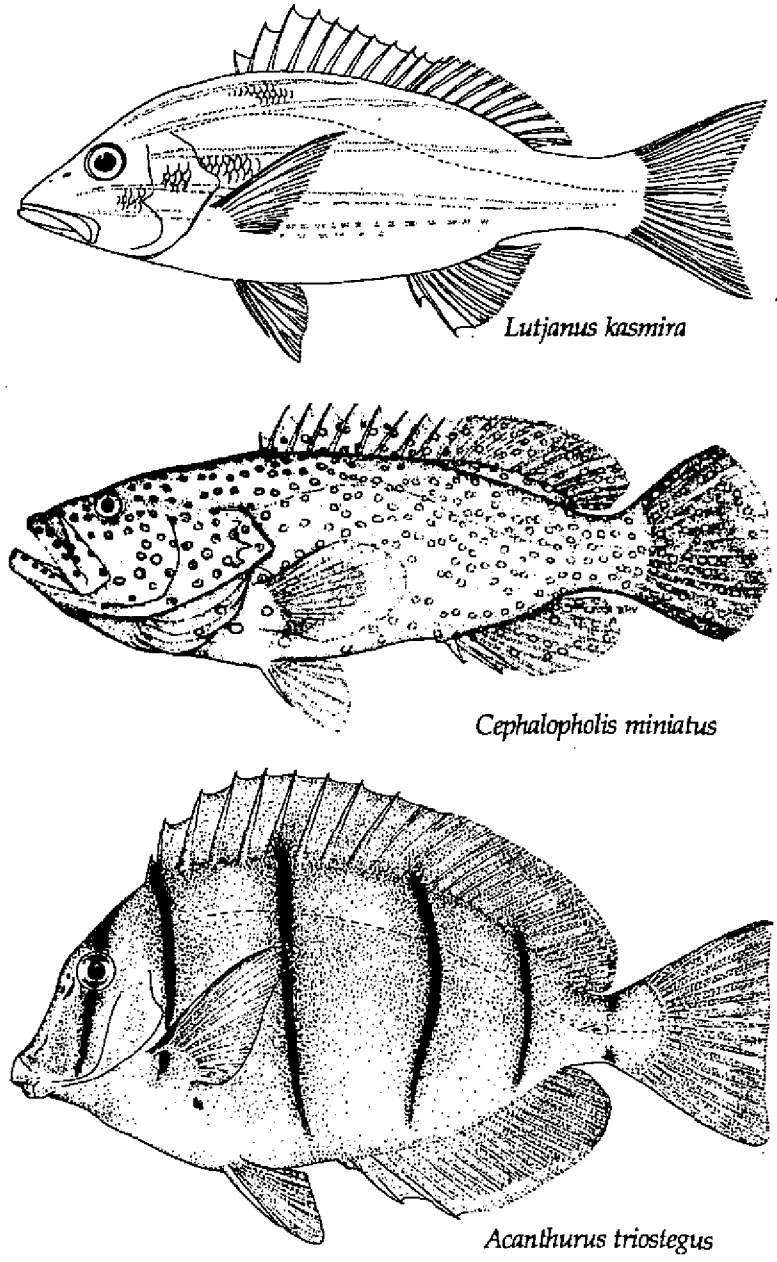
The 'Christmas Tree'

The only fish observed in ten mid-water handline catches from the canoe fishermen was the rainbow runner. Catch rates by mid-water handlining ranged from 1.7 to 14 fish/line hr and 0.9 to 14.0 kg/line hr, with means of 3.4 fish/line hr and 2.8 kg/line hr respectively.

Observations on bottom-fish catch composition from powered skiffs was limited to two landings, where the blue line snapper (*Lutjanus kasmira*) and several squirrelfish species (Holocentridae) formed over 90 per cent of the catch. Catch rates for four bottom fishing trips ranged from 7.9 to 16.0 fish/line hr and 3.2 to 5.7 kg/line hr, with means of 7.9 fish/line hr and 3.7 kg/line hr respectively. Six landings of bottom fish were recorded from canoes, however, it was only possible to obtain the composition of one of these as the catches were quickly sold after the fish were landed. In the single observation recorded here, snappers (principally *L. kasmira*) formed about 77 per cent of the catch, with the balance made up of jacks, squirrelfish and groupers.

Other species observed in bottom-fish catches from canoes include the snappers, *Pristipomoides multidens, Aphareus furca, A. rutilans, Lutjanus bohar, L. malabaricus, L. gibbus, L. kasmira, L. monostigmus, Paracaesio* sp.; the jacks *Caranx lugubris, C. ignobilis, C. melampygus, Seriola dumerili*; the groupers *Cephalopholis miniatus, C. sonnerati, C. argus, Variola louti*, and a mix of other species such as barracuda and squirrelfish. Catch rates by bottom fishing from canoes ranged from 2.7 to 17.1 fish/line hr and 1.7 to 6.0 kg/line hr, with means of 10.7 fish/line hr and 3.7 kg/line hr.

The average catch rates from two spear-fishing trips were 11.2 fish/man hr and 3.3 kg/man hr. No counts were made of the individual species; however, the following species were observed in the catches: *Lutjanus kasmira, Caesio kuning, Holocentrus* spp., *Sargocentrum spiniferum, Mypristis* spp., *Acanthurus nigricans, Elegatis bipinnulatus, Aphareus furca, Cephalopholis miniatus* and *Enchelynassa canina*. The single record from a castnet fisherman gave catch rates of 19 fish/man hr and 4 kg/man hr. The catch comprised surgeonfish (*Acanthurus triostegus, A. lineatus, A. guttatus*) (52.6 %), drummers (*Kyphosus cinerascens*) (42.1 %) and wrasse (*Thalassoma quinquelineatum*) (5.3 %).



Some of the species observed in the catches

Catch monitoring programme

Since the initial data collection in July, further catch records have been collected by Mr Debao. A computer database will be designed to enter and summarise the catch records so that monthly and annual summaries can be produced. It is hoped that catch records can be collected for at least 12 months so that the annual cycle of fishing activity can be described and annual fisheries production assessed from the reef and pelagic zones.

Particular attention is being given to catches from the reef zone, since this is the area of most concern to the Government and people of Nauru. Much concern has been expressed about the effect of spear fishing by SCUBA divers on reef fish stocks. Anecdotal information suggests that stocks of snappers and groupers have been depleted and are not as plentiful as in the past, and that to escape the spear fishermen, the remaining snapper and grouper populations have retreated into deeper water.

During the sampling programme an inventory will be made of fishing vessels and gear on Nauru. During the initial phase of the programme in July, 218 powered skiffs and 128 canoes were counted, most of which are used for fishing. The frequency with which the different vessels go fishing and the types of gears used will be determined through questionnaire sampling of the owners. The daily pattern of fishing activity on Nauru is also recorded through observations of numbers of boats and people out fishing in the morning and afternoon.

The Inshore Fisheries Research Project will continue to be involved with the Nauru catch monitoring programme by reviewing the ongoing collection of data, assisting with database design and data entry, and helping with the analysis and interpretation of results after the six and twelve months of data collection.

References

Cusack, P. (1987). Phospate, FADs and fish. *SPC Fisheries Newsletter*, No 43, 34—40.

Petit-Skinner, S. (1981). *The Nauruans*. MacDuff Press, San Francisco, 292 pp.

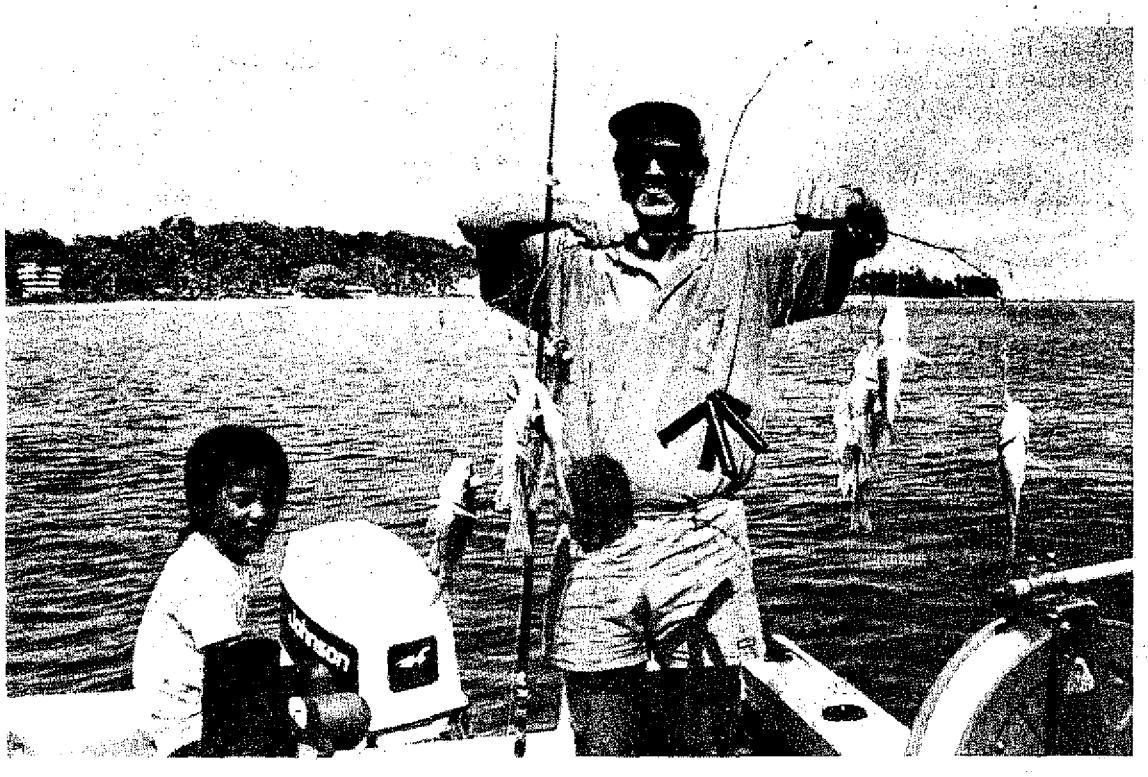


Photo: Alan Debao

Even fisheries scientists can catch fish! SPC fisheries scientist Paul Dalzell displays a good catch of blue-line snappers taken with a 'Christmas tree' bottom fishing rig.

ARE YOU SURE THAT FISH WAS A YELLOWFIN?

by D. Itano
South Pacific Commission
Noumea, New Caledonia

This may seem like an absurd question to appear in the *SPC Fisheries Newsletter*, but it is surprising to find how many fisheries officers, fisheries biologists and fishing vessel observers are not able to reliably distinguish yellowfin from bigeye tuna. Worse yet, fishermen are often unable to distinguish the smaller sizes of these two species and generally report all small yellowfin-like fish as yellowfin.

For instance, it is a well known fact that juvenile bigeye are often found in association with drifting logs and fish aggregation devices in the western Pacific region. Purse seine vessels take a significant quantity of bigeye during fishing operations on logs and FADs, but the catch is usually sold to canneries that pay the same price for purse seine-caught yellowfin and bigeye tuna.

This eliminates any economically driven motivation for the fishermen to target the two species independently or to sort them during the fishing operation or in the holds. The canneries also mix purse seine-caught yellowfin and bigeye together during the unloading and cold storage process and pack them together in cans as 'light meat tuna'. This means that the levels of bigeye landings by regional purse seiners can only be estimated from catch reports made by the fishermen or observed catches and landings by a few at-sea observer programmes or port sampling programmes that are being conducted in the region. The problem is that purse seine fishermen under-report or simply do not report bigeye catches while at sea and even trained observers make mistakes when distinguishing small bigeye from juvenile yellowfin tuna.

In 1990, the US purse seine fleet, operating under the FFA-administered Multilateral Treaty on Fisheries with the United States, reported a bigeye catch of only 0.5 per cent of the combined yellowfin/bigeye catch by weight. An independent and comprehensive dock sampling programme of the US National Marine Fisheries Service has been collecting data on landings, logbooks, length frequency and species composition of the actual landings of this fleet since 15 June 1988 when the Multilateral Treaty came into effect. An analysis of these data revealed that bigeye landings during 1990 actually made up almost 9.5 per cent of the combined yellowfin/bigeye catch as observed during the time of unloading, which represents a 19-fold increase over the 0.5 per cent reported by the vessels.

The percentage of bigeye in purse seine landings increases with an increase in the amount of fishing effort that is conducted on log- or FAD-associated tuna schools. The large Taiwanese and Korean purse seine fleets, which expend a great deal of their fishing effort on log schools, reported a zero bigeye catch during 1991. If this under-reporting or non-reporting of bigeye landings by all fleets is extrapolated over the past 20 years, it becomes very clear that a lot of bigeye have been caught and canned without their harvest being properly documented, making assessment of this important species even more difficult.

Bigeye tuna is one of the least understood and most inadequately studied of the commercially important tunas, yet it is the most valuable of the tropical tunas to the sashimi fishery. Regional fisheries personnel should try to remedy this situation whenever possible by recording bigeye catches accurately and separately from yellowfin landings. Simply knowing the difference and training others in the proper identification of the species is a logical start.

General characteristics

1. Medium to large fish (40— 150 cm)

Fins

Differentiating large yellowfin from any other tuna species is very simple as the second dorsal and anal fins become greatly elongated in fish over 70 or 80 cm in fork length. In very large yellowfin, these fins can lengthen to over 20 per cent of the fork length, sweeping back almost to the caudal keel. The fins of bigeye never exhibit this elongation with size and age.

The pectoral fins of bigeye and yellowfin are moderately long, reaching between 22 and 31 per cent of fork length. Yellowfin pectorals will generally reach beyond the start of the second dorsal fin, but not beyond the end of the second dorsal fin

base. However, bigeye pectoral fins are generally longer than those of yellowfin, often reaching beyond the second dorsal fin base (Figure 1).

This difference in pectoral fin length between the species is most noticeable for fish ranging between 40 and 110 cm in fork length. Bigeye of this size have very long, finely pointed pectoral fins compared to the thicker, triangular fins of yellowfin. The bigeye fins are noticeably thinner and 'flopppier' at the tips and curve posteriorly in a smooth arc when they are set out fully from the body. The tips of yellowfin pectorals are usually stiffer, and the fins project more nearly perpendicularly from the body when erected.

Body morphology

The two species differ markedly in morphological characteristics for large fish, with these differences becoming less distinct for small juvenile specimens. Bigeye are generally more rotund and deeper bodied than yellowfin. The dorsal and ventral outlines of bigeye describe a smooth arc, while the dorsal outline of yellowfin from the dorsal fin to tail can be a flat line and the body is often more elongate.

The proportion of head length to total length is also different, with bigeye having a deeper, longer head then yellowfin of the same total fork length. This characteristic is much more noticeable in larger fish over 80 cm.

Colour

Live or freshly caught yellowfin exhibit a dark, metallic-blue back with a distinctive golden-yellow mid-lateral band from the eye region to the caudal keel, fading to silvery sides and a white belly. Live or fresh bigeye have a dark blue/black back shading to a characteristic iridescent metallic blue colour with silvery/white flanks and white belly.

The dorsal and anal fins and finlets of a live yellowfin are bright yellow edged with a thin black line, and the caudal fin is a dusky yellowish colour, with the colours retained fairly well in dead and frozen specimens. The finlets and second dorsal and anal fins of bigeye are also yellow in colour, but the first dorsal fin is a deeper, more subdued yellow and the caudal fin can be purplish-black in live specimens, fading to dusky black after death.

The body stripings or markings are characteristic for each species, but are best seen in live or fresh specimens. Yellowfin are well marked with alternating

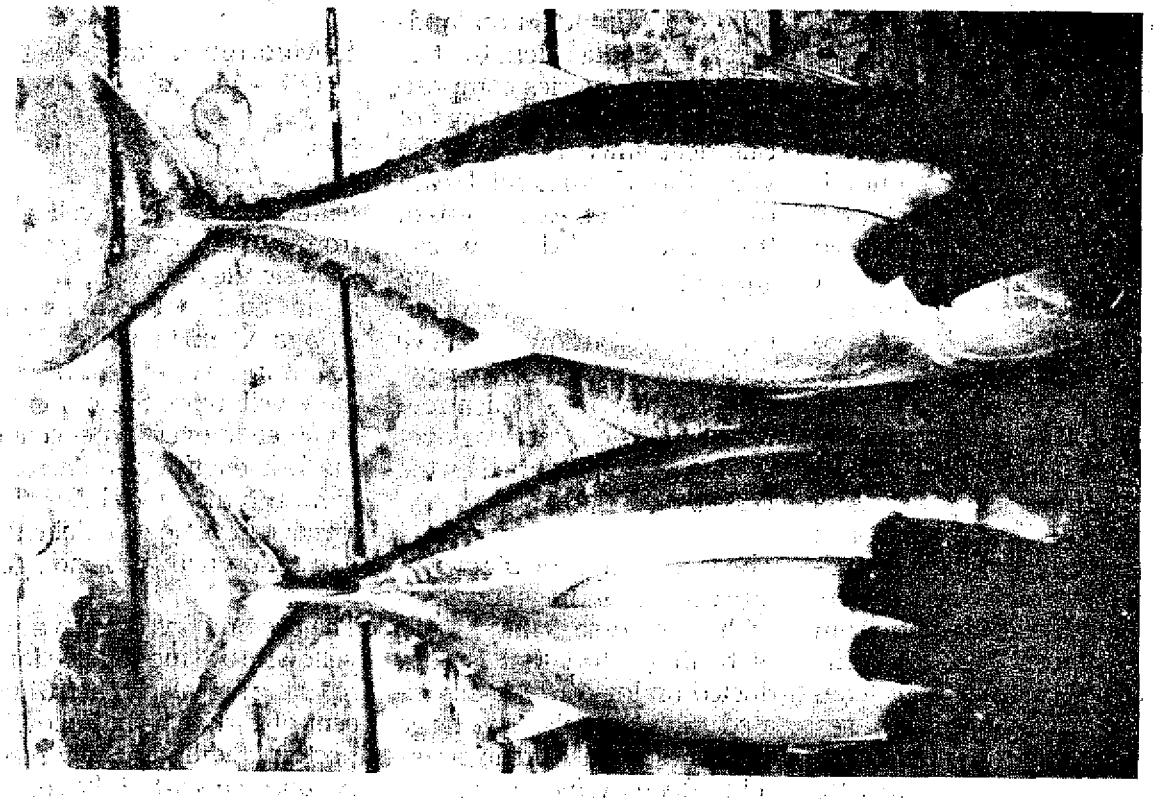


Photo: David Itano

Figure 1. Note the slightly longer pectoral fin and rounded body outline of the bigeye on bottom as opposed to the yellowfin above.

bands of broken white vertical lines and pale spots that extend from below the pectoral fin area to the tail, the mid-line to belly.

Bigeye do not exhibit this alternating pattern of vertical bands and are lightly marked with pale silvery, vertical stripes that fade after death. These stripes are most evident in the posterior half of the body but extend vertically across most of the sides. Large bigeye will sometimes show white, pill-shaped markings on the posterior, lower flanks.

Liver

If all else fails, one of the most reliable ways to differentiate the two species is by cutting them open and examining the liver and gas bladder. The liver of yellowfin has one lobe much thinner and more elongated than the other two lobes and the surface of the organ is smooth and clear of markings. Bigeye livers are composed of three rounded lobes of similar size and the edges of the ventral surface of the lobes are clearly striated (see figure 2). The striations appear like dark, thin channels radiating out to the edge of the lobes. However, in very small fish, these striations may not be clearly evident or fully developed.

Swim bladder

Bigeye have a well developed, gas-filled swim bladder extending along the roof of most of the body cavity. This swim bladder is clearly evident in fresh specimens and is often distended in purse seine and longline-caught bigeye. A rapid rise toward the surface causes a gross expansion of the swim bladder; this can force the stomach to protrude from the mouth and the fish to float in a head-up position on the surface, like deepwater snappers and groupers taken on handline gear. The presence of floating tuna in a purse seine net or sack is a good indication that there is a significant quantity of bigeye in the total catch.

The swim bladder of yellowfin is less well developed, extending only about half-way along the roof of the body cavity. The bladder is not usually fully inflated in dead specimens and the total density of yellowfin is such that freshly killed fish will never float on the surface.

2. Small fish (less than 30 cm)

The real trick is to be able to differentiate small bigeye of less than 25 or 30 cm in length. At this size, the pectoral fins have not fully developed, and some bigeye will have fins of the same length and appearance as those of similarly sized yellowfin. The body form and head length are also similar to yellowfin, although the deeper body and rounded dorsal outline is sometimes evident. On fish of less than 30 cm, the liver is not always well striated, although the evenly three-lobed form is usually apparent.

With live or fresh specimens, the sparse, silvery banding on the sides is usually apparent, although some very small bigeye will exhibit spotted banding similar to the banding of small yellowfin.

A reliable but poorly documented difference between the species can be observed in the region at the base of the tail or caudal fin. With both species, there is a notch in the centre of the trailing edge of the caudal fin and a pair of low keels at the base of the central portion of the tail. Yellowfin will always have a deeply indented, V-shaped notch in the centre of their tail and a larger, more pronounced pair of keels. The central tail notch of a bigeye will appear lunar-shaped or almost flat.

This characteristic was first described to the author by Gordon Yamasaki, Fishery Biologist for the National Marine Fisheries Service in Pago Pago. He has been involved in dock sampling for tuna unloaded from longline and purse seine vessels delivering to the American Samoa canneries. This identifying mark was found to be highly reliable, even for fish that had been long frozen and become discoloured, had fins missing or damaged, and were bent or crushed. It is also a handy way to check large fish protruding from unloading bins with only the tail visible.

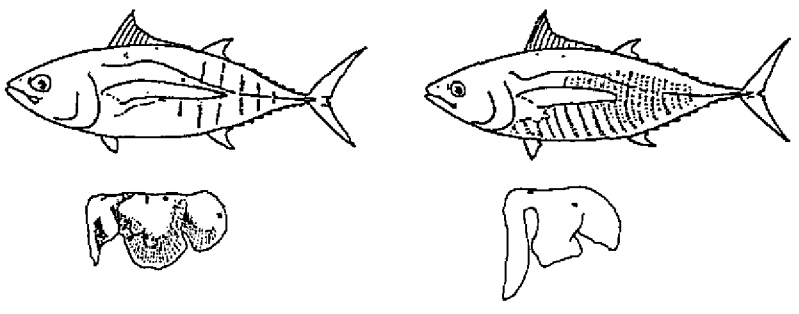


Figure 2. Liver characteristics of juvenile bigeye (left) and yellowfin tuna (right)

During the course of the Regional Tuna Tagging Project, SPC scientists have checked the reliability of this method on over 7,000 bigeye tuna and found that it held consistent for fish in a size range from 21 to 130 cm.

The table below summarises the main differences between small and medium-sized bigeye and yellowfin.

Character	Bigeye	Yellowfin
Body outline	Dorsal and ventral outline from tip of snout to tail almost a smooth arc, rotund deep body form	Dorsal and ventral outline from second dorsal fin to tail somewhat flat, body form more elongate
Colour (live or very fresh only)	Dark metallic blue back, bright yellow mid-lateral band, silver sides, white belly	Dark blue/black back, iridescent blue upper flanks, silvery/white sides, white belly
Pectoral fin	Extends to or beyond the posterior of the second dorsal fin; thin, floppy tip; curves posteriorly when erected	Extends only to anterior of the second dorsal fin; thicker, blunt tip
Caudal fin	Central position of trailing edge forms a small, semi-circular notch, lateral keels low	Central position of trailing edge forms a sharply indented 'V' notch, lateral keels high and well developed
Body markings	Sparsely marked with pale silvery, vertical stripes that are contained in the posterior half of body	Densely marked with slightly curving, vertical bands, alternating between rows of vertical stripes and spots; may begin below pectoral fin and extend posteriorly
Swim bladder	Often distended; extends along the roof of most of the body cavity; highly visible	Usually deflated or slightly inflated; extends partway along roof of body cavity; not obvious
Liver	Three even-sized, rounded lobes; ventral surface striated	One lobe thin and elongated; ventral surface always smooth and clear of striations

Source; derived from Gillett

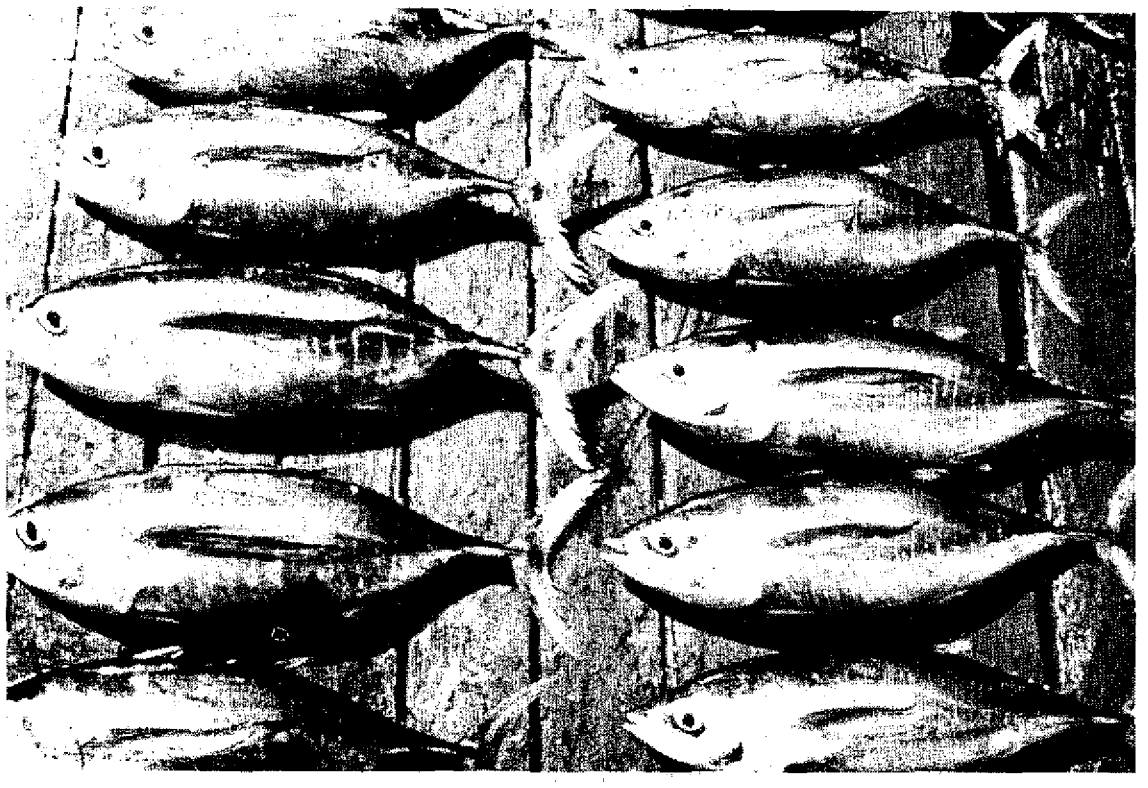


Photo: Robert Gillett

One row is bigeye and one row is yellowfin. Can you see the difference?

EXPERIMENTAL TURTLE FARMING IN MICRONESIA IN THE 1930s

by M. Izumi
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In October 1991, the Marine Resources Management Division, Yap State, Federated States of Micronesia enquired whether any experimental turtle farming had been conducted in the Western Caroline Islands in the 1930s during the Japanese mandate, and whether any technical reports had been published and were available.

As a result of a survey of references, a record was found of two experiments in turtle farming carried out by the Fisheries Experiment Station of the South Seas Bureau of the Japanese Government from 1930 to 1931 and from 1935 to 1937. The results were reported in the following publications:

— South Seas Bureau, Fisheries Experiment Station (1937). Experiments on hawksbill turtle culture [in Japanese]. *Fisheries Experiment Station Progress Report*, no.1, 1923–1935, pages 19–24;

— South Seas Bureau, Fisheries Experiment Station (1937). Experiments on rearing hawksbill turtles [in Japanese]. *Fisheries Experiment Station Progress Report*, no. 2, 1936–1937, pages 41–45.

A combined summary of the two reports is given below.

Today, 55 years after the Japanese experiments, a turtle research project in the outer islands of Yap State has been carried out by the Marine Resources Management Division.

SUMMARY OF REPORTS

Introduction

The shell of hawksbill turtles has been treasured since ancient times as 'tortoise-shell'. It is one of the special products in the South Sea Islands [name given to Micronesia during the Japanese mandated era]. A decline in the number of turtles has been seen lately due to overfishing [already, in the 1930s!]. The two main objectives of the experiments were a rapid growth of hawksbill turtles and a reduction of their predation rate in the natural environment. Experiment No. 1 was carried out at the Fisheries Experiment Station in Koror, Palau from 1930 to 1931, and Experiment No. 2 continued from 1935 to 1937.

Experiment No.1

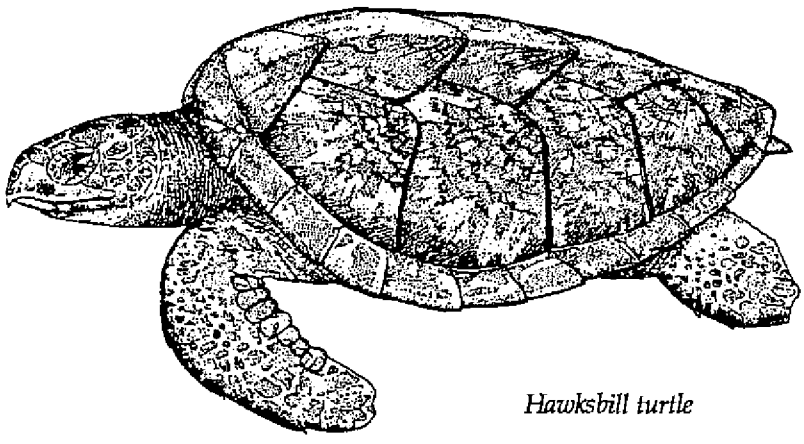
Methods

Eighty-four hawksbill turtle eggs were collected by the captain of M/V *Choumei-Maru* on Gielap Island, Ulithi Atoll (about 90 miles east and slightly north of Yap) on 22 March 1930. Hatching took place between 22 and 26 March. The growth rate of ten juveniles was observed from 13 April (18th day after hatching).

A wooden box (1.2 m long x 1.0 m wide x 0.3 m high), with *Paulownia* wood attached to increase the buoyancy, was used for rearing the juvenile turtles. A few small holes were made in the sides of the box to ensure good water flow, and openings of about 1 mm were made on the bottom. The box was placed in the *Zostera* zone in front of the Fisheries Experiment Station and accommodated ten juveniles.

Feed

During the experiment, different types of feed were given to the juveniles. A meal of fish and shellfish was the most suitable feed. Table 1 on page 34 shows the types of feed given and the results. The dietary requirement per turtle was about 18 g at 50 days after hatching, about 30 g at 100 days, 60 g at 200 days and 90 g at 300 days.



Hawksbill turtle

Table 1. Types of feed given to the turtles

Days after hatching	Turtle no.	Feed	Feed amount (g)	Feed remaining (g)	Amount of diet per turtle (g)	Ave. amount of daily diet per turtle (g)
18—38	10	Oyster	1,200	57.0	114.3	11.7
		Fresh fish	500	4.0	49.6	
		Trochus entrails	100	10.0	9.0	
		Sun-dried sardine	450	28.5	42.2	
		Pork	150	0.0	15.0	
		Salted sardine	150	0.0	15.0	
39—48	9	Oyster	150	0.0	16.7	16.7
		Salted sardine	1,350	0.0	150.0	
49—50	8	Salted sardine	300	0.0	37.5	18.8
51—95	7	Salted sardine	4,400	140.4	608.5	29.0
		Giant clam	800	11.0	112.7	
		Spanish mackerel roe	400	0.0	57.1	
		Oyster	430	0.0	61.4	
		Fresh tuna (fatty flesh)	230	7.0	31.9	
		Salted tuna (fatty flesh)	920	43.5	125.2	
		Ark shell	980	12.5	138.2	
		Fresh sardine	1,250	45.1	172.1	
96—107	6	Salted sardine	2,310	66.2	374.0	31.2
108—154	5	Salted sardine	10,920	331.9	2,117.6	45.1
155—227	4	Salted sardine	11,400	468.7	2,732.8	61.2
		Oyster	1,900	37.5	465.6	
		Salted tuna (fatty flesh)	3,940	115.4	956.2	
		Mackerel scad	1,300	40.3	314.9	
228—327	3	Salted sardine	27,070	613.2	8,818.9	101.1
		Oyster	3,900	32.0	1,289.3	
		Total	76,500	2,064.2		

Table 2. Growth rate of hawksbill turtle

Tagging no. of turtle	Size	Days after hatching								
		50	84	143	174	204	235	270	296	327
1	Weight (g)	37.5	60.0	138.0	-	-	-	-	-	-
	Shell length (cm)	6.2	7.8	10.9	-	-	-	-	-	-
	Shell width (cm)	6.1	7.8	10.0	-	-	-	-	-	-
	Body thickness (cm)	-	3.1	3.9	-	-	-	-	-	-
2	Weight (g)	60.0	123.0	326.0	483.0	498.0	800.0	830.0	832.0	1,036.0
	Shell length (cm)	7.2	9.7	14.2	16.3	17.0	19.6	19.6	20.4	21.6
	Shell width (cm)	7.0	9.3	12.4	14.0	14.4	16.4	17.2	17.6	18.6
	Body thickness (cm)	-	3.0	5.1	5.7	6.0	6.7	6.7	6.7	6.8
3	Weight (g)	45.0	86.3	213.0	313.0	345.0	460.0	540.0	560.0	797.0
	Shell length (cm)	6.2	8.4	12.1	13.6	14.3	15.6	17.8	18.4	19.7
	Shell width (cm)	6.2	8.1	11.2	12.1	13.8	15.0	16.0	16.4	17.8
	Body thickness (cm)	-	3.6	4.5	5.0	5.1	6.0	6.1	6.1	6.1
4	Weight (g)	45.0	75.0	172.0	225.0	251.0	375.0	315.0	318.0	375.0
	Shell length (cm)	6.6	8.1	11.2	12.7	13.0	14.6	15.0	15.2	16.0
	Shell width (cm)	6.1	7.8	10.6	11.8	12.4	13.4	13.6	13.6	14.2
	Body thickness (cm)	-	3.3	3.9	4.4	4.3	5.1	5.2	4.7	4.7
5	Weight (g)	33.8	60.0	135.0	187.0	187.0	-	-	-	-
	Shell length (cm)	5.9	7.5	10.6	11.8	11.8	-	-	-	-
	Shell width (cm)	5.7	6.9	9.4	10.0	10.2	-	-	-	-
	Body thickness (cm)	-	2.5	3.9	3.9	4.2	-	-	-	-
6	Weight (g)	31.9	63.8	-	-	-	-	-	-	-
	Shell length (cm)	5.7	7.5	-	-	-	-	-	-	-
	Shell width (cm)	5.6	7.2	-	-	-	-	-	-	-
	Body thickness (cm)	-	3.0	-	-	-	-	-	-	-
7	Weight (g)	30.0	52.5	-	-	-	-	-	-	-
	Shell length (cm)	5.7	7.2	-	-	-	-	-	-	-
	Shell width (cm)	5.6	6.6	-	-	-	-	-	-	-
	Body thickness (cm)	-	2.7	-	-	-	-	-	-	-
8	Weight (g)	22.5	-	-	-	-	-	-	-	-
	Shell length (cm)	5.4	-	-	-	-	-	-	-	-
	Shell width (cm)	5.6	-	-	-	-	-	-	-	-
	Body thickness (cm)	-	-	-	-	-	-	-	-	-

Table 3. Hatching rate

Group	No. of eggs collected	No. of eggs inspected	No. of eggs hatched	Hatching rate (%)
A	60	8	27	52
B	137	5	114	86

Growth rate

Table 2 shows the growth rate. Although these results are inconclusive because only three turtles survived the experiment, the average increase growth was 20 cm in shell length and 800 g in weight for the year. Shell growth described a parabolic curve and weight increased with a sigmoid curve.

Experiment No. 2:

Methods

In this experiment, turtle eggs were collected at two locations (Kmekumel Island — Group A and Ngerukewid Island — Group B) in Rock Islands, Palau.

Group A

Sixty eggs were collected on Kmekumel Island on 15 May 1935. Twenty-seven eggs were hatched between 22 and 23 July, eight eggs were put aside for closer inspection, and twenty-five failed to hatch (see Table 3).

Group B

One hundred and thirty-seven eggs were collected on Ngerukewid Island on 18 June 1935. One hundred and fourteen eggs were hatched between 20 and 22 August, five were put aside for closer inspection, and eighteen failed to hatch (see Table 3).

A wooden box (1.2 m long x 1.0 m wide x 0.3 m height) with 24 small holes was used for rearing juveniles. The box was placed in a hexagonal-shaped pond made of concrete (1.6 m x 1.4 m x 0.58 m x 0.51 m x 0.58 m x 1.4 m, 4.61 m^2, depth 0.3m), built on the premises of the Fisheries Experiment Station.

Table 4. Diet of hawksbill turtles (Group A)

Days after hatching	Turtle no.	Feed	Feed amount (g)	Total feed amount (g)	Feed remaining (g)	Amount of diet per turtle (g)
0	25					
1—32	24	Oyster	351			
		Fresh tuna	464	815		
33—82		Oyster	440			
		Fresh tuna	346			
		Salted tuna	120	906		
82—120	2	Oyster	500			
		Salted tuna	214	714		
121—151	2	Salted tuna	298			
		Salted marlin	297			
		Rabbitfish	20	615		
152—183	2	Oyster	156			
		Salted tuna	506			
		Fresh skipjack	47	709		
184—214	2	Oyster	475			
		Fresh mackerel	224	699		
215—243	2	Oyster, tuna, skipjack		2,320	230	1,045
244—274	2	Sardine, skipjack, Spanish mackerel, sea grass		2,490	247	1,122
275—304	2	Oyster, tuna, skipjack, mackerel		2,480	240	1,120
305—335	2	Tuna, skipjack, mackerel, Spanish mackerel				

Table 5. Diet of hawksbill turtles (Group B)

Days after hatching	Turtle no.	Feed	Feed amount (g)	Total feed amount (g)	Feed remaining (g)	Amount of diet per turtle (g)
2	114					
3—52	75	Oyster	726			
		Salted tuna	2,635	3,361		
53—90	9	Oyster	1,356			
		Salted tuna	870	2,406		
91—121	9	Salted tuna	561			
		Salted marlin	477			
		Rabbitfish	30	1,068		
122—153	7	Oyster	195			
		Salted tuna	908			
		Fresh snapper	90			
		Fresh skipjack	85			
		Fresh mackerel	64	1,342		
154—184	4	Oyster	743			
		Salted tuna	246			
		Fresh mackerel	324	1,313		
185—214	4	Oyster, tuna		2,440	240	550
215—244	4	Oyster, tuna, giant clam		2,390	107	571
245—274	3	Oyster, tuna		2,540	230	770
275—304	3	Oyster, tuna		2,440	115	775
305—335	3	Oyster, tuna		2,020	230	597
336—365	3	Oyster, tuna		1,740	50	563
366—395	2	Oyster, tuna		1,845	261	792
396—425	2	Oyster, tuna, giant clam		3,625	192	1,717
426—456	2	Oyster, tuna		4,030	371	1,830
457—485	2	Oyster, tuna		4,730	215	2,258
486—515	2	Oyster, tuna		5,780	185	2,798
516—545	2	Tuna		5,780	350	2,715
546—575	2	Tuna		5,190	410	2,390
576—605	2	Oyster, tuna		4,330	145	2,093
606—636	2	Oyster, tuna		4,030	165	1,933
637—665	2	Oyster, tuna		5,160	1,110	2,025
666—695	2	Tuna		3,700	155	1,773
696—730	2	Tuna		4,150	0	2,075

Feed

During this experiment, juveniles were fed once a day between 7 and 8 a.m. Tables 4 and 5 show types of feed and results of turtles' diet in Groups A and B respectively. (Lack of uniformity in data in the tables is caused by the combination of two reports.)

Growth rate

Tables 6 and 7 show the growth rates in Groups A and B respectively. In Group A, the average growth was 14.0 cm in shell length (growth rate was 4.8%). The average increase in weight was 653.2 g with a growth rate of 64.4 per cent for 335 rearing days. In Group B, the average growth was 24.2 cm in shell length (growth rate of 7.4%), and the average increase in weight was 2,444.7 g with a growth rate of 238.3 per cent for 730 rearing days.

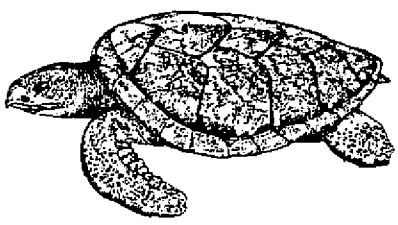


Table 6. Growth rate (Group A)

Date	23/07/35	22/08/35	11/10/35	18/11/35	19/12/35	20/01/36	20/02/36	20/03/36	20/04/36	20/05/36	20/06/36
Days after hatching	0	32	82	120	151	183	214	243	274	304	335
No. of turtles measured	25	24	2	2	2	2	2	2	2	2	2
Average weight (g)	10.3	21.9	52.0	71.0	99.5	121.5	181.0	250.0	379.5	532.5	663.5
Average shell length (cm)	3.7	5.1	7.0	8.4	8.9	9.5	10.7	10.8	14.3	16.0	17.7
Average shell width (cm)	3.5	4.9	6.7	7.6	8.6	8.8	10.0	11.3	12.5	14.2	15.4
Average body thickness (cm)	1.5	2.0	2.5	2.9	2.8	3.5	3.9	4.3	5.2	6.4	6.7

Table 7. Growth rate (Group B)

Date	Days after hatching	No. of turtles measured	Average weight (g)	Average shell length (cm)	Average shell width (cm)	Average body thickness (cm)
22/08/35	2	114	10.3	3.8	3.4	1.6
11/10/35	52	75	27.0	5.4	5.1	2.3
18/11/35	90	9	44.3	6.6	6.3	2.6
19/12/35	121	9	63.7	7.3	6.9	2.6
20/01/36	153	7	84.0	7.9	7.3	3.0
20/02/36	184	4	117.8	8.8	8.5	3.4
20/03/36	223	4	150.3	9.9	7.3	3.7
20/04/36	244	4	229.5	11.4	10.7	4.1
20/05/36	274	3	334.0	12.7	11.8	5.0
20/06/36	305	3	405.7	14.0	13.2	5.2
20/07/36	366	3	487.0	14.7	13.8	5.7
20/09/36	396	2	885.0	18.8	17.5	7.4
20/10/36	426	2	1,040.0	19.8	18.5	7.7
13/07/37	692	2	2,280.0	27.2	23.7	9.3
20/08/37	730	2	2,455.0	28.0	24.5	9.6

Table 8. Mortality

Group	Rearing days	No. of turtles fed	No. of turtles dead	Mortality (%)	Yield
A	335	25	23	92	2
B	335	114	111	97	3
B	730	114	112	98	2

Mortality

Table 8 shows mortality of Groups A and B at 335 days and 730 days. Within 100 days of hatching, most juveniles died due to the following factors:

— they preyed on each other;

— leftover feed and turtles faeces were not removed and water circulation in the experimental box and pond was poor;

— they were washed away by rainstorms;

— they did not discharge their faeces;

— there was an excessive number of feeding turtles in the experimental box;

— they were preyed upon by crabs.

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