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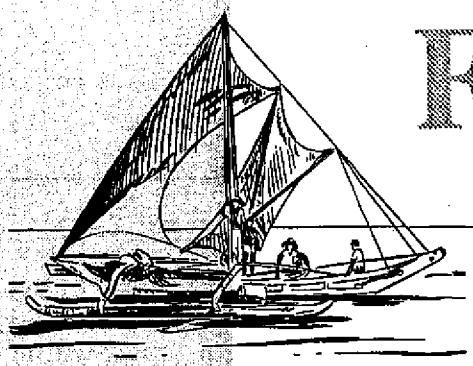

FISHERIES

Newsletter

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JANUARY — MARCH 1992

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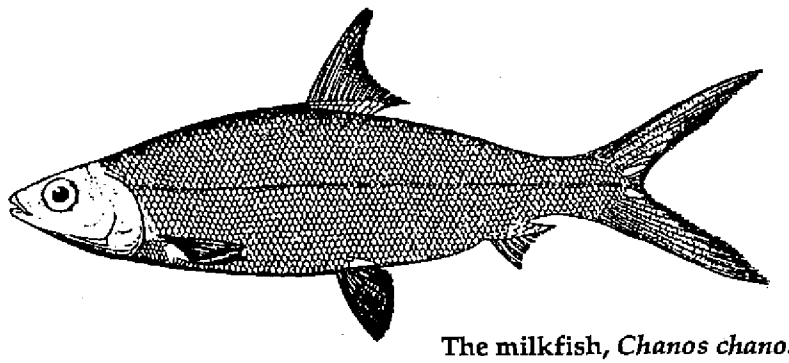


The milkfish, *Chanos chanos*

Readers already familiar with the SPC Fisheries Newsletter will realise that this issue appears with a revised front page. We hope you like it and look forward to your comments.

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

SPC ACTIVITIES

REGIONAL FISHERIES TRAINING PROJECT (RFTP)

The SPC Fisheries Training Associate, Michel Blanc, spent the first weeks of January making final arrangements for the annual Nelson Polytechnic Fisheries Officers course which opened in Nelson on 27 January with 12 participants from around the region. Michel's task was made considerably easier this year by having the arrangements in Nelson co-ordinated by Alastair Robertson, who is now Head of School in Nelson after retiring in March 1991 from his post as Fisheries Education and Training Adviser with SPC.

The practical module for this year's course will be held in Vanuatu, based at the excellent new facilities of the Fisheries Training Centre on Santo. SPC Masterfisherman Paxton Wellington has been busy in Santo assisting with the deployment of FADs which should make for some exciting fishing for participants.

The RFTP is now fully settled in Noumea and, with the arrival of Hugh Walton, the new Fisheries Education and Training Adviser, is back at full strength and preparing for a busy year. Hugh comes to the SPC from a varied background in commercial fishing, fisheries research, training and education, and more recently the FAO Regional Fishery Support Programme, where he worked as a programme officer with Bob Gillett.

A Chilled Fish Post-harvest Workshop, run in conjunction with the SPC Fish Handling and Processing Project, commenced in Suva, Fiji on 16 March and will end on 24 April. The workshop continues the training programme's emphasis on 'train the trainers' and will be followed by in-country workshops for local extension officers and fishermen, conducted by participants in the present course. This ICOD-funded programme is likely to continue for most of 1992.

In mid-April, the Training Project will host a training workshop at SPC headquarters in Noumea. This workshop involves most Pacific Island fisheries training institutions and is being run by the Western Pacific Fisheries Consultative Committee (WPFCC) with funding support from CIDA and the French Government. The workshop includes a number of ASEAN training and education institutions and is primarily concerned with promoting greater co-operation between the two regions in fisheries training and education.

Other Project activities for the near future include the completion of the long awaited Training Directory, follow up to the Human Resources Study, and evaluation of the extension training programme that has been running for the last two years. Michel has been working to organise a report-writing skills course through distance education and is hopeful that a programme for this will be operational by mid-year.

Attention has also been given to the possibility of developing a Certificate-in-Fisheries Programme and options for this will be prepared for discussion at this year's Regional Technical Meeting on Fisheries (RTMF). Input from the University of the South Pacific, the New Zealand School of Fishing, the Australian Maritime College and regional institutions has been drafted into a discussion paper which will shortly be circulated to Fisheries Divisions.

The Training Project is looking forward to a busy and interesting year and is always keen to receive country input, be it positive or negative. It is likely that the workshop at this year's RTMF will concentrate on training matters, so participants and interested persons will have plenty of opportunity to direct the on-going activity of the project.

(Contributor: *H. Walton*)

INSHORE FISHERIES RESEARCH PROJECT

Beche-de-mer poster for Papua New Guinea

In support of the Papua New Guinea Department of Fisheries and Marine Resources' research work on beche-de-mer, being carried out by Paul Lokani at the Kavieng Fisheries Laboratory, SPC is providing technical and financial support for the preparation of a poster on beche-de-mer species.

Although compiled in response to a request from PNG, the final version of the poster is likely to be of interest to fisheries officers, traders and those involved in marine resource education in all Pacific Island countries, especially those with large beche-de-mer fisheries.

The poster will be principally aimed at fisheries inspectors and other fisheries officers, and is intended to help them identify beche-de-mer correctly down to species level, in order to improve export statistics on this group of animals. At the present time, there is much mixing and most beche-de-mer exports are not classified by species. This makes it difficult for fisheries research staff, who are expected to provide advice to the government on management of the fishery, to understand how heavily the various different sea cucumber species are being exploited.

Because inspection of beche-de-mer happens after processing, the poster will mainly feature photographs of the various types of finished product, although for each species treated pictures of the live or fresh animal will also be shown. As well as distinguishing the various beche-de-mer types, the poster will also show examples of differences in quality to help inspectors check on grading and on the approximate relative values of export consignments.

Earlier in the year Detlef Blumel, Graphic Arts Officer at SPC's Regional Media Centre in Suva, Fiji, spent some time working with SPC scientist Garry Preston, visiting beche-de-mer traders in Fiji to photograph as many types and grades of beche-de-mer as possible. These were pasted up into a mock-up and forwarded to Papua New Guinea for comment. Feedback from PNG will be incorporated in the final version of the poster, which is expected to appear early in 1992.

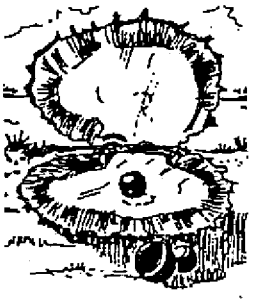
Thelenota ananas

(Contributor: *G.L. Preston*)

Research on pearl oysters

SPC Senior Inshore Fisheries Scientist Garry Preston has been working with Australian and Pacific Island marine scientists in the development of a major three-year research programme aimed at investigating specific research questions on the biology and culture of the black-lipped pearl oyster *Pinctada margaritifera*. The Pacific Island Pearl Oyster Resource Development Project is expected to form Phase 1 of a two-part activity, the second phase of which will focus on extension of research results to Pacific Island countries. The Phase 1 project is to be submitted for funding consideration to the Australian Centre for International Agricultural Research (ACIAR).

The project is still under development, but at present Phase 1 consists of four components, to be carried out by three different Australian institutions working in collaboration with interested Pacific Island governments and agencies. Collaborating institutions are: James Cook University, Townsville (Coordinating organisation); the Australian Institute of Marine Science, Townsville; the Queensland Department of Primary Industries; the South Pacific Commission; the Ministry of Marine



Resources, Cook Islands; and the Ministry of Natural Resource Development, Kiribati. Other countries are likely to join in as the project develops.

The overall aims of the project are:

— to support Pacific Island countries' attempts to develop and increase fisheries and aquaculture activities based on pearl oysters;

— to investigate methods of restocking, hatchery production and husbandry of these organisms suited to application in the Pacific Islands;

— to improve understanding of the population biology, genetics, pathology and histology of these animals in support of this work.

Specific research targets are:

— *Develop a simple, low-technology method for increasing settlement and survival of pearl oyster larvae in locations where resources are impoverished*

This component will be carried out by James Cook University, under the direction of Dr John Lucas, and will involve developing and testing a simple, low-cost larval and juvenile rearing system for improving pearl oyster spat-falls. If this can be done successfully, it is likely that a substantial part of the extension phase (Phase 2) of the project will involve applying the system in selected Pacific Island locations to assist pearl oyster replenishment in those islands.

Other activities will include the evaluation of simple hatchery culture techniques, the study of aspects of reproductive biology and early life history of pearl oysters, and investigation of the biological and technical characteristics of low-key culture technologies that may be applicable to pearl oysters.

— *Identify and describe common pathogens, diseases and parasites present in pearl oysters and recommend practices to minimise disease outbreaks*

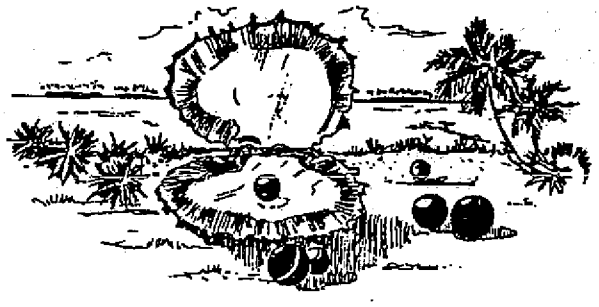
Using samples collected by a variety of means, including pearl oyster surveys carried out by SPC and national fisheries agencies, Drs John Norton and Ian Anderson of the Oonoonba Veterinary Laboratory of QDPI will conduct pathological and veterinary examination of pearl oyster populations. Specific aims are to document the occurrence and distribution of parasites and pathogens within and between atolls, to estimate the likely potential for introduction of pathogens and diseases when translocating pearl oysters from one location to another, and to recommend action that might be taken to minimise deleterious consequences of such translocations.

— *Develop more productive methods of seeding cultured pearls using improved surgical techniques, and assess the feasibility of tissue culture as a means of improving pearl-sac and pearl quality*

This component, to be carried out by the Queensland Department of Primary Industries, will involve surgical and histological studies of pearl seeding techniques and of the pearl formation process, in order to identify means of increasing the proportion of gem-quality pearls produced by seeding operations. Specific areas of investigation will be: possible improvements in surgical techniques used during innucleation (stress reduction, anaesthetics, sterile technique, etc.) that will lead to fewer rejected nuclei and deformed pearls; to examine the histological process of pearl formation and identify characters of the pearl-sac responsible for variations in quality; and to develop mantle tissue culture lines that could ultimately be used as a superior alternative to donor oyster mantle tissue as a basis for pearl-sac formation.

— *Describe the population structure of pearl oyster resources in the Pacific, and monitor the effects of translocation and stock enhancement programmes on genetic resources*

Samples collected at the same time as those used in the pathological/ histological studies (above) will be analysed by the Australian Institute for Marine Sciences using allozyme electrophoresis techniques, to determine variations in the genetic makeup of pearl oyster populations from different Pacific locations. This work, to be supervised by Dr John Benzie, will enable documentation of the degree of genetic differentiation



occurring within and between locations; estimation of the degree of genetic interchange occurring; and elucidation of the likely consequences, in terms of loss of genetic material, of translocating pearl oysters among atolls of the region. Monitoring of the genetic effects of translocation and resource enhancement programmes through repeat analyses in selected locations will also be undertaken. By the end of the three-year research phase, it should be possible to acquire a broad picture of the pearl oyster population genetic structure across the region, and to recommend action that might be taken to minimise deleterious consequences of translocations.

The activities to be undertaken during the extension phase will be developed in response to the results observed as Phase one proceeds. Likely activities during the extension phase, which should commence in 1995 (or perhaps earlier) are: extension to Pacific Island countries of low-technology methods for enhancing pearl oyster reproductive success and spatfalls; field trials of improvements to surgical methods used in pearl seeding to improve pearl quality; and dissemination of Phase one research results through a technical workshop on pearl oyster resource development.

In March 1992, the draft project outline will be discussed by representatives of the Australian agencies and Pacific Island countries that have so far been collaborating in its development. This will permit finalisation of the project document in time for the ACIAR board of management meeting at the end of March. In the meantime, SPC will be financing the genetic analysis by AIMS of pearl oyster samples collected from the Cook Islands (Penrhyn, Manihiki and Suwarrow) and Kiribati (Abaiang and Butaritari) during the first few months of 1992.

(Contributor: *G.L. Preston*)

DEEP SEA FISHERIES DEVELOPMENT PROJECT NOTES

In the first months of 1992, Project masterfishermen were engaged in three field assistance projects in Tonga, Palau and Vanuatu.

Tonga: Flying fish scoop-net demonstration and training

Masterfisherman Tuainetai Rata, an experienced flying fish fisherman who completed a flying fish resource assessment and fishing demonstration assignment in Vava'u in late 1991, was, at the request of Tonga Fisheries Division, transferred to Ha'apai in late January this year to continue the programme there. Early fishing trials revealed a significant resource of flying fish in the area, at least during the summer months. Nightly captures per boat averaged around 200 fish. By late March, Tuainetai had worked directly with five fishing crews in demonstrating the scoop-netting technique and had assisted these men rig their own nets and lights. It remains to be seem whether Ha'apai fishermen will adopt the technique on a regular basis and attempt to deliver their catches to Tongatapu, where a strong market for the fish exists. In the meantime, Ha'apai fishermen are discovering that flying fish make a very effective troll bait for wahoo and large tuna.

Palau: FAD-based tuna fisheries development

Following the success of vertical longlining work conducted by Masterfisherman Peter Watt in Western Samoa, Palau Marine Resources Division requested the Project to assist local fishermen make best use of a series of new FAD deployments, by exploring the potential for development of small and medium-scale tuna fishing gear and methods. Peter was assigned to Palau in October 1991. Since that time, before the onset of Palau's prime tuna season, he has concentrated his efforts on assisting the progress of the FAD programme through accurate site survey using a GPS navigation unit and exploring the potential for establishing a local bait fishery to support later tuna fishing. Bait fishing trials are enjoying some success, with the use of lights and jigs to take small pelagic species offshore from Babeldoap. Palau's long-term aim with this development effort is to see local fishermen take a share in the large sashimi tuna fishery currently controlled by foreign fishing fleets operating out of Palau.

Vanuatu: national FAD programme

Project Masterfisherman, Paxton Wellington, was assigned to Vanuatu in November 1991 to provide technical assistance and advice in the planning and implementation of a national FAD programme. Although several offshore FAD deployments are scheduled, making use of an experimental FAD raft, the main thrust of this work will be the deployment, monitoring and assessment of a series of shallow-water FADs in inshore waters designed to gather small pelagic species and thus assist subsistence and small-scale commercial village fisheries.

Paxton is based at the Fisheries Training Centre on Espiritu Santo where he has so far deployed three inshore FADs in range of Tangoa Island and one deep-water raft offshore from Araki Island. At the end of March the inshore FADs were reported to be aggregating small pelagic species as well as skipjack and fishing trials were commencing.

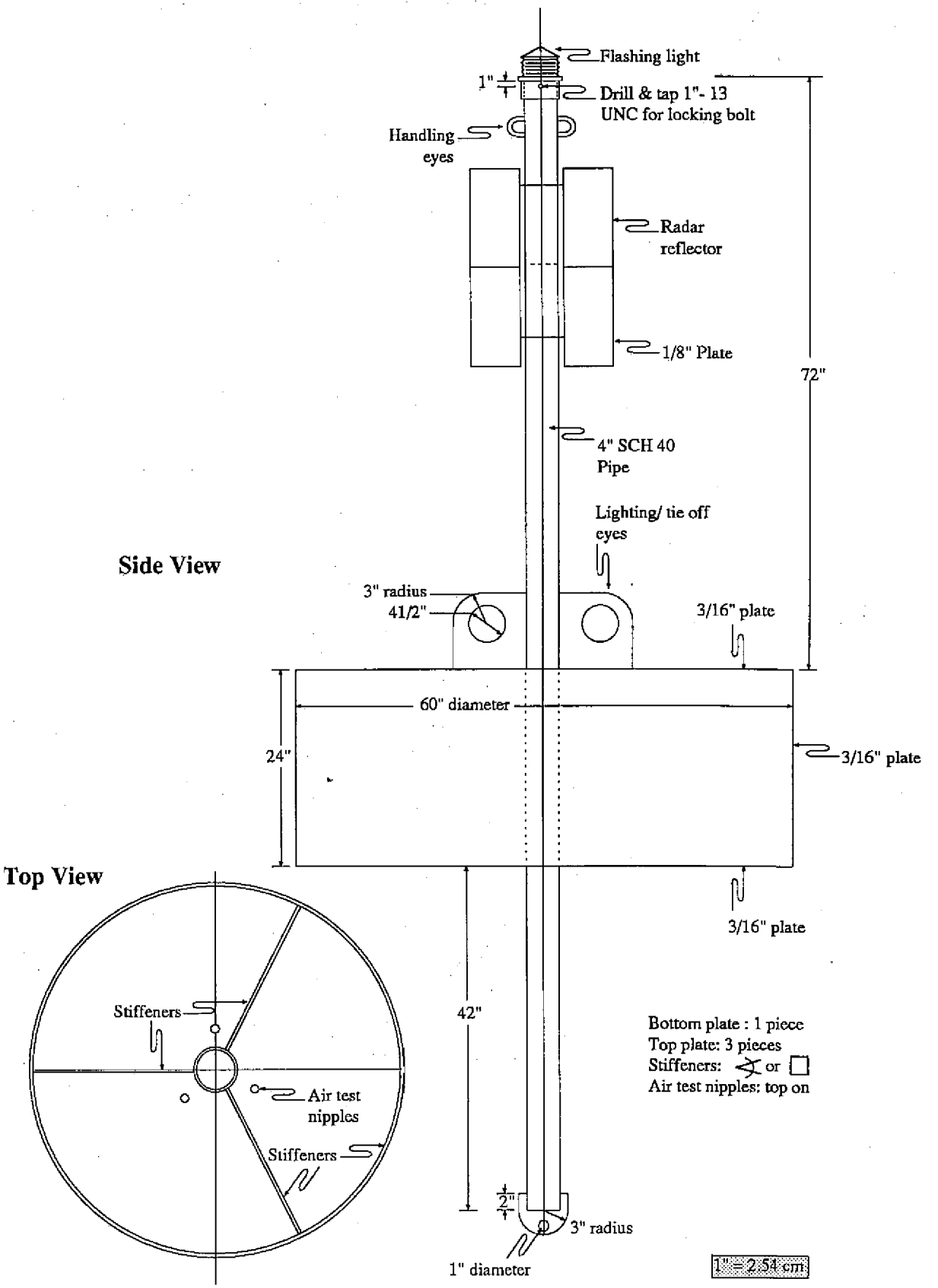
Nauru builds and deploys a Pacific FAD raft

Following the design by Lt. Rich Boy of the US Coast Guard, longtime consultant to the DSFD Project in FAD engineering, of a steel FAD raft suited to construction in Pacific island countries, the Republic of Nauru decided to construct and deploy three of these units as part of its first-ever domestic FAD programme. Although the construction of these rafts in Nauru was undertaken by the Nauru Phosphate Corporation, with its skilled metalworkers and extensive workshop facilities, it is believed that the raft type could be constructed by most competent steel fabrication shops in the islands. The project's Masterfisherman Paxton Wellington was assigned to assist in deploying the new FADs once they were complete.

(Contributor: *P. Cusack*)

Photo: Kevin Bailey

SPC Fisheries Statistician Tim Lawson and Nauruan Fisheries Officer Peter Jacobs inspect the new rafts on the beach at Nauru



Sketch plan of the Pacific steel FAD raft designed by Lt. Rich Boy, USCG (material specifications, estimated costings and plans for the Nauru steel raft are available from SPC)

TUNA AND BILLFISH ASSESSMENT PROGRAMME

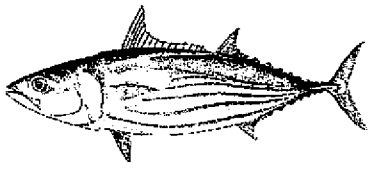
Regional Tuna Tagging Project (RTTP)

Over the last three months, the field-work component of the RTTP has been in abeyance, as the Tuvalu pole-and-line vessel *Te Tautai*, her crew, and the SPC personnel who regularly spend two-month stints on the vessel, have taken a well-earned break. During 1991, the *Te Tautai* spent 11 months away from her home port of Funafuti, including 302 days of RTTP charter and 254 days actually searching and fishing for tuna. A similar amount of time was spent in tagging operations in 1990.

Although the *Te Tautai* is the major tagging platform of the RTTP, small-scale in-country projects have been undertaken in Solomon Islands and Kiribati, using local pole-and-line vessels to extend both spatial and temporal distribution of releases. The most recent of these projects is currently under way in Fiji. Between mid-January and the beginning of March, this project has succeeded in tagging 3,459 tuna from the Stonefish Co. pole-and-line vessel *Trapper*. The majority of these releases were made around Vanuabalavu and to the south of Taveuni, in the north-eastern part of Fiji. Plans are to continue tagging on the *Trapper* until the full moon on 19 March and then to investigate the possibilities of tagging medium-size yellowfin on a local longliner. As mentioned in *SPC Fisheries Newsletter # 59*, this in-country project aims not only to determine the size and movement patterns of the tuna stocks in Fiji waters but also to measure the amount of interaction between the various tuna fisheries operating in the zone.

At the time of writing, the RTTP has tagged and released a total of 118,772 tuna, of which 26 per cent are yellowfin, 70 per cent are skipjack and 4 per cent are bigeye (see table below). A small number of longtail tuna ('Other' in table) have also been tagged. With these numbers and the remaining three to four months of charter, the RTTP is expected to achieve its stated goal of 40,000 yellowfin (and bigeye) releases. The goal of 60,000 skipjack releases has been reached and surpassed, so the emphasis in 1992 will be on catching and tagging yellowfin.

Present plans are for the *Te Tautai* to begin the 1992 charter in Fiji in early March and move north to the Tuvalu, Kiribati and Nauru area to



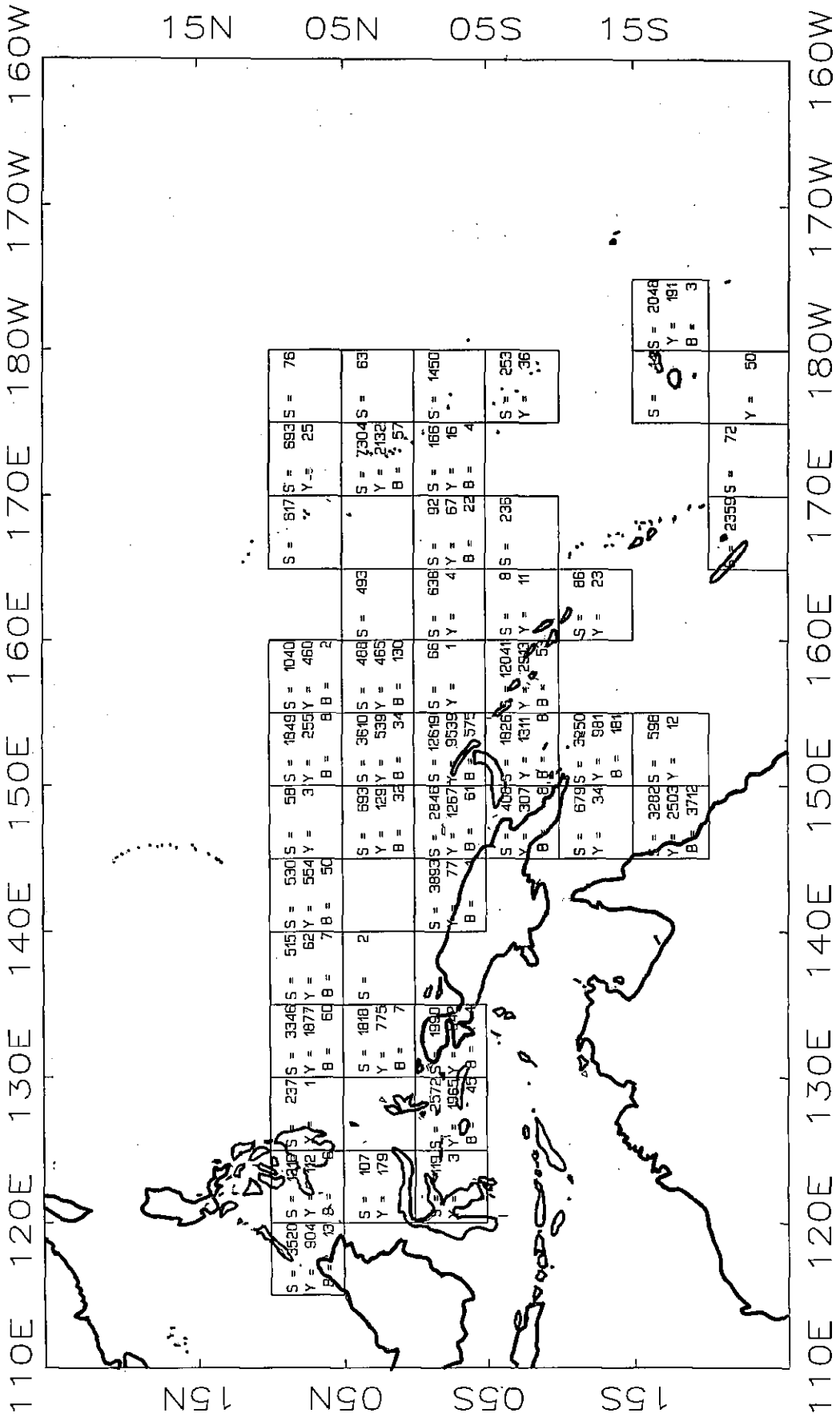
work amongst the U.S. purse seine fleet. As shown on the map of releases by five-degree squares, this particular area has received little tagging effort over the past two years.

Another area that requires attention is to the east of Kiribati and Tuvalu, in the vicinity of the Phoenix and Howland/Baker groups of islands. This particular area is regularly fished by U.S. seiners and yields significant catches of school fish. The *Te Tautai* will remain with the fleet as much as possible, but this will largely depend on how far the seiners roam from the bait-grounds in Kiribati and Tuvalu that are essential to the tagging operation.

Depending on the availabilty of funds, there may also be further but brief periods of tagging in north-eastern Australia and New Caledonia. There is also the possibility of tagging work in Wallis and Futuna, but this is dependent on gaining access to bait grounds at Uvea Island.

Tag releases to 1 March 1992

Vessel	Area	Yellowfin	Skipjack	Bigeye	Other	Total
Soltai 6, 8, 12	Solomon Islands	574	7,729	1	0	8,304
Nei Kaneati	Kiribati	1,058	3,165	43	0	4,266
Trapper	Fiji	710	2,835	4	0	3,549
Te Tautai	Western tropical Pacific	28,359	68,917	5,003	82	102,361
Japanese seiner	Federated States of Micronesia	144	118	30	0	292
Total		30,845	82,764	5,081	82	118,772

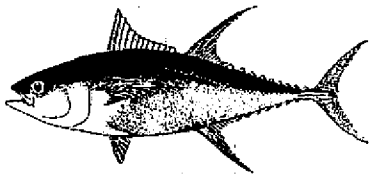


Regional Tuna Tagging Project — Releases as at 29 February 1992
(S = Skipjack; Y = Yellowfin; B = Bigeye)

Negotiations for this access are on-going.

A report on the first two months of field activities of the *Te Tautai* in 1992 will be included in the next *SPC Fisheries Newsletter*, along with further details on the Fiji in-country project.

The total number of recoveries of tagged fish now equals 10,266, consisting of 26 per cent yellowfin, 72 per cent skipjack and 2 per cent bigeye. This represents an interim overall return rate of 8.6 per cent. Of these recoveries, 75 per cent were made by purse seiners, 22 per cent by pole-and-line vessels and the remaining 3 per cent by handline, troll and longline gear.



To date, only 4 tags have been returned by longliners, even though these vessels regularly catch 10 to 15 per cent of the overall tuna production in the SPC statistical area of the western Pacific, albeit of larger fish than those caught and tagged by the pole vessels.

Although we can expect a time lag of one year or more between release and recruitment into the longline fishery, we should have considerably more longline recoveries than the small number at present. As a first step towards resolving this problem, the RTTP has increased its publicity of the project amongst the longline fleets working in the region.

(Contributor: *K. Bailey*)

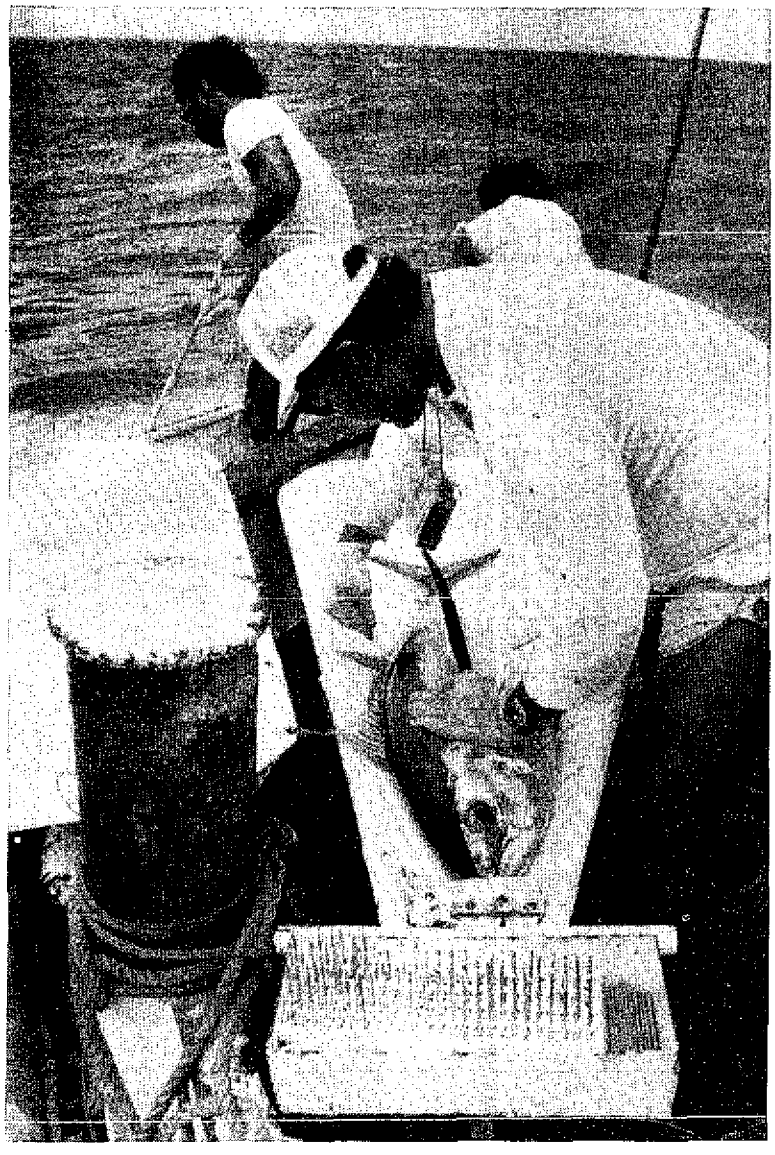


Photo: Thor Carter

Fisheries Experimental Officer Etimoni Palu tags a large bigeye tuna during RTTP operations in the Coral Sea in November 1991

NEWS FROM IN AND AROUND THE REGION

ARTIFICIAL REEF EXPERIMENTS IN THAILAND

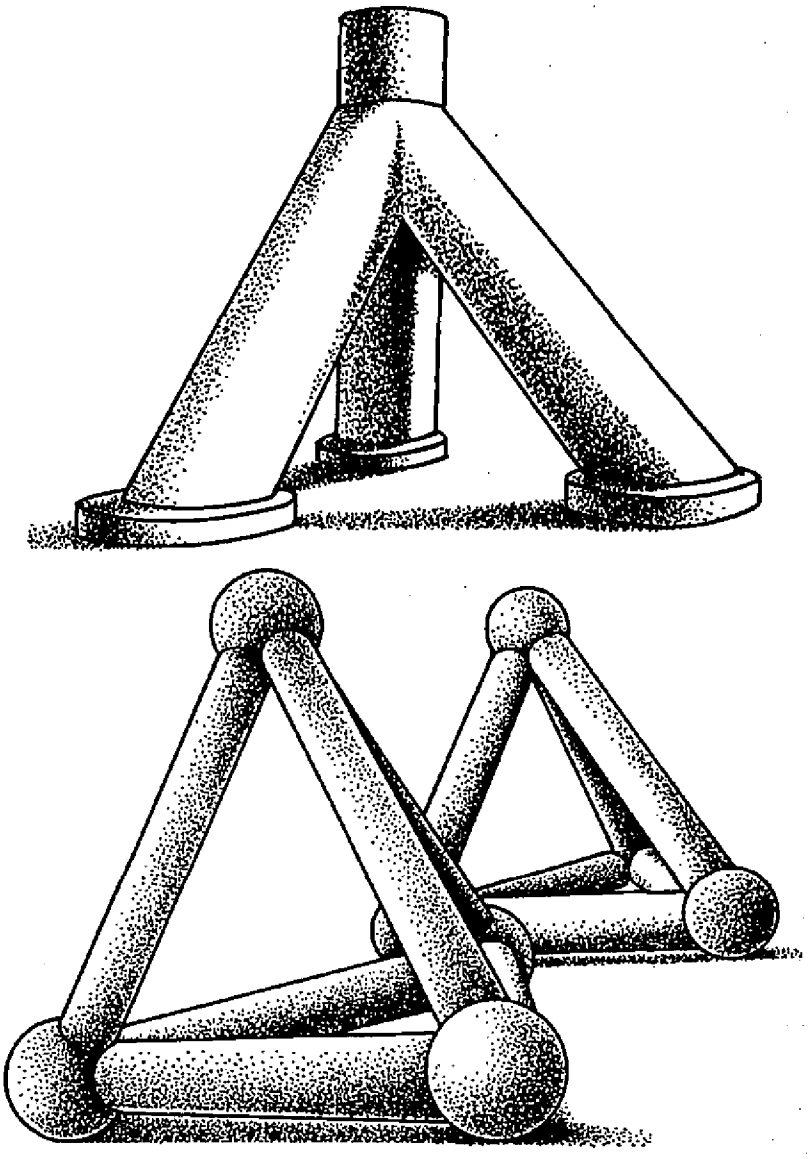
Fishery resources have declined rapidly over the last 20 years because of the world-wide modernisation of the fishing industry. In 1987 a joint team of the Department of Fisheries Thailand (DOF) and SEAFDEC began evaluation of an artificial reef project in Thailand, in an effort to aid the advancement of marine resources technology.

A report was published in 1989 and a *Technical manual for resource enhancement* in 1990. From January 1990, further experiments were conducted to test the practicality and effectiveness of the new artificial reef modules recommended by these reports. Test were carried out to verify the modules' hydrodynamic physical stability and carry out biological surveys.

When structures are placed on sand, rubbing and damage occur because of wave action and current forces; this can lead to movement and overturning. It is therefore important to use modules that are durable and do not move. To reduce this problem, areas in contact with the sea bed need to be minimised or the module attached to plates. Two types were compared, a triangular pyramid shape and a ball-joint pyramid; a cubic-base type was used for biological experiments in marine forestation with *Sargassum*.

The three types were built from bamboo-reinforced concrete. Although bamboo is less effective than steel, it was used because of its abundance and low cost. A total of 17 modules was made and the triangular and ball-joint varieties installed. Calculations showed that these two types were at the time subjected to external forces close to or over the design limits. The remaining modules were installed at the end of the month, along with nine bamboo-only modules weighted with concrete blocks.

Artificial reef effectiveness largely depends on the durability of the modules used. Their condition may alter depending on the type of construction used, materials, transportation methods, sea conditions, operation of fishing gears and illegal fishing activities. A follow-up study was therefore conducted, beginning three weeks after the modules' installation. Physical features were ascertained from diving observations and biological features by looking at fish vol-



Triangular module (upper) and ball-joint module (lower)

ume at the site and the presence of sessile organisms.

Surveys were carried out for one year, monthly for three months and at two-month intervals thereafter. Recording of results was by photo, video, echograph and notes. Data on wind, waves, swell, currents and transparency were recorded. A 48-hour continuous current meter was also operated at the site. Sessile organisms were collected by scientific divers, and fish by fishing gear operations, handline and trap.

The bamboo modules began to disintegrate after four months, with only the concrete weighting blocks (no bamboo at all) in evidence by the end of the year. Most of the compound modules were found to be stable on the sea bed throughout the observation time.

Sand sedimentation rates at the base of the modules were initially slow, at 5 cm in the first three months. During the south-west monsoons this increased to 15—25 cm, but decreased again to 10—15 cm during the north-east monsoon. Over the year sand deposits were greater over the ball-joint modules. This type is easier to manufacture, however, and sand thickness could be reduced by design modification allowing a larger space between the base bars and sea bed.

Biological observations noted that within three weeks barnacles were attached to the modules. These were followed by bryozoa, sponges, bristle worms, pearl shells, polychaetes, sea cucumbers and a variety of algae. Organisms were collected on concrete plates attached to the modules. Samples were preserved, photographed, sorted and identified. The attempted construction of a marine forest by transplanting *Sargassum* was unsuccessful.

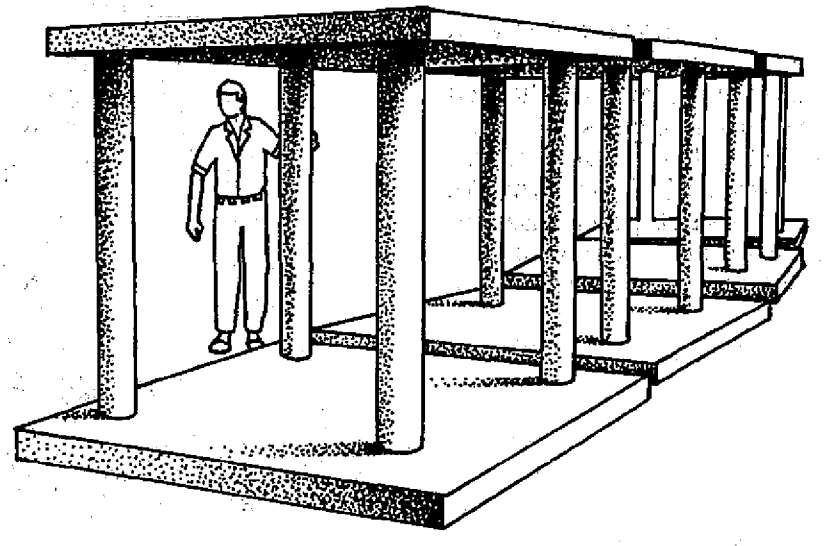
Within the first three months bottom fish were seen; a month later sweetlip, grouper and juvenile grouper; and after six months snapper, grouper, catfish, siganid and sweet lip. Later, anchovy and pelagic fish were also in evidence. Movement of fish in and around the modules was variable according to the type of fish. However, fish sampling at the site was thin and two of the main species seen were not reef fish.

From the biological point of view, the number of modules was too small to judge their effectiveness as aggregation devices. To gain a better understanding of the relationship between prey and predator around the modules, further study of data on sessile organisms is needed.

Other considerations, when looking at artificial reef construction, are module size and methods of transportation and installation. Natural reef studies have shown that large modules are preferable and their greater weight (2—3 t each) makes them more stable. However, because project sites are often near small fishing villages and transportation therefore difficult, careful thought must be given to methods of both land and sea transport, so that damage to the modules is avoided. In these surveys, a crawler crane was used at the construction site and then fixed onto a barge and used for installation of the modules at sea.

The economic viability of artificial reefs was not considered in this study and is fundamental to deciding their future use. However with the rapid industrialisation of the fisheries industry, investment levels are huge and only a small percentage is required for the fisheries development and conservation that is becoming increasingly necessary. The true value of artificial reefs within industrial budgets will become more clear in the future as their importance in the development of small-scale fisheries and the conservation of industrialised fishing grounds becomes apparent.

(Source: *SEAFDEC Newsletter*)



Algae base module

THE MANGROVE LOBSTER FISHERY IN FIJI

The **mana**, or mangrove lobster, is scientifically known as *Thalassina anomala*. This species is widely distributed in the tropical Indo-West Pacific region and the eastern extremity of its distribution is probably Fiji. Adult specimens can measure 26 cm in length and weigh 250 g.

The mangrove lobster is considered a pest in the coastal areas of the region where aquaculture is prevalent, because its burrowing activities release impounded water bounded by dikes or flood such structures with unwanted water.

However, in Fiji, the mana constitutes an important marine crustacean food resource; it also has a sociological and mythological significance for many Fijians, especially the people of Rewa. Fiji may well be the only country in the world where the mana is regularly exploited for human consumption.

The mana has more or less a cryptic burrowing mode of life within the sandy or silty sediment of estuaries (brackish water); it lives close to the upper tide level, usually in association with mangroves. Its presence is usually manifested indirectly in the form of conical mounds which can strongly break the micro-relief of the shores.

The mana thrives better in the sandy or silty shores of south-eastern Viti Levu than those of northern shores, because the environmental conditions are more suitable in the wet zone than in the dry zone. Hence the bulk of the mana is sold in the Suva/Navua area.

The 1986—1990 market statistics compiled by the Fiji Fisheries Division show that during this five-year period, an average of 9 mt a year was sold. This figure represents approximately eight per cent of the total marine sales of crustaceans in Fiji for one year. About 15 years ago, two or three times as much was sold. It would be interesting to know why mana sales have declined so markedly over this period.

Mana is considered a delicacy by Fijians living on the south-eastern coast of Viti Levu, but is not commonly eaten by the coastal dwellers of the north and north-west part of the island (even if the mangrove lobster occurs in the estuaries of this region, as well as in other islands, Kadavu for example).

The mana fishery is seasonal. The animals are normally caught between December and June, when adult females tend to be gravid. During this period, the eggs are usually borne within the body. The egg-carrying capacity of females is increased by the distension of the ovary to almost the entire length of the animal.

In this condition, the egg-laden posterior extension of the ovary is visible as narrow bands of orange colour, through the translucent membranes of the ventral side of the abdomen. The mana consumers attribute a particularly nice taste to the developing eggs.

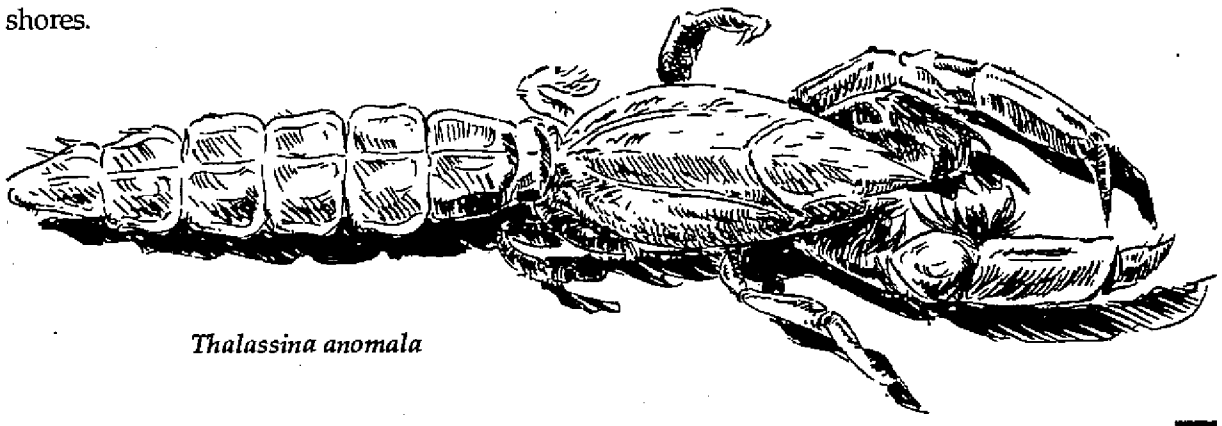
Fishing methods

The mangrove lobster is a difficult animal to catch because it leads a hidden, subterranean life-style. However, the Fijians have devised an adroit method of trapping it.

The trap design cannot be compared to any other. It was first described by J. Hornell, a former Director of Agriculture in Fiji in 1940 (his description was not accompanied by a diagram).

The raw materials necessary for the construction of the mana trap are readily available in the mangrove.

The top of the **mana** mound is removed (to a depth of about 20 cm) with a cane knife. A noose (**a**), usually made of **vau**



Thalassina anomala

(*Hibiscus tiliaceus*) fibres is passed around a length of bamboo (**b**) with a diameter approximately equal to that of the burrow. The bamboo serves as a mould in the artificial extension of the burrow.

The open end of the bamboo is placed so that it just covers the freshly truncated end of the burrow and the mould is made to rest at an obtuse angle to the axis of the shaft of the upper part of the burrow.

Mud is placed over and around the bamboo and rammed down with the hands. After an appropriate framework of **tiri** (**c**) has been made to support the tension trigger mechanism (**d**), the bamboo is gently withdrawn in a single rotating motion.

A vertical stick (**e**), a tiri twig which was made to rest on the bamboo, is then pushed down to approximately three quarters of the vertical depth of the burrow (see figure below). A bent pole (**f**) under tension — normally a **dogo** sapling — is coupled to the trigger device by a small length of vau fibre (**g**). The free end of the noose (**a**) is wound around the pole and loosely knotted. Finally the burrow opening is plugged with mud. The trap is now ready and it is usually set on the rising tide.

When an adult mangrove lobster comes to the entrance to unload mud (or for any other reason), it sets off the trigger; the pole then springs up and the noose tightens violently around the mid section of the animal's body.

The action may result in the animal being dragged out of the ground; otherwise it remains trapped underground. If the trapped animals are not recovered soon enough, they may fall prey to the mongoose.

The mana trap is an ingenious device designed by a pre-technological Fijian (probably from the Province of Rewa). He was not only a highly skilled trapper but also seems to have had a thorough knowledge of various aspects of the mana.

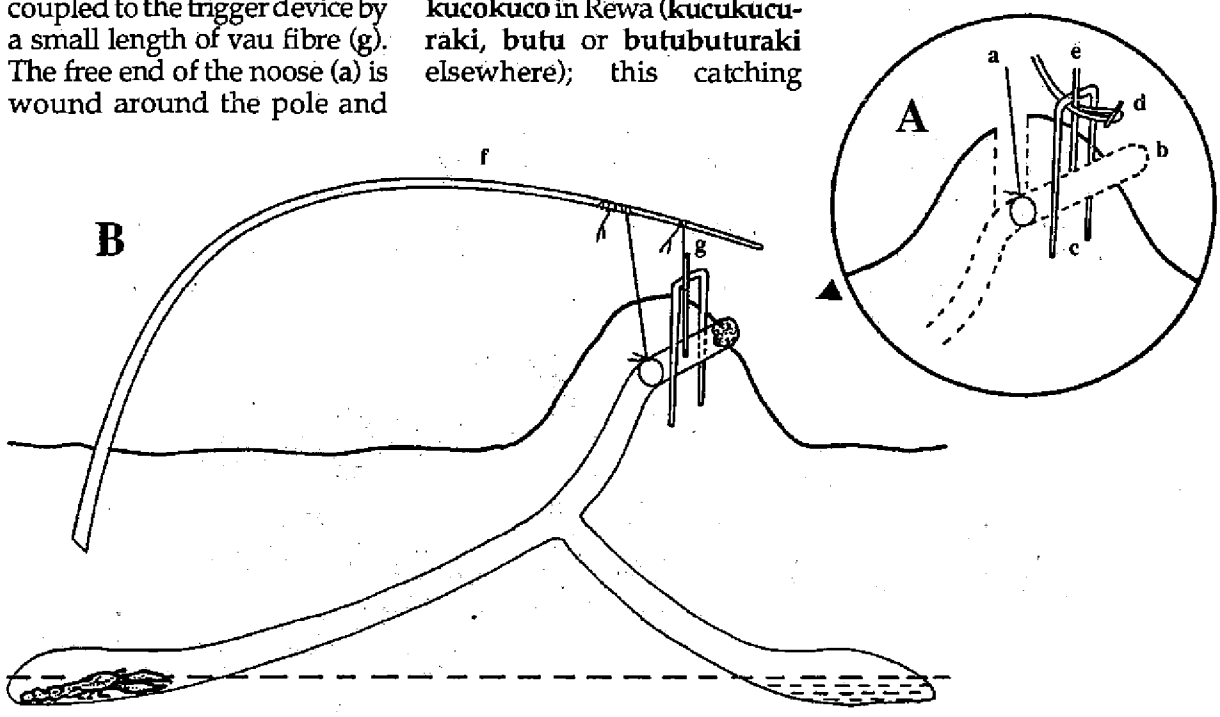
Another method of catching mana exists and is known as **kucokuco** in Rewa (**kucukucuraki, butu** or **butubuturaki** elsewhere); this catching method is only possible during high tides. It requires locating one of the several lower accesses to the burrow. Pressing vigorously into one of these depressions with the foot (or less commonly with the hand) sets in motion the water column inside the burrow.

The reciprocal movement of water and/or the trapper induces a disturbance in the neighbourhood of the base of the mound and drives the animal up the burrow to the surface, where it is caught in the hands.

Of the two fishing methods, it would seem that trapping is the domain of men, whereas **kucocuko** may be resorted to by either men or women.

Skilled trappers can set up about 10 snares an hour, and a success rate of 80—90 per cent is not uncommon. The mangrove lobster is sold in bundles of 5—6 individuals tied together at F$ 5 a bundle.

(Source: *G. Pillai, USP, Suva, Fiji*)



The mana trap: (A) Trap set up; (B) operational trap

ABSTRACT

Fisheries management and extended jurisdiction — Publication of *Management of World Fisheries*, subtitled *Implications of extended coastal state jurisdiction* and edited by Edward L. Miles, has been announced by the University of Washington Press, P.O. Box 50096, Seattle, WA 98145-5096.

The volume constitutes the proceedings of a workshop organised by the World Fisheries Project, Institute for Marine Studies, College of Ocean and Fishery Sciences, University of Washington, Seattle, and held from 8 to 11 July 1985.

During the last 10—15 years many changes have occurred in the world's fisheries and their management, relating particularly to the extension of authority of coastal nations over their resources to 200 miles. This volume provides a good look at those changes and an assessment of their effect and implications for the improvement of fisheries management in the future. The contributions, by recognised fisheries authorities, are divided into three parts.

Papers in Part I present an overview of the effects of extended fisheries jurisdiction (EFJ) on the management of fish stocks, including a comparison of the effects in a region under the open-access regime with regions under EFJ.

Part II evaluates in more detail the trends that have occurred in six regions: North-East Atlantic, East Central Atlantic, North-East Pacific, West Central and South-West Pacific, and the East Central and South-East Pacific.

Finally, in Part III, J.A. Gulland, Robert Kearney and Edward Miles present their views on whether and how fishery management might be improved under EFJ. Some of the conclusions include: managing fisheries by objective (indeed defining fishery management objectives); elaborating in more detail the nature of authority needed to make timely decisions and take effective action; defining specific management alternatives and evaluating their probable consequences; and others. Indexed, the 318-page hard-bound volume is sold by the publisher for US$ 30.

Vacancy advertisement — Marine Resources Adviser

The United States Agency for International Development (USAID) seeks qualified candidates for the position of Marine Resources Adviser in the Agricultural Development Office. A three-year contract is envisaged with U.S.A.I.D.'s Regional Development Office/South Pacific (RDO/SP) in Suva, Fiji.

Minimum qualifications for this position include:
— BS in relevant field (fisheries, economics, business);
— Three years experience in fisheries and/or marine resources development in a small island country.

Preferred qualifications include:
— MS or higher degree in relevant field (fisheries, economics);
— Private sector experience in fisheries in the Pacific Islands;
— A.I.D. project implementation experience.

The Marine Resources Adviser (MRA) will be responsible for implementation and management of RDO/SP's Pacific Islands Marine Resources Project (PIMAR). The MRA will be directly responsible to the Agricultural Development Officer. Preference will be given to U.S. citizens.

PIMAR is a 5-year, US$ 13.7 million foreign assistance project to six Pacific Island countries. PIMAR has country components in: Cook Islands (black pearl culture development), Tonga (small-scale tuna longlining), Tuvalu (bottomfish fishery development), Kiribati (lagoon assessment and management), Fiji (commercial fisheries development), and Papua New Guinea (private sector fisheries development).

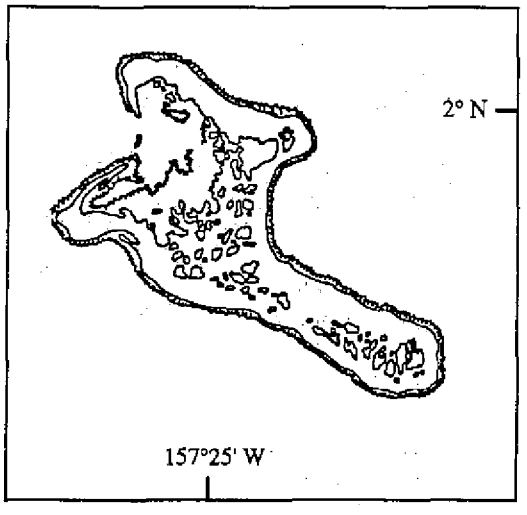
For further information on this posting, please contact: Ms. Sharon Fee, Agricultural Development Officer, USAID RDO/SP, P.O. Box 218, Suva, Fiji. Phone: (679) 311 399, Fax: (679) 300 075. Please send applications and curriculum vitae to Ms. Fee at the above address. Deadline for receipt of applications is 30 April 1992.

MILKFISH CAPTURE ON CHRISTMAS ISLAND, KIRIBATI

by G.L. Preston
South Pacific Commission
Noumea, New Caledonia

Christmas Island, or Kiritimati as it is officially called, is in the Line Islands, one of the four island groups that make up the Republic of Kiribati. It has the distinction of being the world's largest island of purely coral formation and for the most part it is flat and somewhat featureless, the highest point being only a few metres above sea level. The shallow lagoon is heavily loaded with sediment and has a single, wide passage in the west: water in this area is exchanged fairly regularly and is of normal salinity, but water temperatures, salinity and turbidity progressively rise the further one goes away from the pass, due to the high rate of evaporation and low rate of water exchange.

These features make the lagoon a very favourable habitat for two related fish species: bonefish (*Albula* spp.) which attract game fishermen from Hawaii and the mainland USA to Christmas Island for what is widely acknowledged to be some of the finest bonefishing in the world; and milkfish (*Chanos chanos*), which are prized as food by Gilbertese people and are netted fairly intensively by local fishermen using monofilament gillnets.



Map of Kiritimati (Christmas Island)

In fact, since gillnetting also captures bonefish, something of a conflict was arising in late 1989, when I visited the island in connection with a survey of pearl oyster resources. Those local people who acted as guides for visiting game-fishermen were becoming increasingly upset at net fishermen targeting more and more on bonefish. While they recognised the need of subsistence fishermen to feed themselves and their families, they also pointed out that fishing-related tourism was practically the only industry bringing money into the Kiritimati economy at that time. There was much talk that 'something should be done', although no-one seemed sure exactly what.

Much of the eastern part of the atoll is covered in enclosed or semi-enclosed hypersaline ponds which only refill on the spring tides. Some of these are used for commercial salt production, while others have in the past been successfully used to cultivate brine shrimps, whose 'eggs' (they are actually not eggs but cysts) are a valuable product used as food for aquarium fish. More recently, quite a number of the saline ponds have been linked in a complex network of man-made canals equipped with simple wooden sluice gates or other forms of barriers. By opening and closing the sluices at appropriate times of the tide, water-flow through the canal/pond system can be controlled and this has led to the development of an interesting fishery, which is perhaps unique in the Pacific.

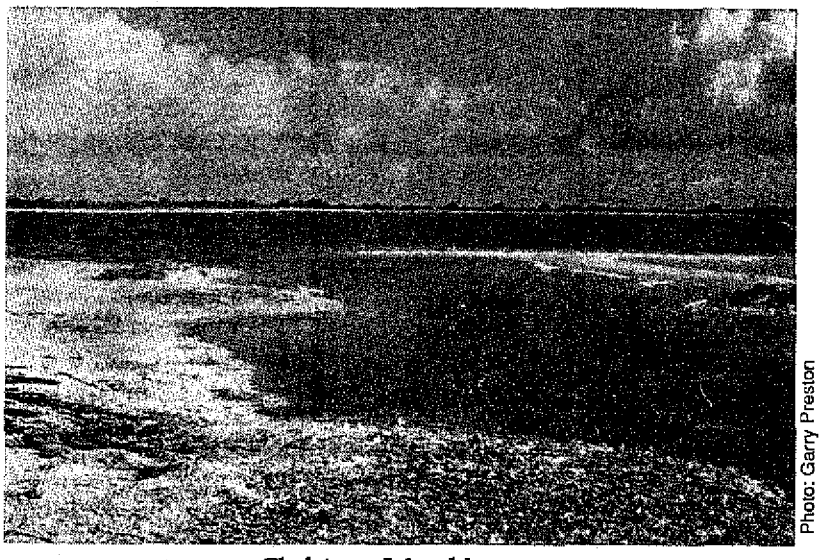
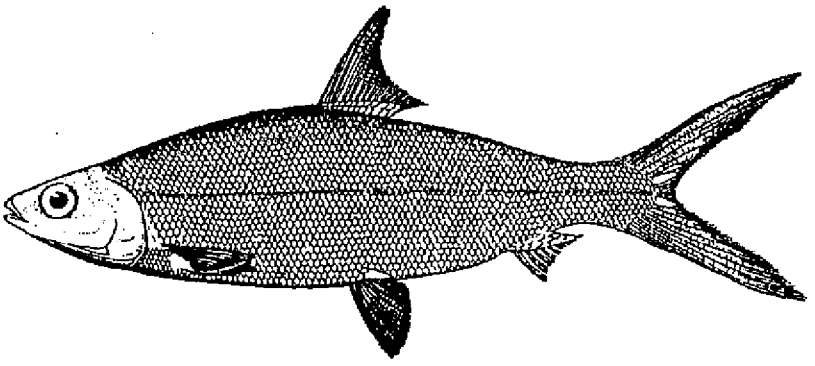


Photo: Garry Preston

Christmas Island lagoon

Juvenile milkfish naturally follow the tide, swimming up the beach, for instance, as the tide rises. This behavioural feature is widely known and allows the capture, by dip-netting or trapping, of fry for milkfish farming in many South-East Asian countries. This feature also causes juvenile milkfish to enter the Kiritimati salt ponds at high tides, where they then remain and grow in a semi-captive state, their escape being prevented at first by their tide-following instincts. As the fish grow older, they lose the tendency to swim with the tide, but by this stage they are too large to escape from the ponds through or over the sluice boards.

Removing sluice boards in the canals on an incoming tide lets a flow of less saline water into the hypersaline ponds. This attracts the milkfish, which aggregate around those sluices that have been opened. The staff of Kiritimati's Fisheries Division then gill-net the fish in



their aggregations and sell them to the Marine Export Division (MED), a government-run company which is charged with commercial development of Kiritimati's fisheries and exports locally-caught fish to Hawaii.

Although some of MED's export fish is caught troll fishing (Kiritimati is also one of the richest wahoo grounds in the Pacific) and deep-bottom fishing (SPC Master Fisherman Pale Taumaia helped carry out the first bottom-fishing trials in Kiritimati in 1984, and achieved excellent catch rates), milkfish is the mainstay of the MED operation.

During one visit to one sluice gate, about 20 good-size milkfish (1—2 kg each) were taken in 5—10 minutes. The Fisheries staff say they get anything from 250—500 kg a day when they are fishing seriously. Serious days are Monday and Tuesday, since the fish are exported fresh to Hawaii on the weekly Wednesday flight to Honolulu. Milkfish are very bony, but are nevertheless much loved by Hawaii's large Filipino community, who are the principal consumers, as well as by the Kiritimati Islanders (including the Fisheries staff) themselves.

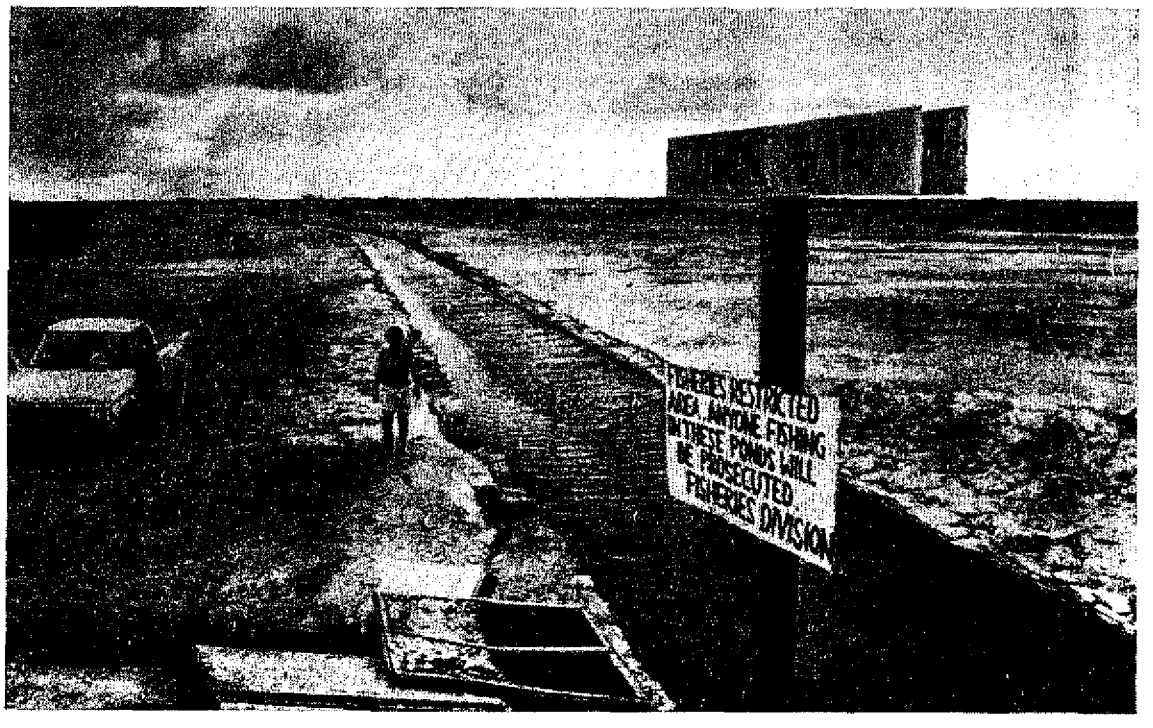


Photo: Garry Preston

Man-made channels such as these criss-cross parts of Kiritimati, linking salt ponds and the main body of the lagoon.

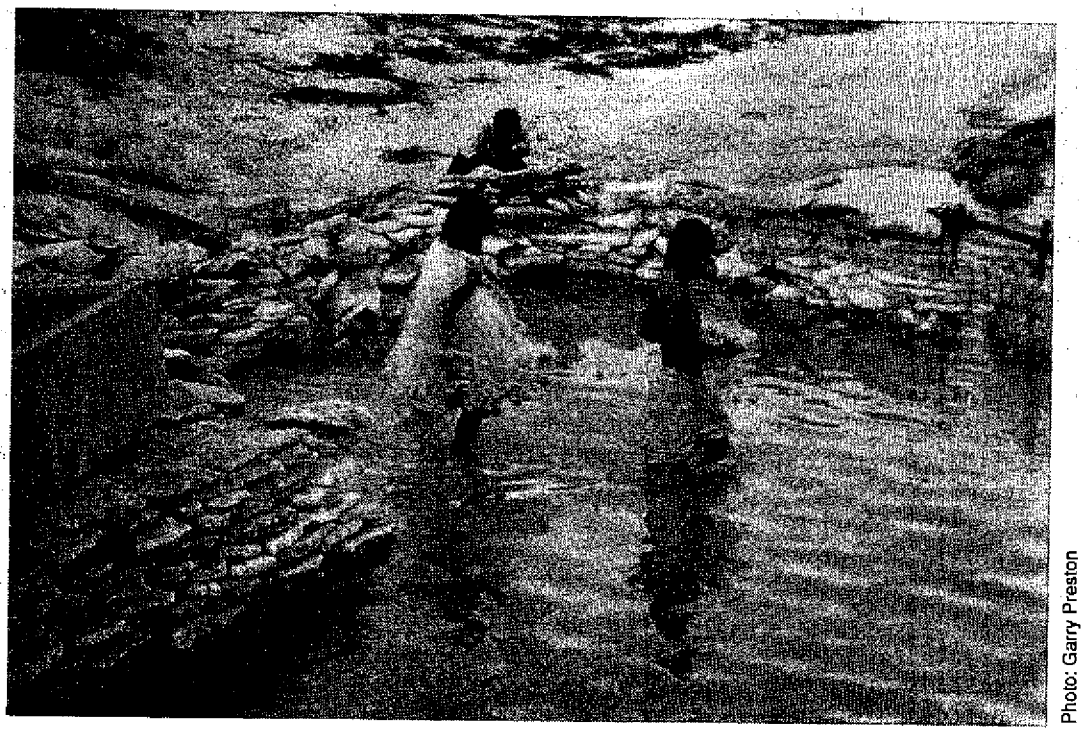


Photo: Garry Preston

Gill nets are set in a a circle in the enclosure in front of the gate. Splashing and noise-making by the fishermen help scare the fish into the net, from which they are immediately removed.

Photo: Garry Preston

Boxed fish are transported rapidly to Marine Export Division, which will send them fresh on ice to Hawaii within two days of capture

TRAINING AND EDUCATIONAL MATERIALS ON MARINE ENGINES

by M. Izumi
South Pacific Commission
Noumea, New Caledonia

This article introduces a local training course in New Caledonia and provides some information on educational material available at SPC. The Ecole des métiers de la mer (Maritime College), Noumea and the Lycée professionnel de Touho (Technical College), Poindimie, North Province, New Caledonia, enquired whether any educational material on marine engines (outboard motors, diesel engines etc.) and related information were available at SPC for improvement of their college programmes.

One of the field training courses conducted by the Ecole des métiers de la mer (EMM) was observed in order to see actual conditions of the training course and identify suitable educational material for the training programme.

The field training programme of the EMM, requested by the Provincial Governments (Northern, Southern and Loyalty Islands) is organised and conducted by the EMM under the administration of New Caledonia's Territorial Government, in co-operation with each provincial government.

This year's training programme started in January 1992. It will continue for six months in the Northern Province and Loyalty Islands and for a year in the Southern Province. The training programme consists of the following courses:

— Mechanics and maintenance of outboard motors (petrol, diesel and kerosene);

— Safety operation of outboard motors;

— Safety operation and maintenance of small boats;

— Mechanics and maintenance of inboard diesel engines;

— Fish handling and maintenance of ice machines;

— Demonstration of fishing techniques;

— Electrical system of small boats.

Each course is conducted for a week at field locations, about 20 throughout the Territory. At each main location, two or three training courses on the same subject are conducted for the convenience of trainees' participation. For instance, there are three training courses on outboard motors on Ouvea Island, one in the north , one in the centre (Fayaoué) and one in the south (Mouli village). Also, three training courses on boats are conducted. Therefore, a total of six training courses will be organised on Ouvea from January to June 1992.

The teaching material and text/manuals in the course are well prepared with originality. Actual outboard motors (Yamaha 25 hp) and models (piston cylinder and propeller) are used for demonstration and practical work. Besides the outboard motor training, video-tapes on post-harvest are introduced to the participants, who are generally interested in further fishing activities. The course is a good example of co-operation between an experienced professional technical teacher and a local fisheries extension officer.

Besides the field training programme, EMM runs the following programme in Noumea.

— Three-month course (twice per semester): 25 m boat navigation for the French national certificate;

— Six-month course (once per semester): CMP (Maritime and Fisheries Certificate) for New Caledonia's certificate;

— Three-month course (once per semester): marine engine (450 hp) for the French national certificate;

— Three-week course (once per semester): PCM (Certificate of Small Boat Operation, engine: 150 hp) for French national certificate.

As a result of observation of the field training course, communications with major Japanese marine engine companies and the material search at SPC, the a considerable amount of information was located. Tables on the following pages show educational material on marine engines available at SPC.

Two major Japanese marine engine companies provided educational material on marine engines such as textbooks, wall charts, video-tapes, pamphlets,

slides and catalogues, which are available at a reasonable price from both companies.

Textbooks are used for the preparation of hand-out material in the training course. A good combination of textbooks will produce adequate training manuals. Wall charts (72 cm x 102.5 cm) are good for spatial workshops or classrooms at colleges or training centres. Video-tapes and slides are good supporting material for any training courses and for self-learning, and are highly recommended for use in the course.

Pamphlets and catalogues give good information to trainees on various engine models which are currently available in the world market. Films are only suitable for classrooms at colleges or training centres because of the need for certain facilities and equipment.

A number of textbooks on marine engines are published by international organisations, regional organisations, bilateral aid agencies, commercial companies and others.

An effective use of the above material will help your training programmes. Further information on educational material on marine engines would be very much appreciated.

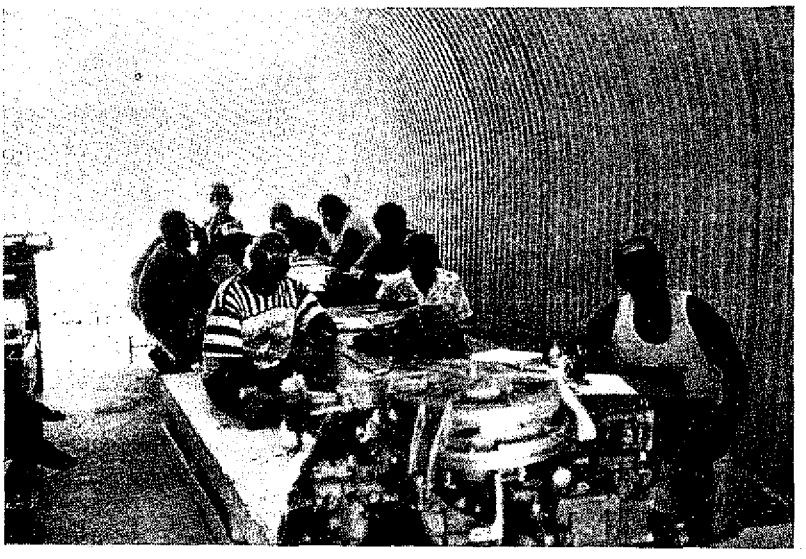


Photo: Masanami Izumi

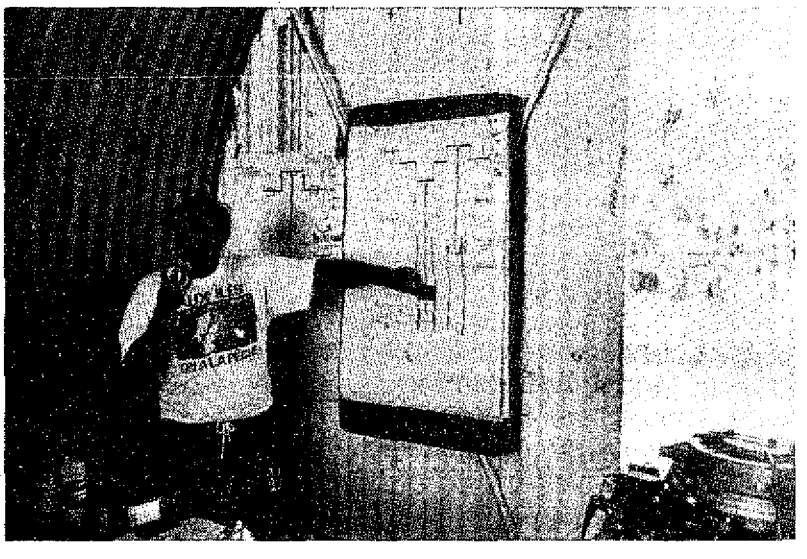


Photo: Masanami Izumi

Training course on outboard motor mechanics and maintenance held at Mouli village, Ouvea Island, New Caledonia from 24 to 28 February 1992

List of materials on marine engines for educational purposes

1. Yanmar Diesel (marine diesel & outboard motor)

Item	Description	Type	Reference no.
1	Marine engine handbook	book	AOA1744
2	Diesel engine instruction book 1	book	AOA0002
3	Diesel engine instruction book 2 (industrial)	book	AOA0003
4	Diesel engine instruction book 3 (marine)	book	AOA0004
5	Marine gear (mechanical type for small engine) & stern arrangement	wall chart	AOA3253-8404
6	Cooling system (HA)	wall chart	AOA3254-8404
7	Lubrication system (HA)	wall chart	AOA3255-8404
8	Marine gear section (Yanmar)	wall chart	AOA3256-8710
9	Marine gear oil flow (Yanmar)	wall chart	AOA3257-8710
10	Marine gear power train (NICO)	wall chart	AOA3258-8404
11	Marine gear section (NICO)	wall chart	AOA3259-8404
12	Marine gear oil flow (NICO)	wall chart	AOA3260-8404
13	Fuel system (HA)	wall chart	AOA3262-8404
14	TD series periodical maintenance (1)	wall chart	AOA3336-8710
15	TD series periodical maintenance (2)	wall chart	AOA3336-8710
16	TD series periodical maintenance (3)	wall chart	AOA3336-8710
17	TD series major checkpoints in installation	wall chart	AOA3336-8710
18	D27 RCL 3DIM (French/English)	wall chart	AOA3828-8806
19	D27 RCL (French/English)	wall chart	AOA3828-8806
20	YDOM (diesel outboard motor) PER	wall chart	AOA3850-8703
21	YDOM (diesel outboard motor) FLAT	wall chart	AOA3851-8703
22	Engine installation for workboat	video tape	
23	*Y-DOM (diesel outboard motor) disassembly/reassembly*	video tape	
24	TD engine disassembly/reassembly	video tape	
25	Diesel outboard motor (French)	pamphlet	
26	Diesel outboard motor (English)	pamphlet	

2. Yamaha Motor (outboard motor)

Item	Description	Type	Reference no.
1	Service promotion guide '91	copy	298128
2	Training text (1) to (7)	book	071768
3	Training text (8)	book	071793
4	What is an outboard motor	slides	071671
5	Engine for outboard motor	slides	071672
6	*Lubrication*	slides	071673
7	Carburettor	slides	071674
8	Ignition system	slides	071675
9	Spark plug	slides	071676
10	Power transmission system	slides	071677
11	Propeller	slides	071678
12	Cooling system	slides	071679
13	Mounting and demounting	slides	071680
14	Inspection and maintenance	slides	071681
15	Troubleshooting	slides	071682
16	Instruments	slides	071683
17	Special tools	slides	071684
18	General service I	video tape	NK-001E
19	General service II	video tape	NK-002E
20	Special tool	video tape	NK-003E
21	O/B basic knowledge	video tape	NK-004E
22	Crankshaft reassembly	video tape	YE-001E
23	Oil mixing chart (litres)	wall chart	071642
24	Oil mixing chart (gallon)	wall chart	071746
25	Service data chart ('91 all line-up)	wall chart	296041
26	Service data book ('91 all line-up)	book	296502
27	Inspection poster (pre-delivery inspection & service)	wall chart	297001
28	Inspection poster (periodic inspection & service)	wall chart	297000
29	*Cut-away view poster* (250A)	wall chart	031408
30	Special tool manual (all line-up)	book	298111
31	Special tool manual (supply (T.P.I.))	book	298121
32	Assembly chart (E25F, E25FK, E20FK)	wall chart	295027
33	Assembly chart (other models)	wall charts	
34	Service manual (all models)	books	
35	Parts catalogue (all models)	catalogues	
36	Kerosene outboard motor	pamphlet	

List of materials on marine engines for educational purposes - cont'd

3. Yamaha Motor (marine diesel)

Item	description	type	Reference no.
1	Service promotion guide '91	copy	298128
2	ME & MEF how to use S.S.T.	video tape	072224
3	Periodic inspection poster (ME63, ME125, ME188)	wall chart	072175
4	Periodic inspection poster (ME130F, ME130FT, ME200F, ME200FT, ME200FTI)	wall chart	072186
5	Periodic inspection poster (MU1, MU2)	wall chart	072198
6	Periodic inspection poster (ME380T, ME400(L), ME650)	wall chart	072226
7	Assembly chart (ME130F, ME130FT)	wall chart	072194
8	Assembly chart (other models)	wall charts	
9	Service manual (all models)	books	
10	Service guide (NSD 161)	book	070201
11	Parts catalogue (all models)	catalogues	
12	Installation manual (all models)	books	
13	Engine & propeller selection manual (all models)	books	
14	Recommended parts list	copies	
15	Marine diesel sales guide (all models)	book	072204

List of films on marine engines for educational purposes

Publication List of Marine Engine for Educational Purpose - films

Item	Title	Length	Producer	Distributor	Ref.
1	Clean air that engines may live	10	John Deere, U.S.A.	John Deere, U.S.A.	(1)
2	Clean fuel that engines may live	9	John Deere, U.S.A.	John Deere, U.S.A.	(1)
3	Construction of diesel engines	15	U.S.Navy	United World Films Inc., U.S.A.	(1)
4	Diesel engine—ideal diesel cycle	6	McGraw-Hill Book Co., U.K.	McGraw-Hill Book Co., U.K.	(1)
5	Diesel engine lubrication	31	Mobil Oil Co., U.K.	Mobil Oil Co., U.K.	(1)
6	The diesel fuel system	12	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
7	DPA fuel pump	20	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
8	Diesel lubricating and cooling systems	9	Audio Productions, U.S.A.	United World Films Inc., U.S.A.	(1)
9	Efficient cooling system that engines may live	14	John Deere, U.S.A.	John Deere, U.S.A.	(1)
10	Four 99 servicing technique	20	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
11	Functions of lubrication that engines may live	13	John Deere, U.S.A.	John Deere, U.S.A.	(1)
12	Good valve job pays	24	Ethyl Corporation, U.S.A.	Ethyl Corporation,	(1)
13	Ignition and spark plug	19	Champion Spark Plug Co., U.S.A.	Champion Spark Plug Co., U.S.A.	(1)
14	Introducing the turbocharger	6	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
15	Six 354 servicing technique	19	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
16	Thin film lubrication	29	Mobil Oil Co., U.K.	Mobil Oil Co., U.K.	(1)
17	Top overhaul	20	Perkins Engines Ltd., U.K.	Perkins Engines Ltd., U.K.	(1)
18	Fishing is their business	17.5	Caterpillar Tractor Co., U.S.A.	Caterpillar Tractor Co., U.S.A.	(2)
19	The magic of a name	24	R.H.R. Productions & Film Producers' Guild, U.K.	R.H.R. Productions & Film Producers' Guild, U.K.	(2)
20	Diesel engine lubrication	33	B & W	B & W	(3)
21	Ensuring efficiency	27	B & W	B & W	(3)

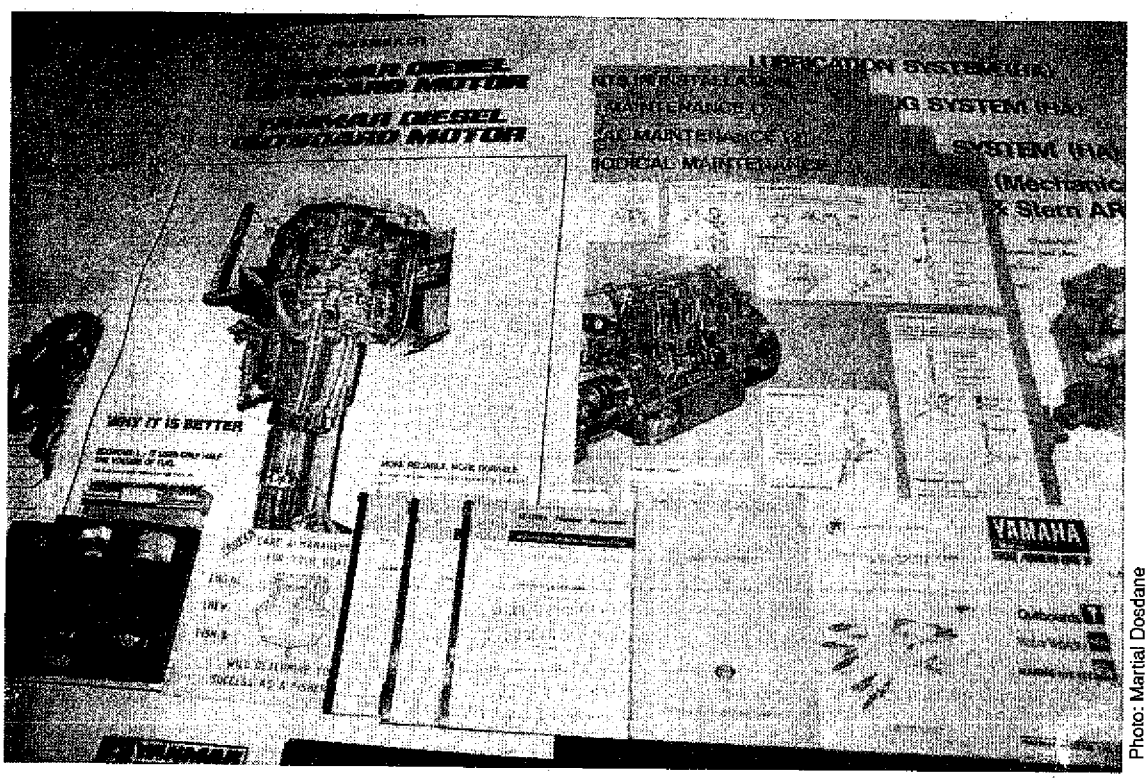
Reference:
(1) Food and Agriculture Organization of the United Nations (1979).
FAO film loan catalogue. 277 pages.
(2) Department of Primary Industry, Fisheries Division (1973).
Union catalogue of films on fisheries and related subjects available in Australia.
Fisheries Paper, no. 13, 173 pages.
(3) Department of Primary Industry, Fisheries Division (1979).
Union catalogue of films on fisheries and related subjects available in Australia.
Australian Fisheries Paper, no. 13, 224 pages.

List of books on marine engines for educational purposes

Item	Title	Author, year of publication & page nos.	Publisher	Details	Pages
1	Marine engineering I	Overseas Fishery Cooperation Foundation (1985) - 299 pages	Overseas Fishery Cooperation Foundation	1. outline of fishing boat engines 2. internal combustion engine 3. shafting and propellers 4. fuel and lubricating agent	1-46 47- 219 220 - 257 258 - 299
2	Visual training manual for Fiji's rural fishermen's training programme	Fisheries Division, Government of Fiji (1985) - 28 pages	Fisheries Division, Government of Fiji & Food and Agriculture Organization of the United Nations	1. two stroke cycle in outboard engines 2. principles of oil in the engine 3. oil system diagram 4. fuel & air cycle 5. fuel system diagram 6. cooling water system 7. periodical check 8. power transmission 9. propeller shaft assembly	17 18 19 20 21 22 23 24 25
3	Trolling techniques for the Pacific Islands - a manual for fishermen Handbook no. 28	G. L. Preston, P. D. Chapman, P. D. Mead and P. Taumaia (1987) - 162 pages	South Pacific Commission	1. fishing action - before setting off (avoiding accidents) 2. after fishing - care of the boat (engine maintenance) 3. trouble at sea - breakdowns (engine maintenance)	105 139 150
4	Engineering applications: 1. installation and maintenance of engines in small fishing vessels Fisheries technical report no. 196	B. Mutton (1979): English version 127 pages (1979): French version 128 pages	Food and Agriculture Organization of the United Nations		
5	Engineering applications: 2. hauling devices for small fishing craft Fisheries technical report no. 229	B. Mutton (1982): English version 146 pages (1985): French version 154 pages	Food and Agriculture Organization of the United Nations		
6	Internal combustion engine (III) Text/reference book no. 9	M. Tanaka (1979) - 18 pages	Southeast Asian Fisheries Development Center		
7	Operation and maintenance of diesel engine Text/reference book no.10	S.Yamamoto (1980) - 25 pages	Southeast Asian Fisheries Development Center		
8	Introduction to engineering Text/reference book no. 14	H. Mizuno (1980) - 95 pages	Southeast Asian Fisheries Development Center		
9	Combustion engine, parts I, II and III Text/reference book no. 15	M. Tanaka (1980) - 163 pages	Southeast Asian Fisheries Development Center		
10	Marine engineering Text/reference book no. 16	M. Tanaka (1980) - 137 pages	Southeast Asian Fisheries Development Center		
11	Trouble shooting of diesel engine Text/reference book no. 19	S. Yamamoto (1981) - 19 pages	Southeast Asian Fisheries Development Center		
12	A simplified method for calculation of the cruising speed and cruising propeller dimensions of a small fishing boat Text/reference book no. 22	S. Yamamoto (1981) - 41 pages	Southeast Asian Fisheries Development Center		
13	Selection and installation of a fishing boat engine Text/reference book no. 23	S. Yamamoto (1982) - 54 pages	Southeast Asian Fisheries Development Center	1. selection of fishing boat engine 2. installation of fishing boat engine 3. installation guidance	1-6 6-11 12-54

List of books on marine engines for educational purposes - cont'd

14	Stern equipment for small fishing boat Text/reference book no. 24	S. Yamamoto (1982) - 60 pages	Southeast Asian Fisheries Development Center		
15	Fundamentals of diesel engine (questions & answers) Text/reference book no. 25	S. Yamamoto (1982) - 72 pages	Southeast Asian Fisheries Development Center	1. horse power 2. fuel consumption 3. engine load 4. engine cycles 5. combustion 6. supercharging 7. valve timing 8. vibration 9. engine trouble 10. gas laws	1-9 9-13 13-17 18-24 25-34 34-41 41-54 54-58 58-66 66-71



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Educational material on marine engines

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