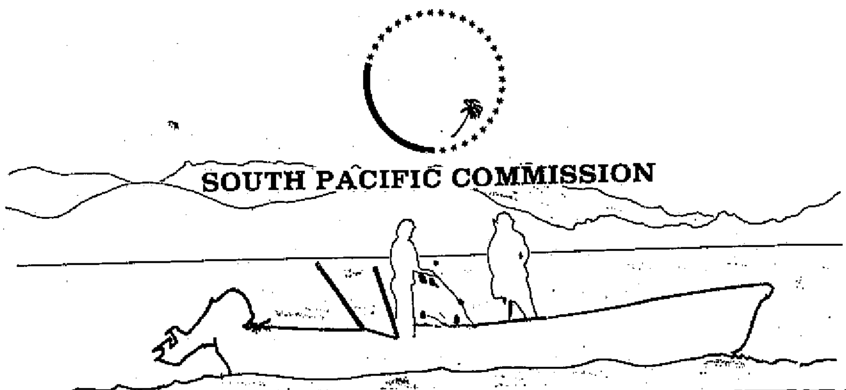

FISHERIES NEWSLETTER

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Contents

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SPC ACTIVITIES

DEEP SEA FISHERIES DEVELOPMENT PROJECT NOTES

Republic of Palau

After completing his assignment in French Polynesia (see *SPC Fisheries Newsletter* #42) Master Fisherman Lindsay Chapman was appointed to supervise the DSFD Project's third visit to Palau. The visit followed a request for assistance in conducting a trial-fishing survey in the hope of locating productive, unexploited deep-bottom fishing grounds. The search for new grounds was prompted by reports that catches of deep-water snappers on grounds located during previous DSFD Project visits were declining; part of Lindsay's brief was to conduct comparative fishing trials to ascertain the accuracy of such reports.

Lindsay arrived in Koror on 10 October, 1987 and in the early stages of the visit fished areas to the west and south-east of Koror, aboard the Palau Marine Resources 11 m fibreglass vessel *Mesekiu* , skippered by experienced fisheries officer Pablo Siangeldeb. Despite rough sea conditions caused by cyclones to the north and persistently strong currents over fishing sites, Lindsay was soon able to determine that catch rates in this well-fished area were indeed low, and that fish species which Lindsay was accustomed to taking from 200-300 m were here more commonly found from 130-160 m.

Lindsay is presently awaiting the arrival of new echo-sounding gear which he hopes will assist in the search for new fishing grounds and in locating offshore seamounts as FAD deployment sites. Later in the visit he hopes to travel to the northern states of Babeldoap Island to fish areas surveyed by SPC Master Fisherman Pale Taumaia in 1983, for the purpose of comparing changes in catch rates and species composition of catches from that visit with the present one.

Palauan fishermen sorting catch

Kosrae - Federated States of Micronesia

Archie Moana continued on assignment in Kosrae, conducting a training programme for owners of Kosrae's new fleet of 70 fibreglass catamarans. In addition to practical fishing training and gear construction, Archie carried out echo-sounding surveys to locate fishing grounds. These surveys included a trip aboard Kosrae's pole-and-line vessel *Mutunte* in search of a seamount reported to lie about 100 km off the island, and the use of a fast motor launch *Hunter* in echo-sounding surveys for deep-bottom fishing grounds along Kosrae's outer reef-slope.

Archie was also asked to advise on suitable sites for FAD deployment. After noticing on several occasions, when deep-bottom fishing off Utwe Harbour, that yellowfin tuna were rising to take bait scraps, Archie decided on the area as a good FAD site, accessible even to canoe fishermen. While echo-sounding to select the exact anchoring spot, Archie's echo-sounder revealed a small seamount rising to about 300 m and he decided to deploy the FAD over it.

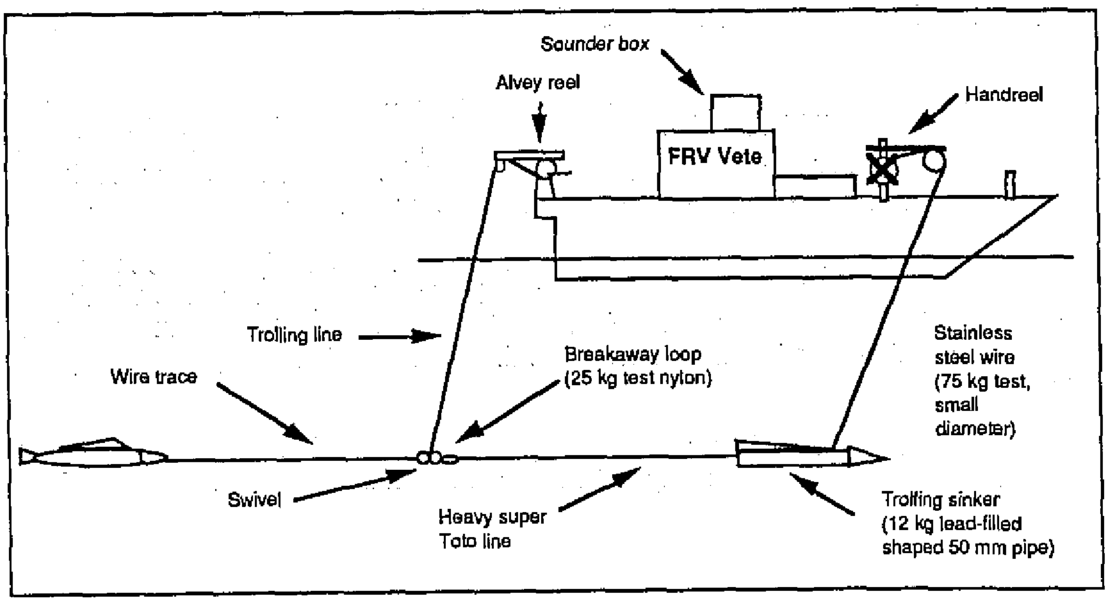
Returning to the spot the next day with two trainees, Archie tied up to the FAD and had the crew lower their baited deep-bottom fishing rigs to the bottom. The result was immediate and spectacular — of the 12 hooks lowered on the three lines, nine were taken right away by **kiuhf srusrah** or longtail snappers (*Etelis coruscans*). When strong currents began to flow over the seamount about two hours later the crew had landed 25 **kiuhf srusrah** averaging around 4 kg each, as well as 16 kg of other species. This catch was a good deal better than that taken elsewhere with more fishing effort.

At the conclusion of the Project stay, on 15 December, 1987, Archie had conducted training for 34 local fishermen as well as four staff of the Marine Resource Department.

Tonga - Gear development sub-project

The gear development sub-project based in Vava'u, Tonga, continued under the supervision of Master Fisherman Paul Mead.

Paul has recently been experimenting with the deep-trolling of flying fish dressed as baits, using a variety of 'cannonball' downrigger arrangements to take the baits deep. The FAD monitoring programme by echo-sounding and inspection dives also continues.



Deep-trolling gear arrangement

In October Paul motored the Project's assigned fishing vessel *Vete* from Vava'u to Nuku'alofa for an engine overhaul.

REGIONAL FISHERIES TRAINING PROJECT

Regional refrigeration course in Papua New Guinea

Following the success of the two refrigeration courses run in Rarotonga in 1985 and 1986, SPC received a request from the government of Papua New Guinea for a similar course, mainly for Papua New Guinea participants. This was held at the National Fisheries College, Kavieng, from 3 August to 4 December 1987, for eleven participants from PNG and six regional trainees.

Adopting the approach developed for the earlier courses, the eighteen weeks of training were broadly divided into two sections, with the initial nine weeks covering fundamental refrigeration theory and practice, including refrigeration equipment, components and tools. The second nine weeks were largely practical and included commercial service calls and supervised workshop experience in the repair of a variety of equipment. The course also included diesel maintenance and repair, electrical repairs, and training in a variety of welding and soldering techniques.

The Papua New Guinea trainees were funded by the Government of New Zealand. The costs for the six regional students were covered by UNDP (1), CFTC (1), FAO/UNDP (2), and AIDAB/SPC (2). FAO/UNDP met all costs associated with supplying the senior tutor, Mr M. Vincent, and the Government of Papua New Guinea provided the use of the college and services of staff for administrative, teaching and support duties.

FAD workshop held in Kiribati

Nineteen participants from 16 countries attended an SPC Regional Fisheries Training Project FAD Workshop hosted by the Government of Kiribati at its Marine Training Centre in Betio, Tarawa from 26 October to 7 November, 1987.

The workshop, co-ordinated by SPC Fisheries Training Officer Alastair Robertson, involved participants in an extensive review of FAD design, materials procurement, construction and deployment. Special emphasis was given to an exchange among participants of experiences of premature FAD losses and attempts to identify technical errors associated with such failures.

Expert technical instruction was provided by Lt. R. Boy, Ocean Engineer with the Civil Engineering Division of the United States Coast Guard, a specialist in FAD design; and by Capt. A. Scotland, Tutor-in-charge of New Zealand's School of Fishing, who dealt with the theory and practice of identifying FAD deployment sites by echo-sounding.

The workshop sessions were largely practical, with the participants constructing and deploying two permanent FADs, and making several sets with a practice FAD which could be retrieved and redeployed as required. Capt. Scotland conducted training in echo-sounding using a Simrad echo-sounder simulator, as well as practical training with equipment on board the deployment vessel.

Funding for 15 participants and core costs was provided by the Government of New Zealand; the FAO/UNDP Regional Fisheries Support Programme funded four other participants.

NEWS FROM IN AND AROUND THE REGION

FISHERIES TRAINING OFFICER APPOINTED AT IMR
(Source : *USP Bulletin*)

Mr Hugh Walton recently joined the University of the South Pacific's (USP) Institute of Marine Resources as Fisheries Training Officer. Before going to USP, Mr Walton was working in the Ministry of Agriculture and Fisheries in Nelson, New Zealand.

Mr Walton received his Bachelor's degree from the University of Canterbury and training in the Nelson Polytechnic Nautical School. He is a qualified skipper and radar operator and has considerable experience in maintenance of fishery equipment, as well as in exploratory fishing and fishing business management.

NEW POSTGRADUATE COURSE IN FISH MARKETING
(Source : HCHE)

Starting in October 1988, the Humberside College of Higher Education (HCHE) in Britain will be running, annually, an intensive one-year course in fish marketing. The course is sponsored by the Commission of the European Communities, the British Council, and the British Overseas Development Administration.

On successful completion of the course, candidates will be awarded the College's post-graduate Diploma in Fish Marketing. An extended version of the course, leading to an M.Sc. degree in fish marketing, is also under consideration.

For further information, contact:

K.H. Haywood, Head of School of Fisheries Studies, Humberside College of Higher Education, Queen's Garden, Hull, HU1 3DH, United Kingdom.

MARINE MAMMAL TROUBLES IN WESTERN SAMOA
(Source : *Samoa Times*/ Mike McCoy)

The following article appeared in Western Samoa's *Samoa Times* in late September, 1987.

> The search for the two fishermen whose boat was swamped when a large fish somehow got itself tangled up by the boat's anchor rope has been abandoned after three days. News of the freak accident was given the police by a third fisherman who managed to swim ashore after the accident happened at about 3 pm on Monday. Superintendent Galuvao Tanielu, the police press spokesman, said the survivor, Petelo Falaniko, told the police his companions Galu Togia of Mulifanua and Alo Fa'alili of Motootua were still clinging to the overturned aluminium alia when the fish started to pull it away. Petelo, the superintendent said, told the police he had grabbed an empty container and used it to swim ashore when he saw the others being dragged away with the boat.
>
> 'According to Petelo their alia was anchored off Saleaula, Savaii, when it was suddenly overturned by the fish,' Galuvao said. Shortly after Petelo swam ashore at Safune he was taken to Safotu and the police there informed their colleagues in Apia by radio, but by then it was too dark to do anything on Monday night. Early Tuesday morning a Polynesian Airlines light aircraft searched for the boat and later sighted it off Falelima, several miles from where it was first overturned. Galuvao said that the information was that the

alia was submerged and the tail of the fish was on top of it, but no one was seen with it. The aircraft landed and gave directions to other fishermen as to where the boat had been seen, but when fishing boats got there the fish had dragged the boat away again. A later flight again sighted the boat, this time off Salailua after 5 pm, but again when fishing boats got there the boat had gone. Galuvao said that the police had decided to call off the search because even though the the boat had been seen twice there was definitely no sign of anyone still with the boat as it was submerged both times it was sighted from the air.

Mike McCoy, Fisheries Adviser with Western Samoa's Fisheries Department, gave us the following notes on events concerning marine mammals in Western Samoa:

I'm writing to let you know two events here. The first is covered by a rather sensational news story *[above]*. It is not very accurate, but the bare bones are that an alia anchored for bottomfishing seems to have been dragged away by a whale entangled in the anchor line, with the loss of two fishermen's lives. This sounds pretty far-fetched, except for two points: several people I've talked to say that the survivor stated they had two anchors out. Since they were fishing close-in near the lava flow in Savai'i, this appears reasonable to believe. They could have put out one bow anchor and one stern anchor to keep them out of the surf (Savali Time says it's a steep dropoff there close in). Secondly Savali reported losing a FAD to a whale some years back. He says they retrieved the FAD with the live whale still entangled. Others have told me the tail was displayed in the fishmarket here as proof. Anyway, as far as I can see (without having been there), the story about the whale appears true. The fullest account is that they were dragged some distance with the whale at the bow while the three fishermen on board argued as to what to do. While arguing about whether or not to cut the line (they had not seen what was dragging them) the whale surfaced behind the boat, and then dragged it backwards, capsizing it and throwing them into the water. The one man swam ashore while the other two stayed with the boat. I doubt the story about an airplane sighting of the hull the following day, as it was clear on the opposite side of the island, sixty or seventy miles away.

I had been out the previous weekend, and saw a huge whale jump just ahead of me, about a half mile away. It was completely out of the water, and looked like a humpback or large sei whale (I was surprised I couldn't get a good identification), but it was completely out of the water and looked to be 15 or 20 m long at least. Other fishermen have been reporting whales near the schools where they are trolling.

Aside from the whale, the other bit of marine mammal information is that there is a serious problem developing around at least one existing FAD with porpoise taking fish off the line. I've experienced the same thing in Kona, but this is the first time I've seen it happen here. The animals started showing up about a month ago, and follow the schools away from the FAD for some distance. They are not present in the early morning hours, thus fishermen are able to get in about one or two hours of trolling before they show up. But once the porpoise are there, fishermen are forced to leave and scout schools far from the FAD. This pretty much negates the value of the FAD for trolling, except for the hour or two one can get in early. If fish are biting well, one can shorten up the lines and with really good fishermen you stand a 50-50 chance of beating the porpoise. But when fish are big, or not biting well, it's impossible to land them (talking about skipjack). I'd appreciate any feedback you or others might have on these two issues, or other similar situations of which any of you might be aware.

If readers from other parts of the region have experience of similar porpoise problems (and how to solve them), we would be glad to hear from you.

FISHERIES STATISTICS WORKSHOP HELD IN POHNPEI

(Source: National Marine Fisheries Service)

A two-week training workshop on microcomputer applications in fisheries was held recently in Kolonia, Pohnpei, Federated States of Micronesia. The course, sponsored by the FSM Division of Marine Resources, was the culmination of a two-year project to establish fishery data collecting and processing systems in each of the FSM States. FSM States are now using the same data base management software as all other Western Pacific Fishery Information Network (WPACFIN) areas and their data systems are therefore compatible with WPACFIN systems.

The workshop was taught by David C. Hamm, WPACFIN Program Manager, and involved students in daily practical training sessions, each student working at individual terminals. For the first seven days of the programme students progressed from an introduction to computer hardware and software through to data base management systems. Special emphasis was on data base design, quality control, report generation, and proper techniques of data base processing and maintenance.

The final three days were spent working on several island-specific applications and data bases, but concentrated on the most important of the data collecting and processing systems established during the two year project.

Eight individuals participated in the workshop, representing the FSM Division of Marine Resources, Pohnpei Division of Marine Resources, Micronesian Maritime Authority, Kosrae Division of Marine Resources, Truk Maritime Authority, and the Yap Fishing Authority.

OCEAN RESOURCES MANAGEMENT COURSE AT USP

(Source: University of the South Pacific)

The emergence of the Law of the Sea Convention, adopted in New York in April 1982, has brought dramatic changes to ocean affairs. This is the case because many of the principles and concepts embodied in the Convention are new, and dramatically different from those tenets on which the former laws governing the seas were based. Above all, the Convention has given coastal states (these include all island countries in the South Pacific region) extensive and comprehensive rights and obligations over marine resources in vast areas of ocean, replacing the old free-for-all practice.

The acceptance of the Convention by all the countries of the South Pacific region has made it necessary for these countries to review administrative procedures, formulate new policies and enact fresh legislation in order to accommodate the comprehensive and complex provisions of the Convention. Without such changes, the countries of the region will not be in a position to take full advantage of the potentially huge benefits due them under the new regime of the seas.

In accepting those new developments, the countries of the region recognised that wise management of ocean resources and other marine uses was essential if the full economic potential of these new entitlements was to be realised. It was also recognised that proper management would minimise the related dangers which the prospect of new wealth always brings: dangers of conflict, waste, and the degradation of the social and physical environment.

Against this background, the countries of the region, in 1986, established the Ocean Resources Management Programme, under the auspices of the South Pacific Forum Fisheries Agency and hosted by the University of the South Pacific, with support from the other regional organisations: SPEC, CCOP/SOPAC and SPC. The programme is funded by the Canadian International Development Agency (CIDA).

The training component of the programme consists of short, in-service courses as well as university degree courses offered at USP. The first of these degree courses was offered during the second semester, 1986. The expanded course (UU:301) offered this year will be enlarged to separate 200-level and 300-level courses next year (1988). Post graduate (M.A./M.Sc.) courses in various aspects of ocean resources management will also be offered in 1988.

This year's course will be a second-year option (200-level) for B.A. and B.Sc. students and a small number of public servants whom governments of the region may nominate. There are no prerequisites.

This course is necessarily broadly interdisciplinary in nature. The approach adopted places emphasis on management measures introduced or applied through administrative procedures, policy guidelines and legislative provisions at the national level, as well as management measures undertaken at the regional, and to a lesser degree, the international levels.

Topics covered include an introduction to international law, the Law of the Sea Convention (particularly as it applies to the countries of the region in regard to their national and administrative structures, resource and manpower planning strategies, policy development and relevant standing legislation), regional arrangements, agreements and treaties, international conventions, and, of course, the economic potential of the oceans.

As the student will need to know something about the ocean resources and other marine uses which are being managed, there will be lectures on living resources, non-living resources, the ocean-energy potential in the region, the marine environment and environment impact assessment, shipping, military uses of the ocean, and tourism.

There will also be sessions on arrangements to exploit ocean resources, including joint-ventures and the involvement of multinational corporations, delimitation of maritime boundaries, and surveillance of maritime zones, such as the 200-mile Exclusive Economic Zone (EEZ).

For further information on the USP course UU:301, or on the Ocean Resources Management Programme, contact the Ocean Resources Management Programme Office, phone 313900 Ext. 289, 258 and 297, or offices at old tutorial room S101, SSED, University of the South Pacific, Suva, Fiji.

TRAINING IN GIANT CLAM CULTIVATION OFFERED IN PALAU
(Source: MMDC)

A 30-day course designed to teach practical aspects of giant clam biology and the technology for clam cultivation in shallow coral reef waters, is offered by the Micronesian Mariculture Demonstration Center (MMDC), based in Koror, Palau.

The aim of the programme is to transfer the technology for ocean culture of giant clams to Pacific Island states and territories and to make seed clams available for the establishment of small ocean farms in coastal communities throughout the Indo-Pacific region. Such farms offer the potential benefit of yielding mature clams for conservation, local consumption, or sale to domestic and possibly foreign markets. In countries intending to establish their own hatcheries the transplanted clams can serve as future broodstock.

Courses are run consecutively, commencing on the first day of each month excepting December, and include practical training at the MMDC Giant Clam Hatchery as well as scuba diving certification at the Palau Pacific Resort.

The course fee of US$ 2 950 covers trainee accommodation at the MMDC, all internal travel, meals, basic diving gear, instructional literature, data notebooks, measuring calipers, 1 000 yearling clams (*Tridacna derasa*), 67 rearing cages, and airfreight charges (up to US$ 100) for clams and cages.

The live clams and culturing equipment are sent to the trainees' home islands after the successful completion of the course. The intention is that upon returning home the trainees assume responsibility for monitoring the clams and recording basic data on growth and survival. The MMDC provides follow-up services including assisting with numerical data analysis, interpretation, and publication. Former trainees are kept abreast of new developments through correspondence, reports, site visits, and an information bulletin.

To date more than 40 participants have undertaken the training course, representing American Samoa, Australia, Cook Islands, Guam, Hawaii, Indonesia, Kosrae, Marshalls, Palau, Papua New Guinea, Philippines, Pohnpei, Saipan, Truk, and Yap. Transported clams are now being successfully cultivated in more than ten Pacific nations.

Further information regarding this course from: Gerald Heslinga, Course Coordinator, MMDC, P.O. Box 359, Koror, Palau 96940.

TAG AND RELEASE IN MARSHALLS

(Source: *Marshall Islands Journal*)

On its first patrol of the group's northern island *Ion Meto*, the Marshall Islands new patrol boat,came upon a Taiwanese fishing vessel anchored off the reef at Bokak island. While President Amata Tabua, Chief Secretary Oscar de Brum, and Foreign Minister Charles Domnick, who were travelling aboard the *Ion Meto*, looked on, the Taiwanese vessel was boarded and inspected and a load of clam meat discovered in the holds.

Despite the Taiwanese captain's claim that the clams had been taken in Fijian waters, he was instructed to steam his vessel to Majuro for further investigation. The fishing vessel was left to make her own way to Majuro, one crew member being taken aboard the *Ion Meto* to guarantee the Taiwanese captain's compliance. The fishing vessel has not been seen since.

FISHERIES SCIENCE AND TECHNOLOGY

GUAM AQUACULTURE DEVELOPMENT AND TRAINING CENTER

(Source: Guam Department of Commerce)

The Guam Aquaculture Development and Training Center (GADTC) hatchery represents the latest thing in hatchery design and technology. The facility was built in 1981 at a cost of over US$ 2 million by the private firm Guam Aqua Research, Inc. (GARI). GARI operated the hatchery with the main objective of developing post-larval production technology for various penaeid shrimps. The hatchery techniques and technology appropriate for the cultured species were to be transferred to grow-out farms established in the People's Republic of China, and to farms planned for Sabah, Brunei and Sri Lanka. However, the techniques and technology employed did not provide support to the Guam aquaculture industry and did not supply the needed post-larvae or fry for Guam's farms. Operation of the facility was discontinued when GARI's Hong Kong-based parent company, Trafalgar, encountered financial difficulties.

Guam Aqua Research, Inc. tried over a two-year period to find a private investor interested in purchasing the facility; however, it was unsuccessful. Subsequently, the Government of Guam took over the facility on back taxes. After its closure in June 1983, the facility suffered from neglect, and signs of deterioration and vandalism were evident. However, the basic structure of this facility was still in good condition. To prevent further deterioration of this valuable asset, immediate action was needed to implement at least the repairs required to allow for the initiation of hatchery operations. The building and electrical system required major repairs, along with replacement of the seawater and freshwater pumps, and general renovation. The tanks, water pipe system, laboratory and concrete buildings were still in relatively good condition. Through the Guam Community College's Vocational Pre-apprenticeship Program, much of the renovation has been carried out.

GADTC represents a key component in the development of commercial aquaculture on Guam and throughout the region. There is a need for regional hatchery facilities, since the capital investment for construction, along with the sophisticated technical expertise needed for hatchery operations, makes it prohibitively expensive to have separate facilities in each of the island groups. Furthermore, small private farms within the region cannot afford the cost of their own hatchery. This network system will be dependent upon the interaction of the major hatchery facilities, GADTC and the Micronesia Mariculture Development Center (MMDC, Palau), with the rest of the islands in the Micronesian region (CNMI, Truk, Pohnpei, Kosrae, Yap and Marshall Islands). The two facilities will complement each other, with GADTC initially emphasising penaeid and *Macrobrachium rosenbergii* culture. MMDC will be emphasising giant clam and marine finfish.

The potential importance of GADTC as a regional hatchery was emphasised by all participants at the Micronesian Mariculture Conference (Palau, 24-27 March, 1987) sponsored by the Department of Interior. The importance of the facility as a hatchery and training centre was also noted at the Federated States of Micronesia's Aquaculture Workshop held in Kosrae in April, 1986. The operation of the GATDC hatchery will allow for the diversification of species raised, encourage expansion of the existing private farms, and provide new opportunities for investors.

The Guam Department of Commerce is responsible for the administration of GADTC and intends to co-ordinate the operation of the facility through a Joint Governing Board consisting of the Department of Commerce, College of Agriculture and Life Sciences, and Guam Community College. This represents an effort to maximise the utilisation of resources within the Government of Guam while minimising the cost of operation. In addition, an advisory committee, consisting of the University of Guam Sea Grant Extension Program, Guam Department of Agriculture, and the Guam Aquaculture Association (private industry), will be formed. Personnel experienced in hatchery operations from the Department of Commerce, Marine Laboratory, and College of Agriculture and Life Sciences will be utilised in the operations of GADTC.

Statement of goals for GADTC

1) Develop private aquaculture within the region through production of post-larvae and fry for private commercial industry.

2) Promote the private commercial aquaculture industry through training and applied research.

3) Pursue privatisation of the hatchery operation while assuring that the needs of the industry are met.

Statement of objectives

1) Renovate the GADTC hatchery facility to meet the basic needs of production.

2) Provide the post-larvae and fry of the major species presently under cultivation.

3) Pursue the diversification of species available to the private aquaculture farmers and the optimisation of production.

4) Provide the required training to the private sector to increase production and stimulate new investment by entrepreneurs.

5) Recover cost of production and initial subsidies through sales of post-larvae and fry.

6) Develop options for privatisation of part or all of the facility.

LOBSTERS AT THE PUSH OF A BUTTON

(Source : *Australian Fisheries*)

A Western Australian Company is in the final research and development stages of a product which it claims could revolutionise lobster fishing. Sonartech Limited is a company formed specifically to develop and market an automatic lobster pot which floats to the surface at the push of a button. The idea was conceived by a Geraldton fisherman, Clarry Challenger, who formed a public company to raise capital to develop the invention.

The chief executive of Sonartech, Mr Peter Hopwood, said that although the product had yet to be perfected, licences to manufacture the pot had already been sold to Malaysia and the United States. Mr Hopwood said that about five million lobster pots were sold throughout the world annually and the company was hoping for about 0.5 per cent of this market.

The baited pot settles on the bottom of the sea and is left there for a few days. When the fisherman is ready, he punches out a four digit code on a special sonar device. A receptor on the pot switches a valve which releases carbon dioxide gas, stored in a cylinder, into plastic piping incorporated in the pot. The pot then rises to the surface, ideally full of lobsters.

Mr Hopwood said the main problem now was getting the valve working properly. The company is now on its tenth valve design, after having considerable difficulty finding a valve able to cope with the great pressures involved. To save the expense of developing the valve, Sonartech searched the world for the best valve manufacturers and found three who were prepared to bear the cost of developing the valve system on condition that the best valve would be used on the pots. Mr Hopwood said the pot used about 5 kg of CO_2 on each lift and, apart from the initial costs of each pot, this comprised the only running cost. He said the average cray fisherman had to buy a new set of pots, lines and floats every year, which cut deeply into profits. He said that although the new pots cost about half as much again as normal lobster pots, there were no lines or floats. In addition the loss rate on the new pots was likely to be significantly less than the old style.

But although the new pots will probably be made in Western Australia, they cannot be legally used there because every pot must have a float and number attached so that fisheries inspectors can identify who is fishing where. Mr Hopwood said his company may or may not be able to get around that difficulty, but could see no problem in selling to the rest of the world. The new pots are expected to be on the market in about three to six months.

OMEGA-3 REVOLUTION PROMISES BOOST TO SEAFOOD CONSUMPTION

(Source : *National Fisherman*)

Since the early 1950s, researchers concerned with dietary habits have tended to emphasise the benefit of vegetable oil over animal fats in helping to reduce the likelihood of heart disease. It has no cholesterol, boasts an excellent ratio of saturated to unsaturated oils, and has a modest ability to decrease cholesterol absorption. Vegetable oil decreases cholesterol absorption because of the low saturated/unsaturated ratio. From this, most researchers have reasoned that fish oil, with its high ratio of saturated fats, would make a poor balm for heavy hearts, never mind the occasional rumours to the contrary.

Fish oil seems an unlikely candidate to wage cellular war against cholesterol and saturated fats, since it contains plenty of both, especially the latter. This has confused researchers and discouraged further investigations for three decades. What the researchers didn't know about until now was Omega-3. Omega-3 is the common name for a group of unique, long-chain, super-polyunsaturated fatty acids, abundant only in seafood. Omega-3 is an essential fatty acid; since our bodies can't manufacture this substance it must be supplied by ingesting foods that contain it. Sea creatures get Omega-3 from the phytoplankton (microscopic sea plants) in their food chain. People who don't eat seafood get a little Omega-3 from the leaves of plants. Those whose diet is primarily marine-based, such as Eskimos and Japanese living in fishing villages, ingest an abundance of Omega-3 and have virtually no heart attacks.

When eaten and metabolised, Omega-3 appears to do at least four things to clean up our blood and counter the effects of other, less beneficial fats. Firstly, it lowers plasma cholesterol levels better than vegetable oils does. Studies vary considerably, but it appears to take three time as much vegetable oil as fish oil to attain the same decrease in cholesterol absorption.

Secondly, Omega-3 dramatically decreases the level of plasma triglyceride, the most common form of fat in food and the body. This is a much more recent discovery. The role of triglycerides in heart disease has yet to be clearly established. The renowned Framingham Heart Study, conducted in Massachusetts, however, has shown that the higher one's triglyceride level upon entering the study, the higher the subsequent rate of coronary heart disease. (Begun in 1949, the Framingham project is the longest-running epidemiological study in the world, credited with first suggesting that certain life styles increase the risk of heart disease.)

The third function of Omega-3 is yet another quite recent discovery. Omega-3 alters the balance of lipoproteins in the blood. These fat-and-protein molecules are like little trucks that haul cholesterol and triglyceride in and out of the bloodstream. Very-low-density lipoproteins (VLDLs) and low-density lipoproteins (LDLs) truck the fat into the blood, while high-density lipoproteins (HDLs) truck it out. In order to keep your blood free from too much fat, you need a high ratio of HDLs to VLDLs and LDLs, and the enlightened diagnosis of heart health now involves measuring this ratio. Omega-3 improves the ratio significantly, reducing VLDLs and LDLs while increasing HDLs.

Finally, Omega-3 alters platelet function. Platelets are the cells in blood responsible for clotting. Omega-3 makes them less 'sticky' — less likely to aggregate, or clump. This effect of Omega-3 has profound implications for the prevention of clots leading to strokes and heart attacks. Beyond this, Omega-3 may actually reduce the total number of platelets, possibly another factor in reduced blood clotting among those ingesting the substance.

These four functions of Omega-3 don't apply only to ocean fish — shellfish also contain high levels of Omega-3. Recent discoveries have shown that much of what was thought to be cholesterol in oysters and clams is actually non-cholesterol sterols. These sterols contain Omega-3 and markedly reduce the body's absorption of cholesterol and saturated fats — just as fish oil does.

These four attributes of Omega-3 are noteworthy in themselves and could soon play a key role in redefining a healthful diet for all. But there exists another dimension to Omega-3 research, one that helps explain why a second wave of study has begun, focusing this time not simply on heart disease, but on a wide range of man's most dreaded diseases.

The fish-oil revolution ties in with another revolution now under way — our understanding of how disease mechanisms work. This may be a puzzling statement to anyone making the common (but erroneous) assumption that we know how illnesses such as multiple sclerosis and cancer work. In truth, we don't know. But some light is beginning to dawn. In 1971, a major breakthrough occurred in our knowledge of disease processes, with the Nobel Prize-winning discovery as to why aspirin relieves aches and pains. Aspirin slows down a specific metabolic activity, convincing the body to stop torturing itself. Subsequent research by others soon revealed that this activity was the cellular production of eicosanoids. While much remains to be learned about them, eicosanoids can be described as powerful, hormone-like compounds that the body produces to defend itself. They regulate various bodily functions, such as platelet aggregation and muscle contraction. They are composed of fatty acids received through the diet: what we eat determines which eicosanoids we get and how strong they are. Vane's discovery was important because it provided the initial clue that the body may often give itself a certain disease. With the best of intentions, the body may read certain signals, decide it has a crisis on its hands, and start pouring out a flood of agents to deal with the problem — only to provoke a far worse situation: a disease.

What does all this have to do with Omega-3? It appears that eating fish is similar to taking an aspirin, but while aspirin is curative medicine, Omega-3 is preventive medicine. Like aspirin, Omega-3 slows down eicosanoid production.

Not surprisingly, the dominant fatty acid in the diet of most westerners is Omega-6, derived from vegetable oil. From it the body makes linoleic acid, which in turn provides the building block for a specific set of eicosanoids. A whole family of diseases, including arthritis, multiple sclerosis and allergies, has been linked to over-production of these linoleic-derived eicosanoids, not because they are 'bad' for us, but because they enjoy a position of overwhelming dominance in our diet. We simply seem to be ingesting too much vegetable oil. When we eat fish, however, we introduce a different fatty acid into our enzyme system, which in turn results in a different set of eicosanoids, a counterbalancing set. We give our linoleic acid some competition. One of the most dangerous eicosanoids, if allowed to over-produce, is thromboxane. Platelets produce thromboxane to initiate platelet aggregation. Over-production can lead to thrombosis, or blood clots, a common killer. Like most of our eicosanoids, thromboxane is derived from the Omega-6 in vegetable oil. Allowed to run rampant, it will turn your blood to mud. But Omega-3 makes an eicosanoid called eicosapentaenoic acid (EPA), which reduces the platelets' ability to produce thromboxane. We may need a certain amount of Omega-3 in our diet to keep the Omega-6 from running wild.

The Omega-3/eicosanoid discoveries haven't penetrated far into the medical profession yet, much less into the public arena. The material is complex, some of the theories are half-baked, and much of the research is mid-stream. Nonetheless, Omega-3 presents a serious challenge to the current notion of a balanced diet. It suggests that we need to balance the composition of fats in our diet by adding seafood.

How much fish should we eat? Could we eat too much and damage the blood's ability to coagulate? There are no definite answers yet. Two long-range studies, however, provides clues. The first is that of a Seattle physician, Dr Averly Nelson, an unsung hero of the fish-oil saga. As a young man, Nelson read that a shortage of red meat in Norway and other countries during World War II had resulted in a high consumption of fish — and the incidence of heart attacks during the same period had plummeted in those countries. Nelson eventually built up a practice in the north-west United States, specialising in the dietary treatment of heart disease. To test the fish oil angle, he routinely asked his patients to eat fish as their main entree three times a week, every week, as long as they were in his care.

Some patients agreed, some didn't — and from 1953 to 1972, Nelson monitored the results. The 80 fish-eating patients ended up with four and a half times fewer fatal heart attacks than the 123 abstainers. Unfortunately, Nelson published in the 'wrong journals' and the dramatic results of his work went largely unnoticed. A better fate was reserved for Dutch scientist Daan Kromhout. He recently published the results of a similar study, which has made him world famous, at least in scientific circles. For 20 years (1960-1980), Kromhout studied 852 middle-aged men living in the small Dutch town of Zutphen. He monitored the amount of fish eaten daily by each man and found that the mortality from coronary heart disease was more than 50 per cent lower among those who ate at least 30 g (1 oz) of fish per day than among those who did not eat fish at all. 'As little as one or two fish dishes per week may be of preventive value,' Kromhout wrote.

Nearly half of all Americans go to the grave because of some form of heart disease, and an estimated two-thirds die with lesions in their arteries. They simply eat too much fat. Forty per cent of their daily calories comes from fat, whereas the American Heart Association recommends a maximum of 30 per cent. There is a clear need to cut fat intake. Beyond that, however, Omega-3 research indicates the wisdom of adding some seafood to our diet. Fish oil offers a way of redressing some of the negative effects of the fats in our diet. All the information isn't in yet, but waiting to act on what is known could be fatal.

ARTIFICIAL REEFS FOR OCTOPUS

(Source: National Marine Fisheries Service/South-West Fisheries Council Honolulu Laboratory)

Fishermen of the East Shimamaki Fisheries Association and the West Shimamaki Fisheries Association fish adjacent grounds off the village of Shimamaki in Hokkaido, Japan. From 1959 to 1977, 40 766 cu m of artificial reefs were deployed off West Shimamaki, and from 1963 through 1985, 8 645 cu m of artificial reefs were deployed off East Shimamaki. The artificial reef modules used in both areas were concrete cylinders placed at depths of 30-40 m.

The fishing grounds of the East and West Fisheries Associations share the same environmental conditions, and, during any year, the composition of the fishing fleets of both Associations and the resources are similar. Jeff Polovina, of the National Marine Fisheries Service Honolulu Laboratory, and Ichiro Sakai, of Japan, evaluated the impacts of the artificial reefs on fisheries for flatfishes, Atka mackerel, and octopus in the two regions by comparing the relative change in catches (and cpue in the case of octopus) between the two regions as a function of their respective cumulative artificial reef volume. A time series of catch data from 1940 to 1985 for both East and West Shimamaki served as the basis for the evaluation for flatfishes and Atka mackerel, and the catch time series, together with a time series of cpue from 1965 to 1984, was used for the evaluation of the impact of the artificial reefs on the octopus fishery.

From 1965 to 1975 when most of the artificial reefs were deployed, there was a threefold increase in vessel tonnage in the octopus fleet in both East and West Shimamaki, and octopus catches increased about 7 times in West Shimamaki and 2.5 times in East Shimamaki during the same period. It is estimated that 100 cu m of artificial reef volume increased the octopus catches by 1 per cent and an average value of the increase in the catches attributed to the artificial reefs is 2.5 kg per cubic metre of artificial reef volume. A survey of Shimamaki fishermen's attitudes toward the artificial reefs conducted by Sakai indicates that over 50 per cent of the fishermen regularly use the artificial reefs, 85 per cent felt that the reefs were at least fairly effective in increasing catches, but only 33 per cent felt that the artificial reefs actually increased the catch in the fishing grounds.

INFORMATION RETRIEVAL AND CURRENT AWARNESS IN PAPUA NEW GUINEA

(Source: *NAGA*/ Paul Dalzell, International Center for Living Aquatic Resources)

Among the problems that face fisheries and other scientific researchers in the tropics is the acquisition of reference material. Papers and books that may be essential for the success of a particular project appear difficult, if not impossible, to obtain. This is further compounded by the fact that the majority of scientific research occurs in the developed countries, mostly in the northern hemisphere, and new advances and techniques take time to percolate down to researchers in remote areas. Geographic isolation is not the only problem; in many instances research budgets are small and do not encourage subscription to scientific and abstracting journals.

For several years I worked as a fisheries scientist for the Papua New Guinea Government and encountered all of the above problems in trying to obtain references for the field laboratory at Kavieng, where I was stationed. Kavieng is a small town approximately 500 km north of the capital city, Port Moresby. The accepted method of acquiring references and books was through the Fisheries Division central library in Port Moresby. For a variety of reasons the library was often unable to provide the field laboratory with requested references. This article describes how my colleagues and I managed to overcome these problems and sets out to demonstrate to other fisheries scientists working in the tropics, and remote from the mainstream of information exchange, that reference retrieval is not a lost cause.

In the absence of journals, researchers rely on receiving a photocopy or a reprint of a particular article. Unfortunately photocopying costs money and most libraries will not do it free.

In Papua New Guinea and Australia, an institution must belong to the Library Association of Australia (LAA) to be eligible for photocopying services from a particular library. This is because the LAA issues photocopy vouchers which are used by libraries and institutions in the region to pay for photocopying. Fortunately, laboratories such as ours at Kavieng can and did join the LAA as 'Voucher Only Members'. We could buy photocopy vouchers and obtain photocopies of papers. Membership in LAA cost A$ 25 and gave us access to the scientific libraries of Australia. We found the CSIRO's Division of Fisheries Research library the most useful, followed by several of the university libraries. When we could not obtain a reprint (which only costs the price of a postage stamp), we bought photocopying vouchers which then cost A$ 3.00 for ten pages of copying.

For newly published papers, especially those pertaining to tropical fisheries science, we at Kavieng found two ICLARM publications particularly useful: *Naga* (formerly the *ICLARM Newsletter*) contains an information section that serves as a current awareness journal for tropical fisheries science; *Fishbyte*, the periodical of the Network of Tropical Fisheries Scientists (NTFS), contains similar information. Both publications give the author's address with the article title and journal reference. Thus reprints may be obtained cheaply. Copies of many papers (e.g., FAO Fisheries Circulars) and reprints are often available on request for NTFS members, while ICLARM's free Selective Fisheries Information Service can provide material and references in response to specific enquiries.

Many readers of this article may be aware of the current awareness journal, *Current Contents*, published by the Institute of Scientific Information (ISI) in Philadelphia, USA. But few probably know of a service offered by ISI called *Custom Contents*. Rather than subscribe to the main journal at a cost of US$ 415, one may nominate only those journals which are of relevance at a cost of about US$ 10 per journal.

Another method found useful for acquiring literature was to gain inclusion on as many institutional mailing lists as possible (e.g., South Pacific Commission, US National Marine Fisheries Service, SEAFDEC), particularly where publications are free. Writing to embassies of various countries to help track down reports (especially old ones) published by government fisheries agencies also paid off from time to time. For books, we found it useful to establish an account with a major bookseller in Britain. The account let us buy on credit and we received regular notification of up-coming publications in the life sciences field.

It would be naive to expect comprehensive information retrieval and current awareness to be entirely free. Unfortunately, there are fisheries scientists in the tropics who have budgets so low that even postage is a problem. This article may help those scientists to lobby for some funding, since costs can be kept to a minimum, and any scientist who cannot access information is being denied an essential tool of the trade.

Naga would be interested to hear other researchers' accounts of how they face or overcome the problems of keeping up to date in remote areas. The best stories will be published.

BOAT PLANS AVAILABLE
(Source: FAO/UNDP)

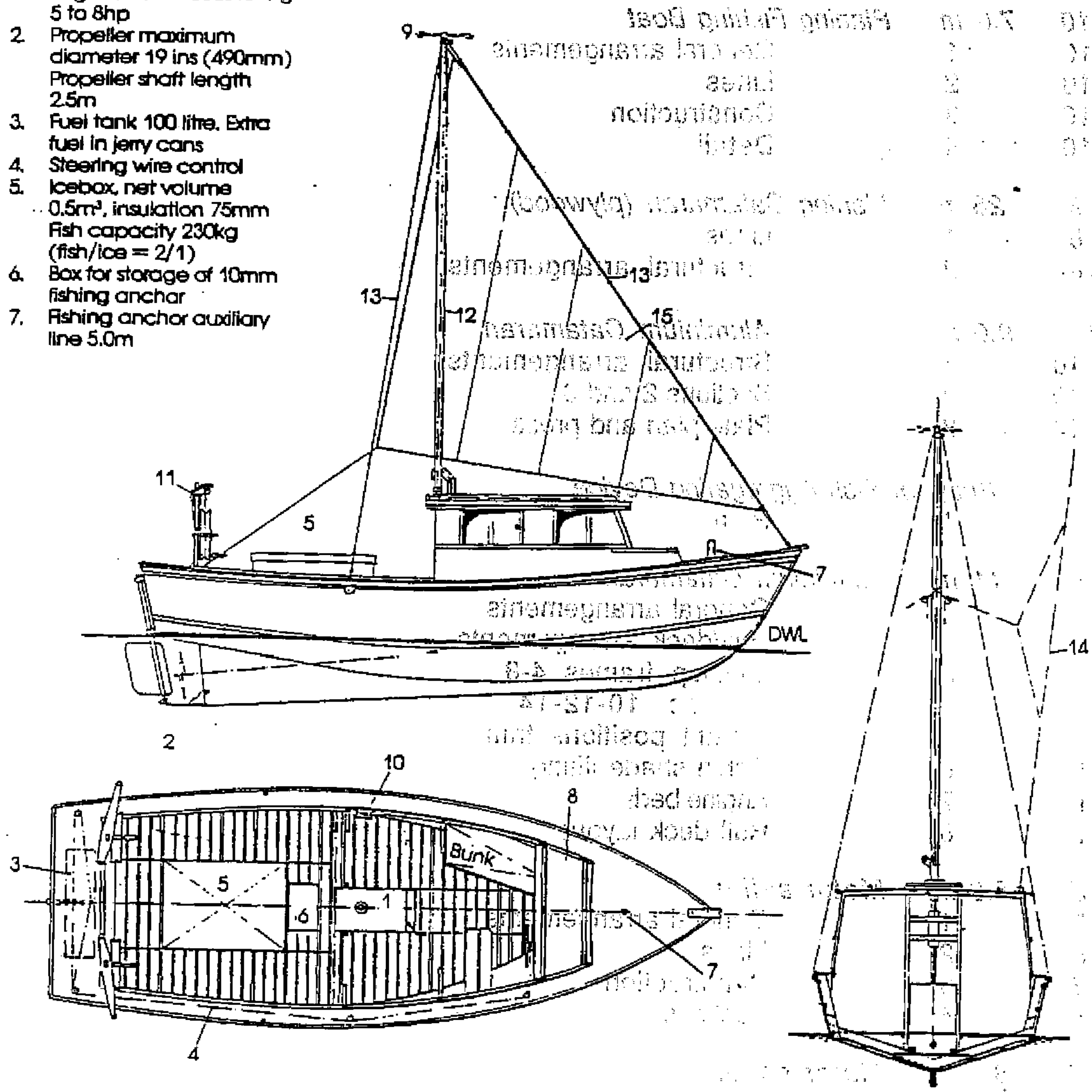
The FAO/UNDP South Pacific Regional Fisheries Programme has available transparencies of various fishing craft designs developed under FAO/UNOP sponsorship. The designs which are listed below are available to bona fide enquirers, who should apply directly to: FAO/UNDP Regional Fisheries Support Programme, UNDP Private Mail Bag, Suva, Fiji.

Code		Plan
KIR 2	*7.25m*	*Proa*
KIR 2	1B	General arrangements
KIR 2	2	Lines
KIR 2	3	Construction
KIR 2	4	Details
KIR 2	5	Frames
KIR 2	6	Plywood utilisation
KIR 2	7	Materials
KIR 2	8	Materials
KIR 3	*5.9m*	*Outrigger Canoe*
KIR 3	1	General arrangements
KIR 4	*7.16m*	*Proa*
KIR 4	1	General arrangments
KIR 4	2	Lines
KIR 4	3	Construction
KIR 4	4	Details
KIR 4	5	Sections
KIR 4	6	Sail rig and rudder
KIR 4	7	Plywood utilisation
KIR 4	8	Building jig
KIR 4	9	Materials
KIR 4	10	Fastenings
KIR 4	11	Order list
KIR 4	12	Alternative bottom plank
KIR 4	13	Alternative side plank
KIR 4	14	Alternative leeboard
KIR 4	15	Alternative leeboard
KIR 4	D-1	Alternative floats
KIR 5	*11.5m*	*Single Outrigger Canoe*
KIR 5	1	General arrangements
KIR 5	2	Lines
KIR 5	3	Construction
KIR 5	4	Frames
KIR 5	5	Outrigger
KIR 5	6	Building jig
KIR 7	*4.7 m*	*One Man Canoe*
KIR 7	1	General arrangements
KIR 7	2	Lines
KIR 8	*7.1 m*	*Sailing/Motor Canoe*
KIR 8	1	General arrangements
KIR 8	2	Lines

KIR 6	*6.5 m*	*2 Man Outrigger*
KIR 6	1	General arrangements
KIR 6	2	Lines, construction
KIR 10	*7.0 m*	*Planing Fishing Boat*
KIR 10	1	General arrangements
KIR 10	2	Lines
KIR 10	3	Construction
KIR 10	4	Detail
WES 8	*28 ft*	*Fishing Catamaran (plywood)*
WES 8	1	Lines
WES 8	2	Structural arrangements
SAM 10	*9.0 m*	*Aluminium Catamaran*
SAM 10	1	Structural arrangements
SAM 10	2	Sections 2 and 6
SAM 10	3	Plate plan and press
SAM		*Buoy for Fish Aggregating Device*
SAM	1	Plan
NIU 1	*11 m*	*Aluminium Catamaran*
NIU 1	1	General arrangements
NIU 1	2	Hull/deck arrangements
NIU 1	3	Midship frames 4-8
NIU 1	4	Frames 10-12-14
NIU 1	5	Weight positions trim
NIU 1	6	Cabin shade lifting
NIU 1	7	Engine beds
NIU 1	8	Hull deck layout
TON 5	*8.6 m*	*Motor-sailer*
TON 5	1	General arrangements
TON 5	2	Lines
TON 5	3	Construction
TON 5	4	Sections
TON 7	*8.8 m*	*Motor-sailer*
TON 7	1	General arrangements
TON 7	2	Lines
TON 7	3	Construction
TON 7	4	Sections
TON 7	5	Details
SOI 1	*6.25 m*	*Proa*
SOI 1	1	General arrangements
SOI 1	2	Lines
SOI 1	3	Construction
SOI 1	4	Sections
SOI 1	5	Building jig
SOI 1	6	Fastenings
SOI 1	7	Materials
SOI 2	*7.8 m*	*Fishing Trimaran*
SOI 2	1	General arrangements
SOI 2	2	Lines
SOI 2	3	Details

ITEM

1. Engine, continuous rating 5 to 8hp
2. Propeller maximum diameter 19 ins (490mm) Propeller shaft length 2.5m
3. Fuel tank 100 litre. Extra fuel in jerry cans
4. Steering wire control
5. Icebox, net volume 0.5m³, insulation 75mm Fish capacity 230kg (fish/ice = 2/1)
6. Box for storage of 10mm fishing anchor
7. Fishing anchor auxiliary line 5.0m



8. Box for storage of main anchors and rope. Main anchor — 9kg, fisherman type. Extra anchor — 5kg, Danforth type, chain 9mm (5/16 ins), length 4m. Anchor line diameter 12mm, length 30m. Mooring lines 10mm, length 12 m.
9. All round light, white
10. Manual bilge pump fitted with loose suction pipe for draining of bilge and icebox
11. Fishing reel, FAO-Western Samoa type
12. Mast, wood. Length 4.5m, diameter 80mm tapered to 60mm at top and bottom
13. Forestay and shrouds 4mm stainless 1 X 19, length 18m. Talurit swages and stainless thimbles.
14. Trolling booms (optional)
15. Emergency and auxiliary sail 7.5m², Halyard, diameter 10mm. Length 12m, through hole in mast. Sheet 10mm, length 12m.

Lines and specifications for the FIJ 6 design (after Gulbrandsen and Savins, 1987)

PNG 1	*11.0*	*Transport/Fishing Canoe*	
PNG 1	1		General arrangements
PNG 1	2		Lines
PNG 1	3		Construction
PNG 1	4		Sections
PNG 5	*Dugout Outrigger*		
PNG 5	1		General arrangments
PNG 5	2		Details
PNG 6	*Oro Bay Outrigger Canoe*		
PNG 6	1		General arrangements
PNG 6	2		Details
FIJ 5	*8.6 m*	*V-Bottom Fishing Boat*	
FIJ 5	1		General arrangements
FIJ 6	*6.4*	*Fishing/Transport Boat*	
FIJ 6	1		General arrangements
FIJ 6	2		Lines
FIJ 6	3		Construction
FIJ 6	4		Sections
FIJ 6	5		Building jig & backbone
FIJ 6	6		Plywood utlisation
FIJ 6	7		Materials
FIJ 6	8		Fastenings
FIJ 6	9		Order list
FIJ 6	10		Order list

FERTILIZER SPEEDS CLAM GROWTH

(Source: Micronesian Mariculture Demonstration)

Because tridacnid clams depend on symbiotic, photosynthetic algae (the zooxanthellae) for most of their nutrition, it has long been suspected that artificial enrichment of basic nutrients such as nitrogen and phosphorus might enhance clam growth. Previous work by Frances Wilkerson and colleagues at the Micronesian Mariculture Demonstration Center (MMDC) showed that tridacnids take up dissolved inorganic nitrogen (as nitrate and ammonium) in low concentrations from seawater, and that the zooxanthellae are responsible for this uptake. Studies in progress at the MMDC by Lee Hastie have recently provided evidence that clam growth rates can be improved significantly by exposure to micromolar concentrations of dissolved inorganic nitrogen. In a recent experiment, eight statistically similar groups of 20 juvenile *Tridacna derasa* were tested. Four of the groups, the controls, received no enrichment. Two groups received a daily 16-hour 'spike' of potassium nitrate (50 micromolar NO_3^-) and two other groups received a similar spike of ammonium sulfate (50 micromolar NH_4^+). At the end of the two month experiment, each of the four enriched groups had grown significantly faster than their respective control groups. On average the fertilized clams grew approximately 15 per cent faster that the unfertilized clams. These findings are of direct relevance to commercial tridacnid hatcheries. They suggest that present nutrient levels (and clam growth rates) in mariculture tanks may be suboptimal, and that there is substantial scope for growth acceleration with nutrient enrichment. Further work is needed to test the effects of different nutrients, concentrations and exposure times. It is possible, for example, that the 15 per cent jump in growth rate observed over 60 days can be improved by fertilizing clams over many months. One negative side effect of the experimental fertilization was an increase in fouling caused by rapid growth of filamentous algae. In large-scale mariculture tanks, however, fouling can be controlled effectively by polyculturing juvenile clams with active algal grazers such as trochus and rabbitfish.

ABSTRACTS

THE MANAGEMENT OF YELLOWFIN TUNA IN THE HANDLINE FISHING INDUSTRY OF HAWAII — A FISH HANDLING HANDBOOK, by R.M. Nakamura, J.S. Akamine, D.E. Coleman and S.N. Takashima, 1987. University of Hawaii. 32 pp.

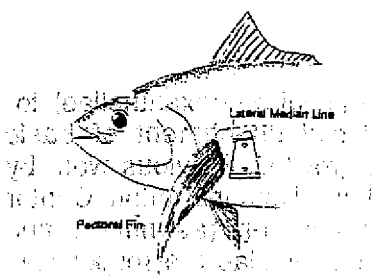
This handbook results from the authors' research into an effect they call Burnt Tuna Syndrome, or BTS, (see *SPC Fisheries Newsletter* #39) that is estimated to have caused losses as high as US$ 1.4 million annually in Hawaii's large-tuna industry.

BTS, they say, is common in tuna taken by trolling and handlining, when the fish's struggles on the line causes chemical-physiological changes which render the flesh 'pale and watery and [with] a sour-to-bitter taste and chewy texture.'

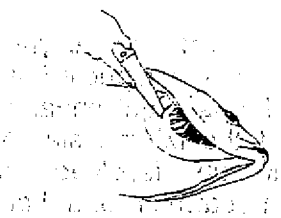
The authors draw on the findings of various other research efforts into the landing of poor-quality fish, to conclude that the essential problem of the large-tuna industry is loss of quality resulting from slow, inefficient cooling and poor handling of the fish.

The booklet sets out to detail step-by-step landing, killing, cleaning, and chilling procedures which are most likely to produce fish of top quality. Each processing step is clearly explained, and particularly well illustrated with clear, anatomically correct drawings, which are easy to follow. The authors have also included sections on the appropriate ice/seawater and ice/brine mixtures, and iceboxes, and numerous practical tips for the working fishermen.

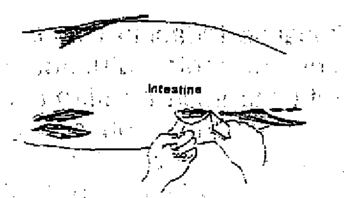
Copies of this booklet are available at US$ 4.00 from, University of Hawaii, Sea Grant College Program, Communications Office, 1000 Popo Road, MSB 200. Honolulu, HI 96822



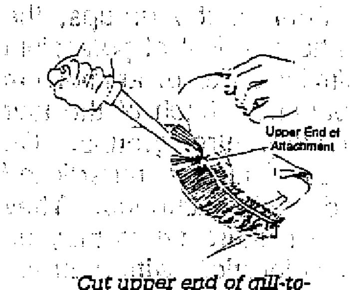
Bleed fish by cutting behind the pectoral fin.



Bleed fish by cutting blood vessels at top of gills.

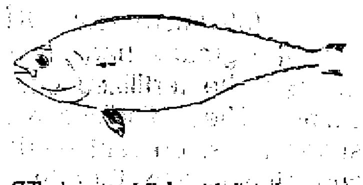


Cut the intestine near the anus.



Cut upper end of gill-to-head attachment.

Scrub spine through gill openings to remove the kidney.



Gilled, gutted fish with head on and fins removed.

The handbook includes detailed, well-illustrated, step-by-step handling procedures for tuna

FIRST ASIAN FISHERIES FORUM PAPERS PUBLISHED
(Source: Asian Fisheries Forum)

The first Asian Fisheries Forum, held in Manila, Philippines in May 1986, drew 289 scientists working in the fields of fisheries and aquaculture, representing 27 countries of the Indo-Pacific faunal zone.

The procedings of the forum have now been presented in book form as *The first Asian Fisheries Forum, 1986*, edited by J.L. McLean, L.B. Dizon and L.V. Hosillos.

The book contains 107 papers presented at the Forum, covering topics including aquaculture systems (integrated farming, monoculture, genetics, socio-economics); biology (developmental, general); biochemistry, fish health, pollution and toxicity (bacterial disease, parasites, toxicity, viruses, general studies); fisheries (education, development, management, gear and methods, information, post-harvest handling and marketing, resource assessment); nutrition and feeding habits; physiology and reproduction.

The book is available at US$ 60.00 airmail within Asia, and US$ 64.00 elsewhere, from the Asian Fisheries Society, MCPO Box 1501, Makati, Metro Manila, Philippines.

PROGRESS REPORT ON BILLFISH BEHAVIOUR AND INTERACTION STUDIES

by

David Holts and Earl Weber
National Marine Fisheries Service
Honolulu, Hawaii

A co-operative research study between the National Marine Fisheries Service (NMFS) Tuna-Billfish Assessment Program and the California Department of Fish and Game (DFG) was successful in tracking two striped marlin and one swordfish. These studies were, in part, designed to gain further information on the local availability of billfish in the area and to determine their vulnerability to various types of commercial and recreational fishing gears. Sonic tagging and tracking of these large pelagic fish is useful in the identification of their habitat preference and will allow for more direct and efficient placement of fishing effort. Accurate knowledge of vertical and horizontal swimming patterns, the distribution of swimming speeds and temperature (depth) preference are also important in developing growth models, and in determining individual energy budgets. This (northern) fall, the authors and DFG Biologist Dennis Bedford participated in six one week long tagging and observation trips in the Los Angeles Bight. The 60 foot sport fishing vessel, *Pacific Clipper* was chartered for these studies.

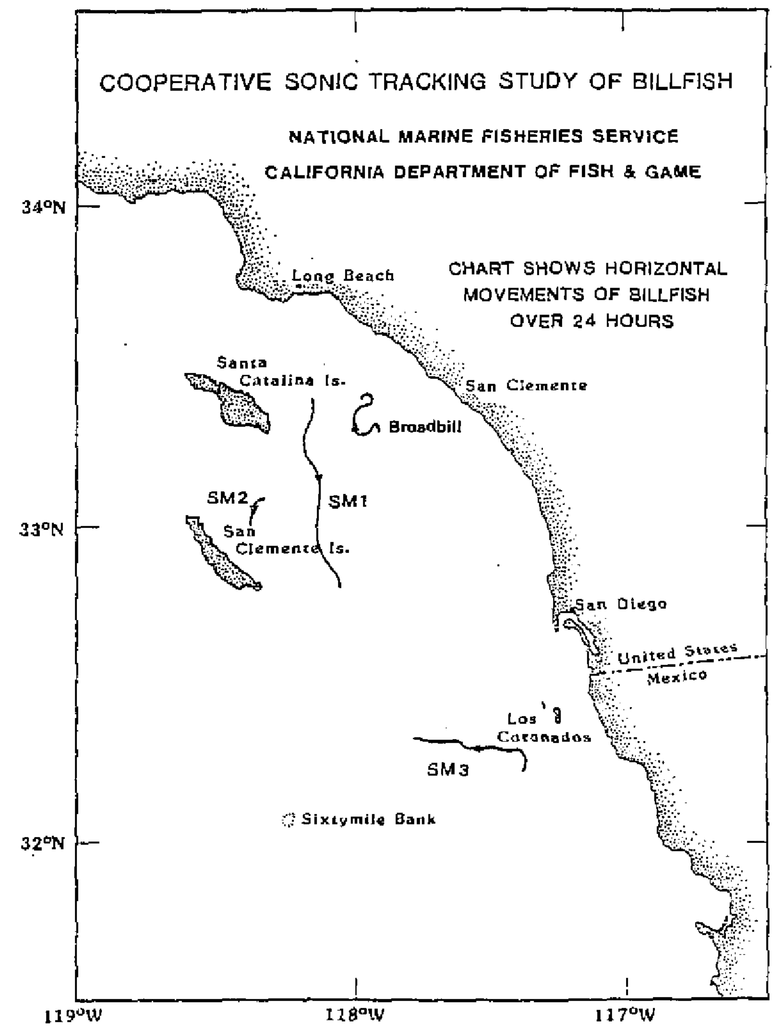


Figure 1. Horizontal movements of billfish over 24 hours

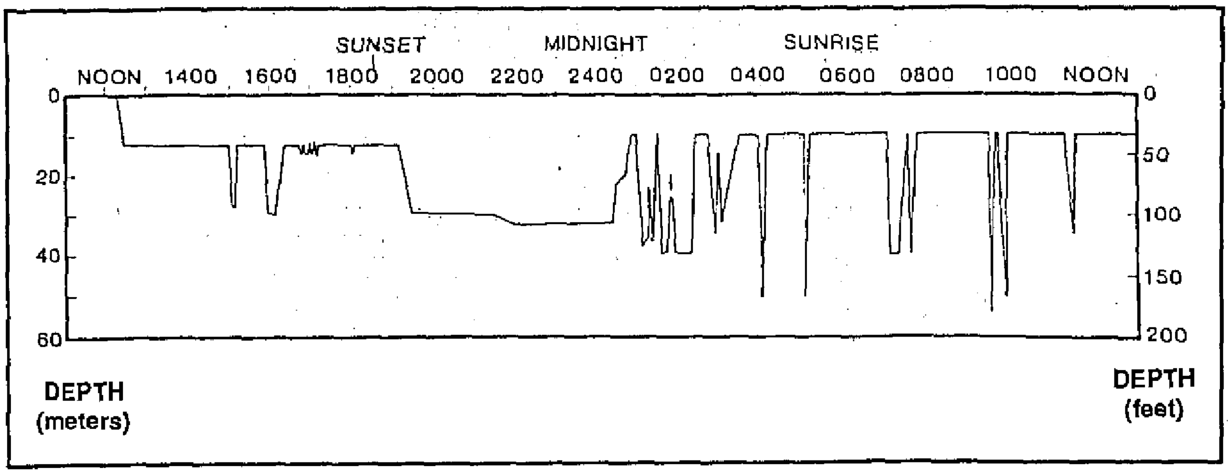


Figure 2. Chart of diving behaviour of striped marlin (SM1) over 24 hours

The first striped marlin was caught and tagged just after noon on 27 September, 1986, only six miles east of Avalon, Santa Catalina Island. The vertical and horizontal movements of this fish were tracked over a 24 hour period (Figures 1 & 2). The fish traveled generally south for 37 nm at an average speed of 1.5 knots, although this varied between 0.5 and 3.5 knots. It spent 63 per cent of the period at or above 12 m, 36 per cent of the time between 12 and 40 m with only four short descents to below 40 m.

The second marlin was tagged near the west end of San Clemente Island and tracked for only three hours, when the signal was lost due to a damaged hydrophone wire. Replacement of the defective hydrophone took approximately 30 minutes but efforts to relocate the fish were unsuccessful. This second marlin traveled 5 nm in a southerly direction and stayed very near the surface during the tracking period (see Figure 1 — SM2 track).

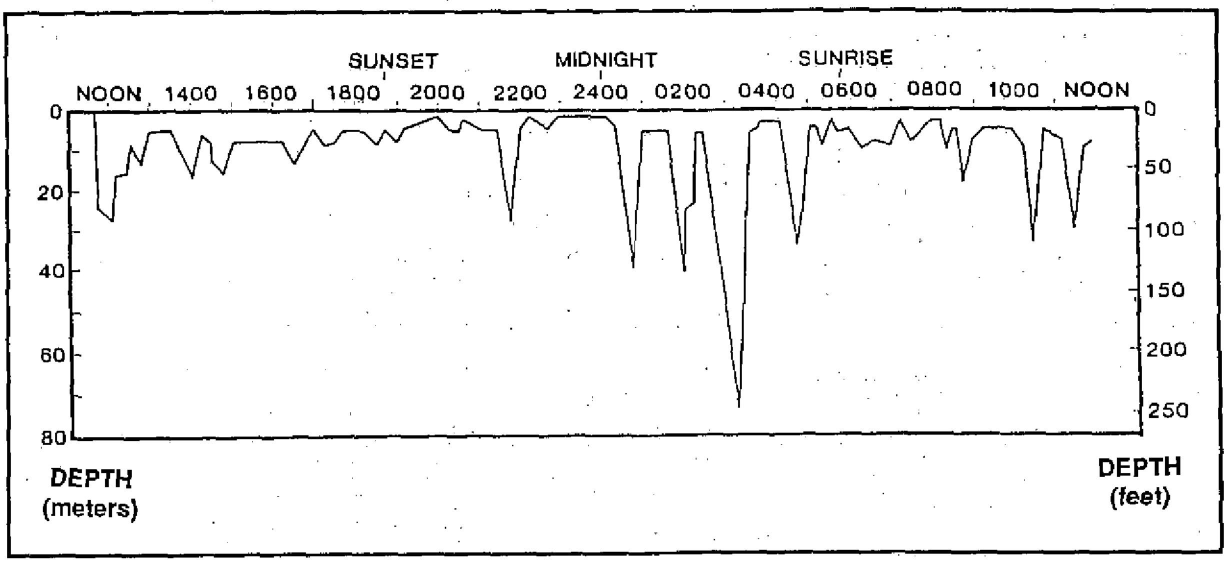


Figure 3. Chart of diving behaviour of striped marlin (SM3) over 24 hours

These observations closely matched the results of another tracking of a striped marlin conducted in 1982. This fish, also tagged and followed by the authors, travelled north for four hours, remained relatively inactive in the evening hours and then proceeded west for the next 17 hours. While traveling at an average of 1.5 knots, the fish covered a total distance of 18 nm (see Figure 1). Nearly 86 per cent of the tracking time was spent in the top 10 m of the water. It made only five short, early morning descents below 30 m (Figure 3). These vertical and horizontal observations of striped marlin are in sharp contrast to the movements of the swordfish.

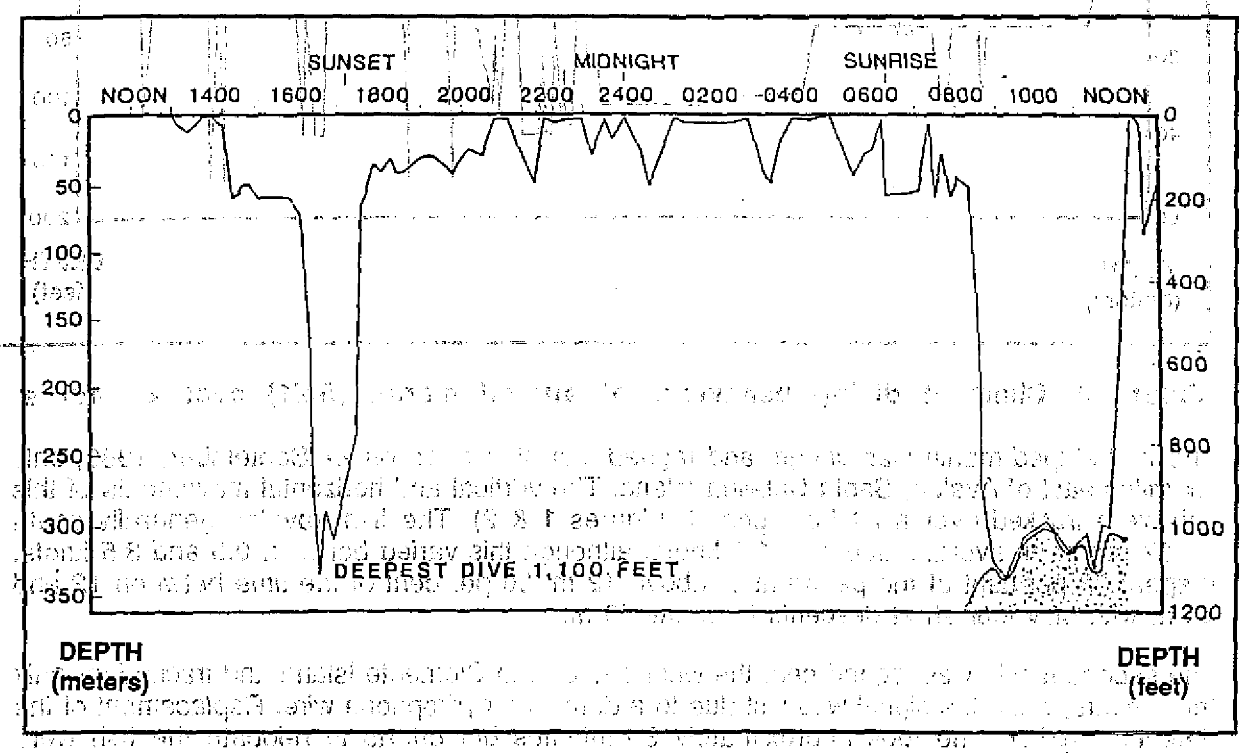


Figure 4: Chart of diving behaviour of broadbill over 24 hours

The swordfish was tagged by a commercial harpoon fisherman halfway between Avalon, and Dana Point, California. This broadbill travelled in a broad clockwise circle that covered approximately 17 nm and ended 8 nm northwest of the location where it was tagged. This fish spent essentially all of the time below 10 m and descended below 320 m on two different occasions. During each of these descents, the swordfish went from 45 m to over 320 m in less than 15 minutes. This constitutes a change in ambient pressure from 80 psi to over 570 psi and temperature change from 14° C to 8° C. The first deep dive occurred in the late afternoon and lasted about 90 minutes. The second dive started at 08.45 hours the following morning and lasted just over three hours. This particular dive occurred at the '14 fathom spot', a small bank reaching to within 57 fathoms of the surface. Here its forward progress decreased and it appeared to be foraging at, or very close to, the bottom.

Preliminary results of this work indicate that the dive behaviour of the two species of billfish differs greatly. Our tracks suggest that swordfish and striped marlin spend 100 per cent of the night time hours at depths between 10 m and 50 m. The striped marlin spent 60 to 90 per cent of their time between 10 and 30 m deep, but did not go below 60 m. Vertical excursions were more numerous at night but also occurred at irregular intervals throughout the tracking period. The swordfish spent considerable time (1.5 and 3.5 hrs) at depths over 1000 ft (300 m). Both dives were marked by abrupt descents (and ascents), which is remarkable considering the tremendous physiological stresses on the fish from changes in water temperature and pressure. The swordfish appeared to be orienting to the shallow bank where its second deep dive occurred. Marlin tended to swim faster and in a more continuous direction. The extent of their vertical excursions, for the most part, was limited to the dark period between midnight and first light. This was also the period of least horizontal movement.

Several factors in their behaviour are similar in both billfish species and also in other pelagic species. As with several species of tuna, billfish show no reluctance to descend into the colder waters below the thermocline. In two separate dives, our swordfish spent 19 per cent of its time in very cold water. At night, tuna generally shift their modal depth to the layers nearer the surface. These billfish showed no obvious sign of this behaviour. The vertical excursions of marlin tended to be greater between midnight and sunset but swordfish indicated no increased activity during the period. Marlin covered a greater horizontal distance and maintained a steady depth over longer periods than did the swordfish. Biologists have suggested that some tuna species reduce the frequency of vertical excursions during periods of migration.

During this study, we tagged three fish in 30 boat-days. This clearly indicates the difficulty of catching and successfully tagging billfish in Southern California waters, where they only occur seasonally and are never very abundant. The co-operative programme is planned through next year in order to obtain additional tracks of the movements of both species of billfish. Final results of this study will be released at the end of the 1987 season.

THE TONGAN GIANT CLAM (VASUVA) REVITALISATION PROJECT

by
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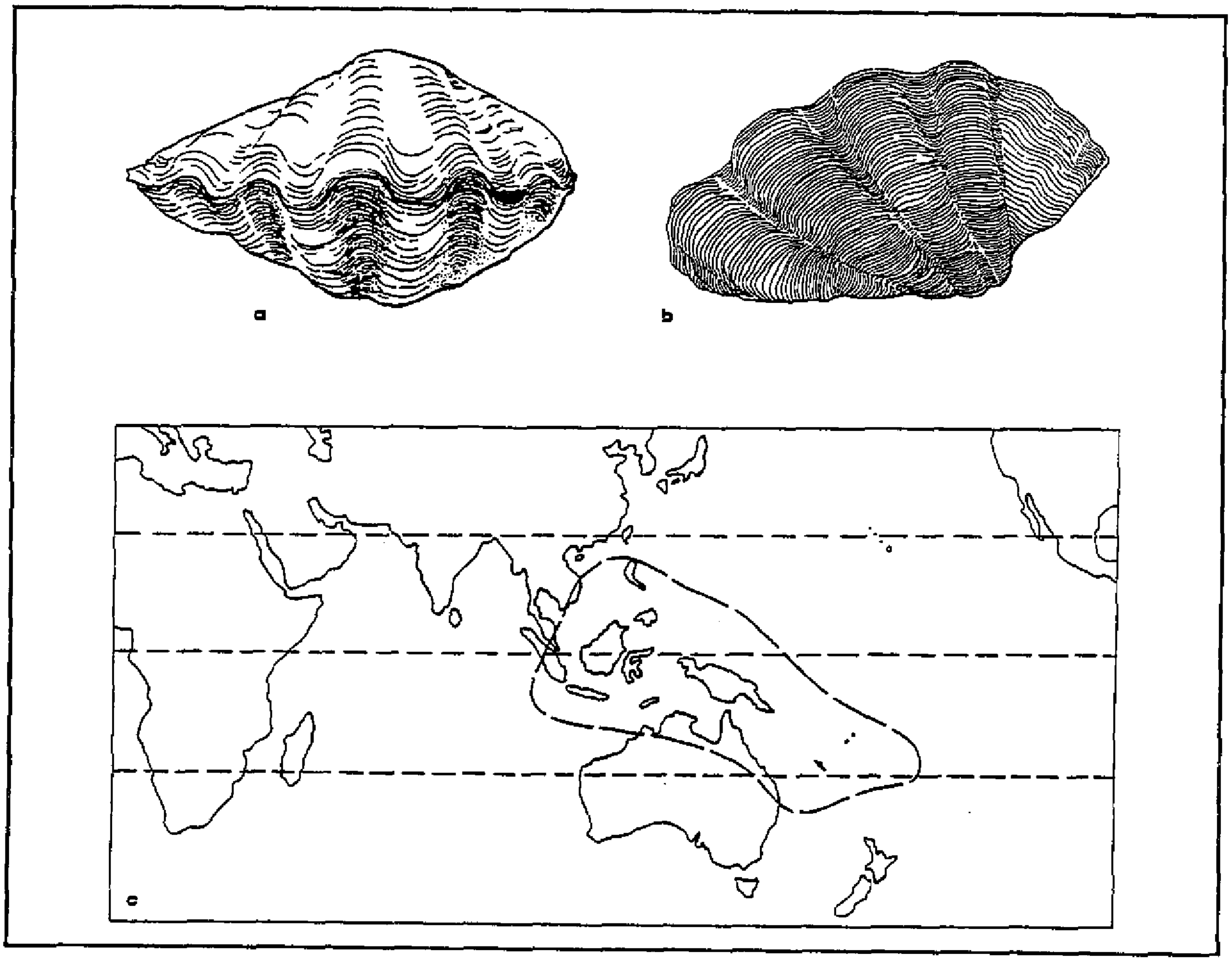
Introduction

During Environment Week in June 1986, the Kingdom of Tonga planted a brood stock of clams (*Tridacna derasa*), or **tokanoa**, on a reef in Nuku'alofa Harbour in an attempt to revitalise the stocks of these animals around the island of Tongatapu (Chesher 1986).

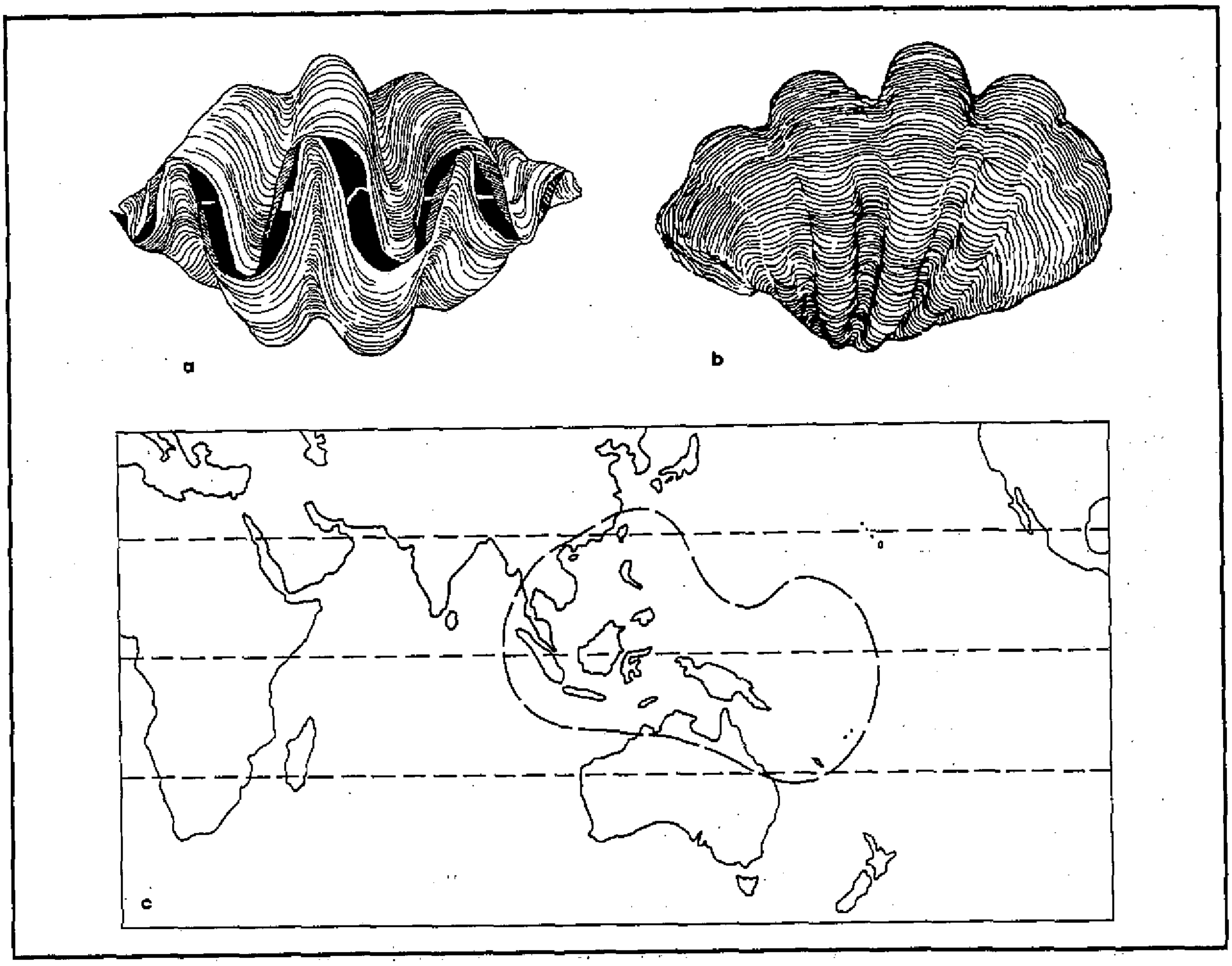
The Project, organised by the Ministry of the Lands, Survey and Natural Resources, with the co-operation of the Fisheries Division of the Ministry of Agriculture, Forestry and Fisheries and the Marine Research Foundation, was the first attempt in the Pacific to increase natural populations of giant clams (**vasuva**) by relocating natural stocks in micro-parks.



***Tridacna derasa*: a. Lateral view of shells. b. Upper view. c. Geographical distribution**

The relocation of natural stocks of giant clams into shallow protected embayments is not a new idea. Johannes (1982) reported that the people of Manus Island in Papua New Guinea collected giant clams and placed them in protected areas on the reef. These clams were left alone until long periods of bad weather prohibited normal fishing activities. Chesher (1980 and unpublished data) observed stocks of relocated and protected giant clams in the Shortlands Islands of the Solomon Islands, and near Tagula in Papua New Guinea. Reports of protected giant clams placed near villages have also come from Savai'i in Western Samoa.

Although a by-product of these cultural practices may have been a local increase in the natural population of giant clams, their purpose was to provide emergency food stocks and not, as in the modern example, a dedicated effort to revitalise the dwindling stocks of *T. derasa*. A second, and major, objective of the Tongan Vasuva Circle Project is to increase public environmental awareness and foster public education on the survival requirements of marine food organisms.



***Tridacna gigas*: a. Lateral view of shells. b. Upper view. c. Geographical distribution**

The larger species of giant clams have become extinct or seriously endangered in many Pacific Island areas through overfishing (Hesler and Jones, 1974; Bryan and McConnel, 1976; Pearson, 1977; Hirschberger, 1980). Although apparently abundant within the recent past, *T. gigas* has not been seen alive in New Caledonia or Fiji for the past two decades (Magnier, Adams, personal communications). McCoy (1980) found stocks of *T. derasa* dangerously low in Tonga and stressed the need for protective measures to avoid overfishing all the giant clam stocks. McCoy also recorded the apparent extinction of *Hippopus hippopus* in Tonga. The International Union for the Conservation of Nature and Natural Resources (IUCN) has placed both *T. gigas* and *T. derasa* on the endangered species list.

As a result of the concern over dwindling stocks of these important food animals, an extensive international research project has been underway for some time to increase knowledge of the biology of the giant clams and methods by which they may be cultured (Munro and Heslinga, 1983). Both *T. gigas* and *T. derasa* have been successfully mass cultured in running sea water systems in Palau (Heslinga *et al.*) and juvenile specimens have been shipped to Guam, Yap, Hawaii, Pohnpei, California, Fiji, the Philippines and Marshall Islands (Heslinga *et al.*, 1983, 1984; Lopez and Heslinga, 1985). However, questions have been raised about environmental problems which might follow transfers of giant clams from one ocean area to another (Munro *et al.*, 1985).

The culture of giant clams has been proven in one location as a research project. A trial commercial-scale hatchery has been started in the Solomon Islands and the researchers involved urge other interested countries to await the results of this facility before attempting further efforts (Pernetta, 1986).

Hatcheries and subsequent transplants of seedling stock to reefs or other countries have many technical, biological and economic hazards. Perron, Heslinga and Fagolimol (1985) report, for example, that an outplanting of seed clams from Palau onto a reef in Yap resulted in an infestation of the gastropod *Cymatium muricinum*. These small gastropods are predators of juvenile giant clams (they do not kill adults) and divers had to clear them from the seed clam trays by hand to prevent serious loss of the stocks. Other, still unknown diseases and predators may seriously hamper clam culture activities in the future. Since the giant clams mature to female size only after five to eight years, and since the new shipment guidelines (Munro *et al.*, 1985) call for the shipment of seedlings, not adults, any new hatchery where adults are not locally available would need to operate for quite a long time before actually producing any product.

In the meantime, while all this is being worked out, the natural stocks need to be protected and, if possible, augmented. The basic reason for the clams becoming rare or extinct needs to be examined and various features of the biology of the tridacnid clams must be researched. Above all, the public needs to be made aware of the need to use marine resources wisely. The Vasuva Circle Project provides a basis for these needs by promoting the creation of protected groups of clams. The clams are collected from wild stocks and then arranged in circles, in areas near villages where they can be cared for and monitored.

Giant clam circles to protect and augment natural stocks

Will giant clam circles protect and augment natural stocks of these animals? The concept is supported by considerable biological evidence:

— Giant clams are males when they are first sexually mature and later become functional hermaphrodites (Wada, 1954). Spawning is induced in nature by the presence of chemicals associated with the eggs. Normally the spawning cycle involves the release of sperm and subsequent release of eggs. 'This results in a chain spawning reaction over a reef but renders the species liable to the non-fertilisation of eggs in depleted population' (Munro and Heslinga, 1982).

— The larger the clam, the more eggs are produced. The increase of eggs is a logarithmic relationship:

$$F = 0.00743L^{4.03}$$

(for *T. maxima* [Jameson, 1976]), which means the larger adults are the main egg producers and are important to the level of population fecundity.

— The larval lifespan is short, from 7 to 10 days depending on conditions (Gwyther and Munro, 1981: Beckvard, 1981) and the juveniles apparently settle out near the adults (Yamaguchi, 1977: Chesher, unpublished data).

— In areas where giant clams are kept in protected embayments for emergency food supplies there is an abundance of clams of all sizes in the same bays and in nearby fringing reef environments (Chesher, unpublished data).

Placement of the clams into circles has several justifications:

— The orderly placement of the clams assures they will not be mistaken for a natural population, but are clearly placed there by someone. Mistaking a clam circle for a natural population is not likely if the circle is put near a village and is done as part of an environmental awareness project. But its symmetry should help identify it as separate from natural stocks to anyone who is not familiar with the project.

— The spacing of the clams is impotant to maximise spawning potential. Braley (1984) has presented evidence that maximum spawning activity can be inhibited by clams which are too far away or too close together. The circle makes the spacing regular and places the clams in a position to ensure that nearby clams detect any spawning activity regardless of the direction of the water currents at the spawning time.

— A broken circle will be obvious at once and the dead or missing clam can be replaced.

— Each member of the circle can be identified by its position and this will assist in growth studies as well as spawning and mortality studies.

To find out if the hypothesis is correct, the Marine Research Foundation and the Center for Field Research have begun studies into the giant clams of Tonga. During the next three years, they will work in association with the Governement of Tonga to:

— Inspect, tag and measure the clams planted in June 1986 and repair the circle as needed;

— Search for juveniles in the vicinity of the clam circle and down-current;

— Conduct hydrographic and bathymetric studies of the embayments of Vava'u to determine the most favorable locations for **vasuva** circles;

— Encourage and assist in the installation of clam circles in the most favourable locations in Vava'u;

— Investigate the existing natural stocks of all species of giant clams in the vicinity of Vava'u and other island groups if time and weather permits;

— Conduct transplanting experiments to determine the best methods of moving the clams from their original habitats to the experimental sites;

— Tag the experimental and selected natural populations for growth and mortality studies;

— Investigate the predators and diseases of the giant clams in Tonga and identify potential hazards for large settlements of clams or for grow-out sites from any future culture activity;

— Study spawning activities in the clam circles to determine optimum spacing of the brood stock and subsequent egg and larval dispersal in the embayments;

— Resurvey the areas in Vava'u and Tongatapu over a period of two or three successive years to determine changes to the clam populations. As a part of this activity, base-line information on subsistence and commercial harvesting of the clam species in question will be gathered.

How to make a giant clam circle

Location

The location of the giant clam circle is perhaps the most important aspects of its future success. Ideally, the circle location should be:

— In clear, unpolluted seawater, with no rivers or swamps close by;

— In a protected lagoon or bay where the clams will not be subjected to strong wave action;

— Where someone can keep an eye on the clam circle (near a village or someone's home);

— There should be live coral near the circle, but the circle should be made on a flat or gently sloping bottom area which is either coarse sand, coral rock or rubble, or a thin layer of medium to coarse sand over a hard bottom. Very fine sand or mud and thick, loose sand are not good for the clams;

— The clam circle should not be too shallow or too deep: 3 - 6 m is about right;

— The larval clams swim for 7-10 days, so there should not be very strong currents in the area or, if there are, there should be an extensive area of reefs and shoals down-current for the young clams to settle on.

Spacing

It is very important that all the clams be of the same species and not placed too close together. When clams are placed right next to each other they create a new microhabitat in which diseases and predators become a problem. Observations on natural populations of giant clams indicates they will do best if they are placed about 2 m apart.

The clams should be arranged neatly in two circles, one inside the other, with 66 clams in the outer circle, 33 in the inner circle, and one very large one in the centre.

The outer circle will have a radius of about 26 m (52 m in diameter). The inner circle will have a radius of 13 m (26 m in diameter). After the general area for the clam circle has been found, locate an area about 50 m in diameter, with the type of bottom specified earlier. There can be live coral heads in the area, but not too many, and there should be open bottom as well. Put a weight at one end of a polypropylene (floating) rope at least 30 m long. Drop the weight in the center of the proposed circle and tie a float onto the line at the surface. The float should be about the size of a 4 l bottle. The bottom weight should be an anchor or something which will not move easily. It could be tied to a piece of coral.

Tie a knot 13 m from the float and another knot at 26 m from the float (or the end of the line).

A swimmer then holds the knot or the end of the line to use line as a guide to swim in a circle with the anchored end at the centre. While one swimmer holds the line and thus marks the circle, two or more divers and a small supply boat move with the swimmer and place the clams one by one along the path described by the line. If the clams are not be put down all at once, the circle can be marked with stones along the bottom, with one stone placed at the place where a clam will later be put. Each clam should be 2 m from the last one. They should be placed so they are all spaced evenly and neatly.

After the outer circle is put down, the diver holds the knot at 13 m from the float and swims the inner circle, while the other divers follow with the rest of the clams.

Transplanting techniques

The biggest clams are the best, as they produce the most eggs. Collect the clams without harming them. Although they are heavy and their shells are strong, they are soft inside and if they are thrown about they can be hurt and die. Move them slowly and carefully. Do not break the shells.

The clams should be kept moist and in the shade when in the boat. It would be best if they were moved only once, from the collection area to the protected circles. They should be kept out of the water for only a short period of time. If the clams are to be collected in an area far from the placement site, they can be moved to a temporary storage area until ready for the move to the circle area. The storage area should be in about the same depth as the final circle area and the clams should be treated gently and placed correctly in an upright position in the storage area and not just heaped together.

In many cases the most practical idea is to select the circle area and then collect the clams and place them in the circle over a period of weeks, moving new clams into position as fishermen happen to find them and bring them in.

The clams should be carefully lifted from the boat and handed to the divers one at a time and then the divers should carry them to the bottom and place them under the diver on the surface. The surface diver, holding the line, keeps the line pulled gently tight to keep it in position. Once the first clam is placed, the next should be 2.25 m from the centre of the last one. A weighted stick can be used to make the distance exact.

If the clams are too big for a diver to swim with, they should be lowered from the boat on a line. Don't just drop them to the bottom or throw them from the boat as this may damage or kill them.

Care of the circles

If the clams are damaged during collection they will die in the first few weeks. Those that show signs of dying (the shells open and the animal does not move when poked, or white decay is evident on the meat) should be removed from the circle and new clams put in place after a few days. Put the replacement in a slightly different location from the place where the first clam died.

If the clams survive the transplanting they can be expected to live for many years, perhaps more than 30 or 40 years, and thus provide a real contribution to the local clam population. Each big clam provides more eggs than thousands of small clams, so the bigger the clam, the older it gets, the more valuable it is to the production of young.

At least once a year the clam circle should be carefully inspected and any dead or missing clams replaced. People should also remove the large white murex shells (with the pink inside) from the area of the circle as these can eat the clams. If anyone sees some shell or fish eating the clams (even small shells may crawl inside and eat clams), this should be reported and the shells removed from the area of the clams.

The people of one village in Savai'i, Western Samoa, have reportedly kept clams for many generations. The clams have each been given names and the children of the village are sent out to brush the shells clean of growth and to be sure the clams are all right. This may actually be of service to the clams as sponges and other organisms can damage the shell over a long period of time.

It is important for everyone in the community to understand that the clam circle is something which will benefit all the people and that it will provide young clams for many years if it is cared for. If someone kills the clams or takes them from the circle everyone, including the offender, will be poorer in the future.

For this reason, making giant clam circles is a good project for environmental awareness week. It is a time when people can help improve and protect the natural world which in turn provides the food and beauty for everyone. The circles do not have to be built in one day, but they could be started - or finished (or inspected and cared for) during environment week.

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PHOSPHATE, FADS, AND FISH

by

Peter Cusack

Nauru

Introduction

A 100 million dollar a year phosphate mining industry, involving the regular traffic of large bulk-carrier vessels which have to load in deep water over a very steep reef-slope, has created in Nauru an inadvertent but lively and productive fishery in rather unlikely circumstances. A description of this fishery invites consideration by those interested in fish aggregating theory.

Faced with deep inshore waters and lacking suitable sites for harbour development, yet requiring large vessels to manoeuvre close to the reef for loading, Nauru, in 1930, deployed an ingenious and elaborate system of deep-water moorings. Using this system vessels of up to 34 000 t deadweight can moor safely within a few metres of the reef-edge and, by taking up and slacking their hawsers, position their holds directly under a swinging overhead cantilever for bulk loading of phosphate.

The system of sixteen buoys, which has been in place almost continuously since 1930, lies in what is locally a comparatively barren marine zone. The moorings are laid off the western shore of the island, in the lee of the prevailing easterly winds, but also in the lee of the South Equatorial Current, in whose stream the offshore schools of pelagic fishes are invariably to be found. Most of the western shore is noted for pool coral growth and generally poor bottom fishing as well. The area where the moorings are laid is subject to a good degree of environmental interference too, from phosphate spill and from warm-water and sewage outfalls.

Yet, for the length of the mooring system a rich marine ecosystem exists, with schools of mackerel scad, rainbow runner, tunas and wahoo almost continuously in evidence — particularly at the mid-water levels. On this marine oasis, in an otherwise rather lifeless stretch of reef, a thriving, efficient and economically significant fishery has been established.

The buoy system

The ground and mooring tackle used to secure the buoys is necessarily of very heavy duty, with the system rated to bear a vertical loading of 50 t and a horizontal loading of 12 t.

Each main buoy has its own mooring and is rated for a five year life before inspection and replacement, though some buoys have been in use for more than seven years. On inspection, the moorings invariably show only a little sign of wear, the lower 200 m particularly being almost free of corrosion or abrasion.

The buoys themselves are fabricated steel cylinders some 6 m long by 4 m in diameter and lie on average over 300 m of water, while their main anchors, 8 t Danforths, lie seaward in 500 m. A few metres above the main anchor a 15 t 'dumper' weight is shackled to the 75 mm diameter ground chain. This dumper is designed to dissipate the brunt of vertical loading without disturbing the main anchor (Figure 1).

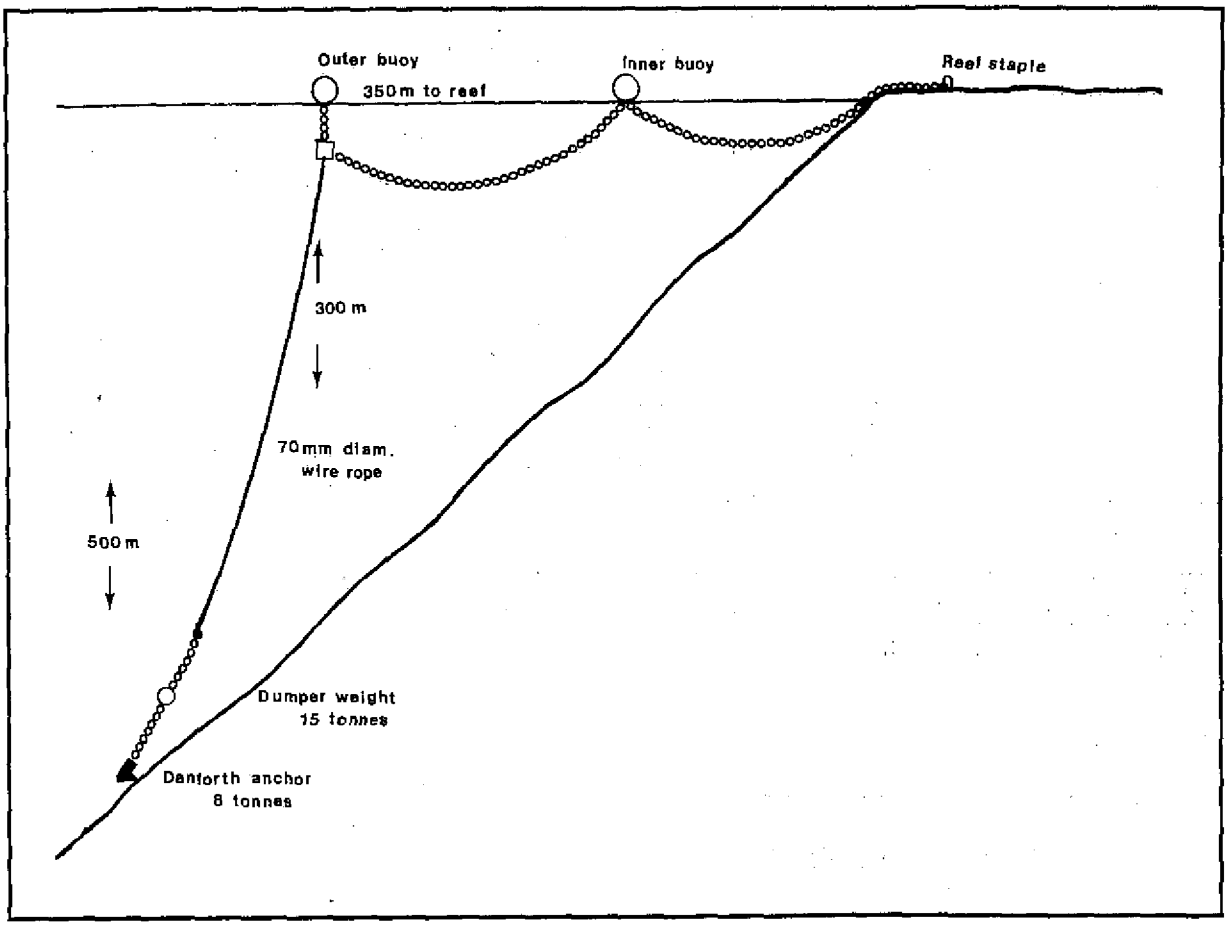

Figure 1. Profile of moorings

The main vertical line of 70 mm diameter cored wire-rope then ascends to a connecting plate below the buoy. From this plate a short vertical length of 70 mm diameter chain attaches to the buoy, while a similar chain runs shoreward. This inshore chain is supported by a smaller 'sister' buoy and proceeds up onto the reef flat where it is secured by a steel staple fixed into the reef.

The buoys are thus secured from dragging inshore by the combination of the Danforth anchor and the 'dumper' weight and restrained from moving seaward by the inshore chain.

The whole system can be tensioned by taking up the inshore chain with bulldozers working at low water.

The fishermen

Nauru's phosphate industry relies heavily on contracted labour from a number of Pacific and Asian countries. By far the largest expatriate group are the I-Kiribati and Tuvaluans, who together number nearly 1 000 adult males, many of whom also have their families living with them in Nauru. With an average weekly wage of around A$ 25-30 it is perhaps not surprising that this group of former atoll-dwellers were quick to realise, and then to exploit, the benefits of what amounts to having a huge fish aggregation device (FAD) laid at their doorstep. Although the buoy system is occasionally fished by powerboats trolling for wahoo, it is the I-Kiribati and Tuvaluan canoe-fishermen who have developed the fishing techniques to exploit this resource most effectively.

Along the foreshore adjacent to the moorings some 150 canoes rest on trestles and, as the phosphate industry works three shifts in every 24 hours, there are nearly always some canoes out around the buoys manned by workers who are off-shift. These I-Kiribati-design canoes, which are usually built locally for around A$ 200, are light and easily carried down to the beach by one man.

The fishermen either paddle out through a narrow gutter cut in the reef or go out over the reef at high water. As the outer buoys lie only 350 m from the reef, little time or energy is spent reaching the ground. From this distance too, the fishermen can keep an eye on the traffic of customers along the foreshore — the fishermen having become keen and canny traders.

The fresh fish market is volatile and prices fluctuate wildly depending on supply and time of day, though demand is constant and enthusiastic. The mainstay of the market are the proprietors of Nauru's ubiquitous Chinese restaurants, who must be able to serve fresh fish all day to satisfy the demands of their Nauruan customers. The restauranteurs' enthusiasm is regularly demonstrated by the sight of fully-clothed Chinese leaping into the sea clutching handfuls of banknotes to meet incoming canoes, in an effort to secure their purchase before their rivals.

With tunas fetching an average A$ 4/kg, and rainbow runner only slightly less, it is the unlucky or unskilled fishermen who doesn't regularly equal or better his weekly wage with one session at the buoys.

The fish

Mackerel scad (*Decapterus pinnulatus*)

Kiribati name : *Kimokino*
Nauruan name : *Iquiri*

Large schools of mackerel scad are commonly found at the upper levels throughout the length of the buoy system; their occasional absence is generally attributed to the presence of large predators, especially dolphins and wahoo. The average fish is around 25 cm in length and is considered the ideal bait for mid-water tuna fishing.

Fishing techniques

Light monofilament line around 2-3 kg, used directly from a handcaster or rigged to a short stiff rod and a No. 10-12 Limerick hook baited with skipjack, is the only gear used. The fish are raised and gathered by setting up a chum trail, usually of chewed skipjack, which is spat into the water as required. Plying his paddle with one hand, holding his line in the other and chewing and scattering chum, the fisherman quietly follows the chum trail and presents his baited hook just below the surface. Providing that the fish are quickly raised, an average 30 minutes is spent bait fishing before the fisherman proceeds to testing the lower depths with the baits.

Rainbow runner (*Elegatis bipinnulata*)

Kiribati name: *Kamaa*
Nauruan name: *Eokwoe*

Rainbow runner are invariably in great abundance around the buoys, and found at lower levels than the mackerel scad. Sizes vary considerably but the average fish is around 1.5 kg. This species is very popular in the local market and easily sold.

Fishing techniques

Jigging

This is by far the most popular method of fishing rainbow runner and is very effective once the fish are found in concentration. The gear consists of a 50 kg monofilament handline rigged to a sinker of special design and with a lower leader of 15 kg monofilament, about 8 m long, which terminates in a feather jig (Figure 2).

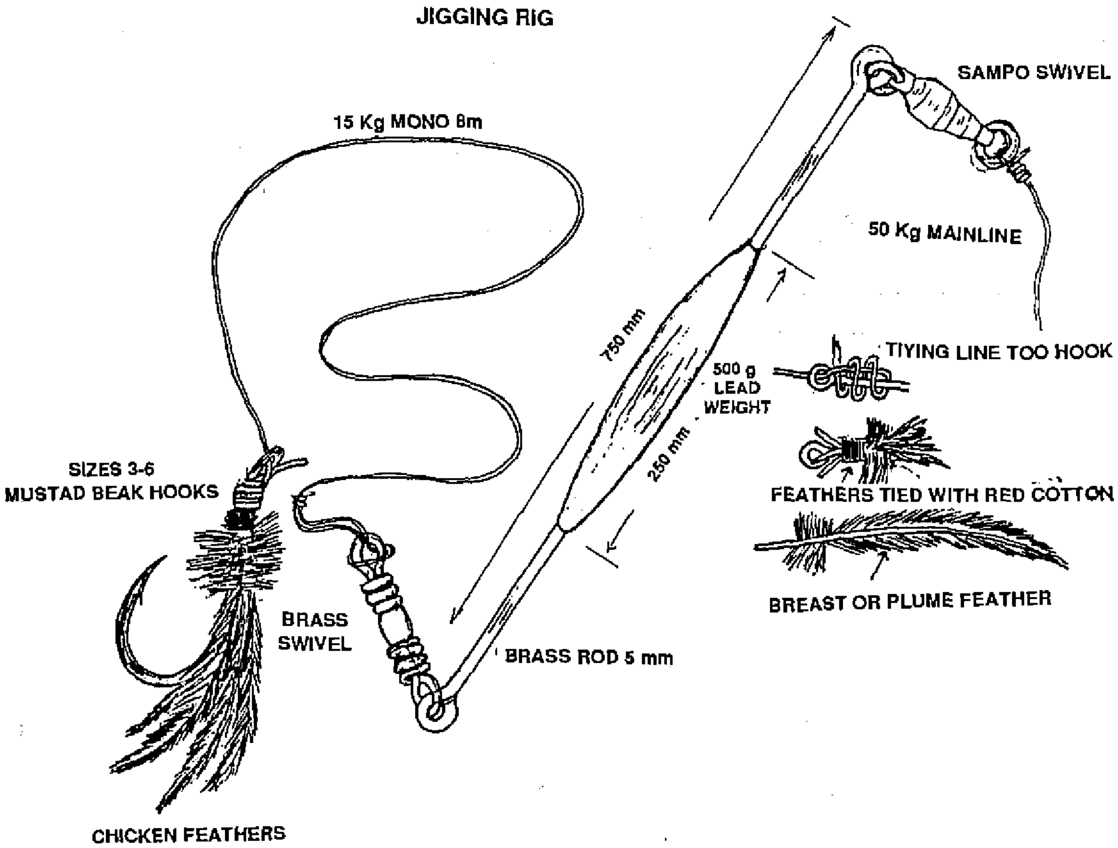

Figure 2. Jigging rig

The sinker is most often fabricated from a 60 cm length of brass rod or heavy wire, with extra weight added towards the centre and swivels rigged at each end. The principle is that the sinker be heavy enough to carry the gear down quickly, but streamlined enough to be drawn up through the water with the least resistance or disturbance.

The jig is handmade using Mustad beak hooks, or a similar hook with a turned-in point, ranging in size from 3/0-6/0. Light chicken feathers (usually brown and white) are whipped onto the hook shank just below the eye, with cotton thread, and extend two shank lengths below the bend. Overall jig size is determined by the size of fish expected.

Once in position the fishermen drops the sinker, which carries the jig down to the desired depth (around 50-80 m). He then begins to draw the jig back up through the water with a brisk upward sweep of his arm. The other hand is used to flake down the line as it comes inboard, ready for the next drop.

The jig's action through the water is regarded as imitating the darting and pausing of a squid. If no bites are made the gear is dropped to progressively lower depths.

Once bites are made at a particular depth the gear is dropped to about 10 m below that level before jigging up through the fish. This same technique is occasionally used offshore on schools of tuna which have sounded at the approach of a powerboat. The technique requires co-ordination and practice but is not difficult to learn. It also develops excellent biceps.

Dropping stones

This method is also popular but depends on the capture of fresh bait and a supply of fist-sized angular stones.

A 50 kg monofilament line is rigged through a barrel swivel to a 5 m length of 15 kg monofilament leader, terminating in a Mustad tuna circle or Tankichi hook around size No. 9.

The hook is baited with a piece of fresh mackerel scad or similar fish (but never rainbow runner flesh, which will drive the schools away) and laid on a flat plane on the stone. Chum pieces smaller than the bait are chopped, or chewed, and spread on the stone. The chum is secured either by wrapping with strands of leader or by overlaying a leaf, a gill plate or a piece of bait skin, which is then wrapped.

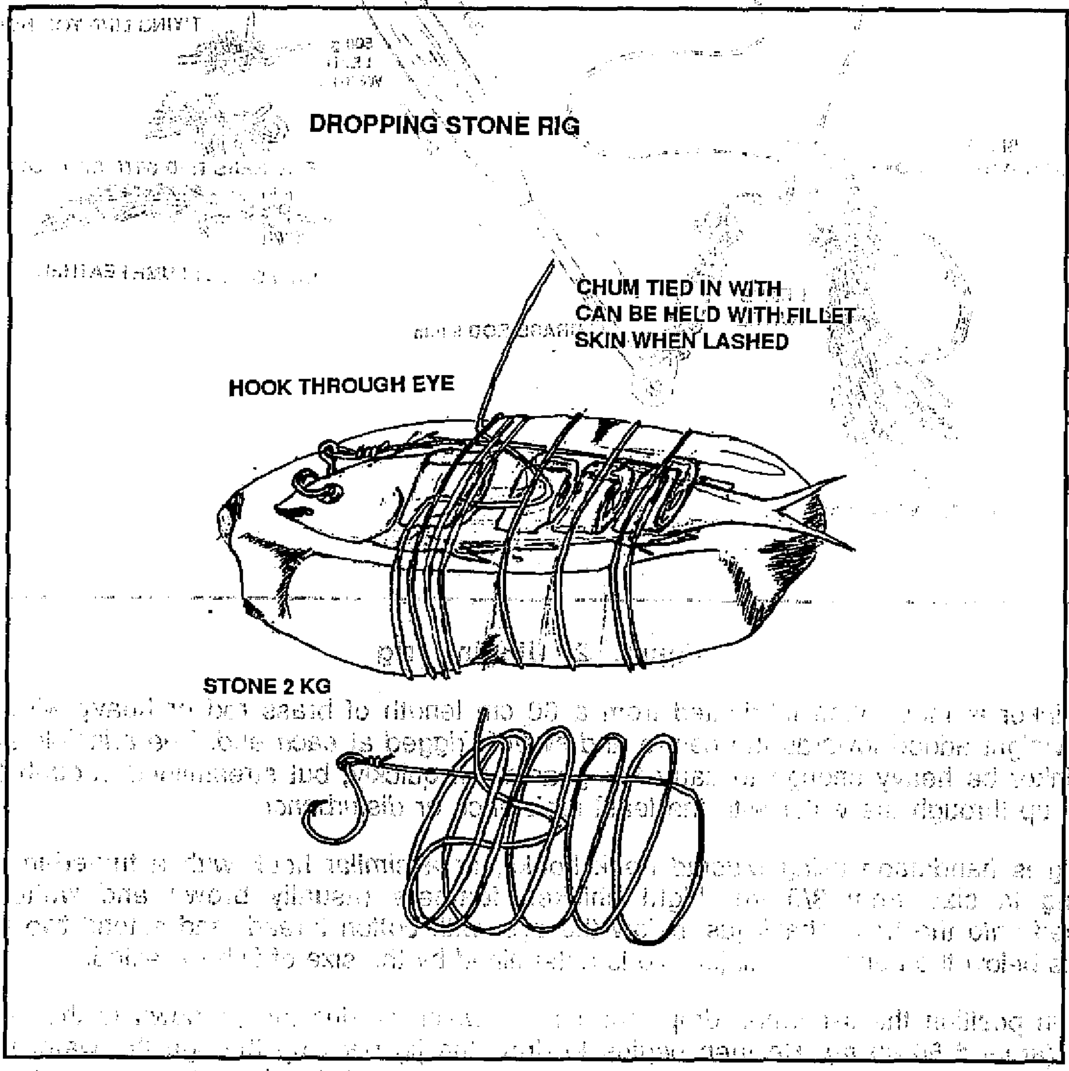

Figure 3. Dropping stone rig

To form a slip-knot, a bight of traceline is tucked under a few strands of the wrapped line. Thus rigged, the stone will carry the baited hook to the desired depth but fall away when the line is tensioned, spreading the chum and presenting the unencumbered hook.

For rainbow runner the gear is dropped to about 25 m to begin. Care must be taken to let the line run free on descent as any tension may slip the knot and release the stone prematurely. If no bites are made, the depth of the drop is progressively lowered. On the bite, the line is tensioned but not struck vigorously, the hook style being relied on to make the capture.

Canoes have a distinct advantage in this fishery because they are easily manoeuvred to keep over the line, even when a strong current is running. This can be overcome if fishing from a larger boat by attaching floats (e.g. Japanese longline floats) to the mainline and casting the rig free once the line is down. The buoyancy of the float seems to provide just enough resistance to set the hook on a bite.

Yellowfin and Bigeye tuna (*Thunnus albacares* and *Thunnus obesus*)

Kiribati name :*Ingimea*
Nauruan name : *Itsibab*

Tunas are found at the lower depths around the buoys and rarely venture near the surface. Both yellowfin and bigeye are taken; they vary in size from around 6 kg to well over 100 kg.

These fish are premium market fish, especially fish of 20 kg and up, and many fishermen devote considerable time to fishing for them. They are not as numerous as the rainbow runner, but the capture of even one good fish in a day offers a very satisfactory return.

Fishing techniques

As for rainbow runner but with variations in gear and depth appropriate to these larger deep-swimmers.

Jigging

Jigging is usually started at around 100 m and jigs and hooks used are larger, up to 10 cm measured from eye to tail of jig. Heavier monofilament leaders, around 30 kg, are used.

Dropping stones

This technique is the most favoured when large tuna are about. The mainline may be 100 kg monofilament or braided nylon and the monofilament leader around 50 kg.

Mustad tuna circle or Tankichi hooks ranging up to size No. 5 are used and the favoured bait is a whole mackerel scad, used alive if possible. The stones are house-brick size. The whole mackerel scad bait is rigged through the upper eye-socket and the hook rolled so that the point is fully exposed. This is then overlaid with chopped chum and the whole rig secured as previously described.

Starting depth is around 150-180 m, or deeper if required. Live baits produce more and quicker strikes, but occasionally attract sharks.

Wahoo (*Acanthocybium solandri*)

Kiribati name : *Baara*
Nauruan name : *Egow*

Wahoo are most often found around the buoys a few days either side of full moon and are usually taken by powerboats trolling whole flying fish baits or lures.

Occasionally captures are made by canoe-fishermen jigging or dropping stones, but most wahoo strikes result in cut-offs due to the monofilament leaders used in these methods.

An unusual technique, only rarely used, is effective when wahoo are seen to be feeding on baitschools near the surface. A bamboo pole is rigged with a short line and a 'teaser' bait, commonly a flying fish, attached. A second pole has a running noose attached at one end. The 'teaser' bait is splashed about on the surface until a wahoo responds and begins making passes at it. The fisherman then attempts to position the noose between the bait and the fish. If the fish enters the noose, the fisherman draws up on the line and snares the fish, usually by the tail. This technique requires a good deal of skill and patience, but is a thoroughly exciting spectacle and its exponents are held in high esteem.

Skipjack Tuna *(Katsuwonus pelamis)*

Kiribati name : *Ati*
Nauruan name : *Eae*

It is worth recording that skipjack have never been reported at the buoys, either on the surface or at depth, even though large schools are common offshore.

Conclusions

This description of Nauru's inadvertent FAD fishery invites some interesting speculations regarding FAD deployment.

— FAD's laid close inshore may produce concentrated stocks of pelagic fishes even in unlikely areas, such as near harbours; such siting could offer advantages in fuel-saving, easy access and safety for small boat fishermen, and proximity to markets.

— The use of heavier than usual mooring tackle (keeping in mind that the moorings described are rated for 34 000 t vessels) may extend FAD life far beyond the usual experience. The increased cost of such gear would be offset to some extent by the relatively shallow depths involved, and total loss of gear is unlikely.

— Developing techniques to fish FADs all through the vertical column of fish habitat is likely to significantly increase their productivity.