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**SPC ACTIVITIES**

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**DEEP SEA FISHERIES DEVELOPMENT PROJECT NOTES**

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**Nauru — FAD construction and deployment project (Phase I)**

In response to a request from the Government of the Republic of Nauru for assistance in initiating a FAD programme, former SPC Masterfisherman, Paul Mead, was engaged to travel to Nauru in order to evaluate potential FAD sites and to investigate the local availability of material resources necessary to fabricate and rig FAD rafts and moorings.

To assist with this, and future FAD site selection and fisheries work, the Deep Sea Fisheries Development Project acquired a dual frequency, deep-water capability, echo-sounder. This unit, a Furuno FCV 362 (28/50 khz), gave good bottom returns at 1,600 m depth, and was adequate to the task of sounding Nauru's deep inshore waters.

After consulting with officers of Nauru's Department of Island Development and Industry (IDI) and local fishermen, Mead completed an extensive echo-sounding survey of potential sites. Three sites, selected to provide access to local launching points in all but very bad weather, were located and plotted. The sites lay at an average depth of 1,100 m and approximatively one mile offshore.

The local availability of potential FAD materials was then investigated and work begun on a suitable raft design and mooring calculation. Mead's design was forwarded to U.S. Coast Guard Buoy Engineer, Lt. R. Boy, for his expert evaluation, and a bill of materials subsequently supplied to Nauru so that IDI can order and land the requisite materials. At that time, it is expected that Mead will return to Nauru to supervise the deployments.

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**INSHORE FISHERIES RESEARCH PROJECT**

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**Survey of pearl oyster resources, Nukulaelae, Tuvalu**

The survey took place in response to the Tuvalu Government's wish to investigate the possibilities of pearl oyster culture as an economic development activity for the outer islands. The survey team spent two weeks on Nukulaelae, the Tuvaluan island reputed to have the highest densities of pearl oyster. Survey work revealed that densities were nevertheless too low for culture work to be envisaged without a substantial programme of stock enhancement through the use of spat collectors. This approach was recommended and the Tuvalu Fisheries Division is now considering incorporating pearl oyster stock enhancement work into an on-going giant clam culture project.

**Review of Pacific Island FAD programmes**

Fish aggregation devices (FADs) are in widespread use as fishery enhancement tools throughout the Pacific Islands region. For the past eight years, the SPC has been instrumental in developing FAD technology and in supporting country efforts to establish effective FAD programmes. An invitation to SPC to participate in an Indo-Pacific Fishery Commission symposium on FADs and artificial reefs provided an impetus to review the problems and issues still facing Pacific Island countries in this area. The review was presented as a symposium paper, and will form the basis of more in-depth analysis of country experience in FAD use currently being carried out by an SPC consultant.

**Inshore Fisheries Research Project (IFRP) /South Pacific Regional Aquaculture Development Project (SPRADP) Reef Reseeding Project**

The activities of the South Pacific Regional Aquaculture Development Project (SPRADP), as well as other organisations (International Center for Living Aquatic Resources Management and SPC), have aroused regional interest in the mariculture of juveniles of commercially exploited inshore marine organisms for use in programmes of resource enhancement by reef restocking. However, most attention has focused on aquaculture technology and techniques and the mechanics of producing seed in large numbers. Little work appears to have been done to assess the real effects of juvenile release on wild, exploited populations of tropical reef organisms.

Working co-operatively, the IFRP and SPRADP are undertaking a two-phase research programme to address this issue. The first phase consists of literature research aimed at reviewing the results of relevant juvenile release programmes carried out elsewhere. Phase Two of the project will probably consist of at least one juvenile release and population monitoring experiment, involving one or more interested national fisheries bodies.

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**FISH HANDLING AND PROCESSING PROJECT (FHPP)****Papua New Guinea, Vanuatu, Solomon Islands — Assistance to women's groups**

Following the successful workshop in fish processing and marketing held for Papuan region women in Papua New Guinea in September 1989, the Department of Fisheries and Marine Resources and the Women's Division have indicated their desire to develop, on a national scale, an ambitious programme to assist women from fishing communities. The Fish Handling and Processing Officer visited Port Moresby in April to help draw up a project proposal to carry out these plans. As Vanuatu and Solomon Islands have indicated their interest in being involved in similar schemes, the proposal was developed as a sub-regional project.

A number of broad activity areas were identified as a result of this visit and it is suggested that an appropriate strategy would be to engage a specialist to oversee the development and implementation of these projects. A Women's Fisheries Programme Officer could be employed within SPC's Fisheries Programme, to undertake this task, under the FHPP, but working in close collaboration with the Pacific Women's Resource Bureau. This officer would be responsible for satisfying requests for development projects for women-in-fisheries for the region, beginning with the sub-regional project for Melanesia.

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**TUNA AND BILLFISH ASSESSMENT PROGRAMME****Regional Tuna Tagging Project**

The Regional Tuna Tagging Project (RTTP) commenced in late 1989, with the field-work scheduled to run for two years. The RTTP is funded largely from the Sixth European Development Fund under the Pacific Marine Resources Programme, and is being carried out by the South Pacific Commission's Tuna and Billfish Assessment Programme. The majority of the work is being done from the RTTP's chartered Tuvaluan pole-and-line vessel, *Te Tautai*, but also incorporates tagging from commercial vessels under short-term charter arrangements or co-operative agreements. Tagging is being carried out in tropical waters between the Philippines and Kiribati.

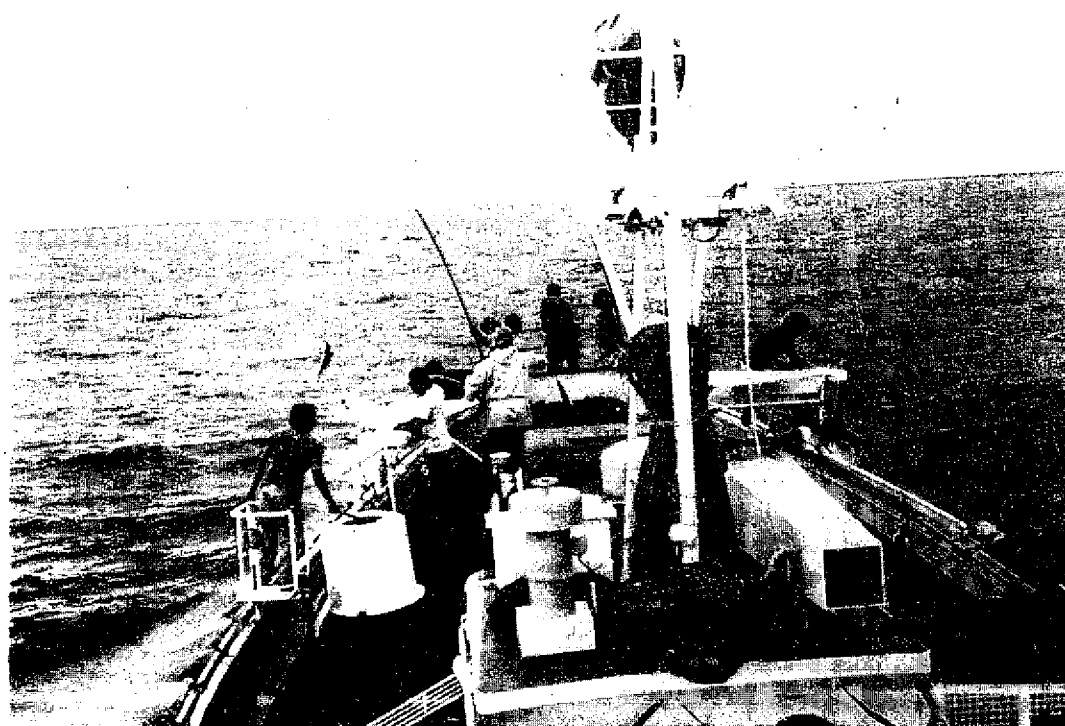
The primary objective of the Project is to gather information on the population dynamics of Western Pacific yellowfin, with emphasis on the estimation of movement patterns, mortality rates and growth. This information will enable an assessment of the status of the fishery and

allow a variety of interaction questions to be addressed. Similar information is also being collected for skipjack and bigeye.

During May 1990, the vessel worked in both Papua New Guinea (PNG) and the Federated States of Micronesia (FSM). Nearly 300 fish, mostly skipjack, were tagged to the north and north-west of Manus Island to conclude a period of three months' tagging during 1990 in northern Papua New Guinea waters. In transit to Pohnpei, FSM, 873 fish (409 yellowfin, 392 skipjack, 72 bigeye) were tagged, mostly in Papua New Guinea waters, on logs.

Fishing in eastern FSM waters was poor, with few school sightings, some bad weather and patchy bait availability. With only 80 fish released over a two-week period around Pohnpei and Kosrae, and no evidence of Distant Water Fishing Nations activity, the decision was made to return to PNG and work westwards along equatorial waters towards Palau. As a result, 867 tuna (402 yellowfin, 421 skipjack, 44 bigeye) were tagged in northern PNG waters, centering on 1°S, 151°E where reasonable fishing on logs and free schools was encountered.

During June 1990, in Papua New Guinea, the vessel first concentrated her fishing activities north of New Ireland on the proven fishing ground of Tench Island, and later on around Dyaul Island. Fishing in the vicinity of these islands was most successful and 2,923 tunas (1,265 yellowfin, 1,624 skipjack and 34 bigeye) were tagged. By mid-June, operations shifted to the Manus Island area. Fishing in the vicinity of Kaniel Island was relatively poor, but a fair number of fish were tagged around a charted 25-fathom seamount. At one point, the vessel ran out of bait and as yellowfin were still breezing around the boat, troll-tagging from the vessel's skiff was successfully tried as an alternative fishing method. All in all, 1,160 yellowfin, 1,508 skipjack and 50 bigeye were tagged.



**Tagging activities on board *Te Tautai***

Towards the end of June, the vessel moved to Palau for a two-week sojourn. A large number of schools, including several yellowfin schools, were sighted around Helen Reef and Tobi

Island, but a poor response to chum did not allow more than 153 tuna (95 yellowfin, 58 skipjack) to be tagged.

#### **Tagging aboard a Japanese group seiner**

A trial tagging cruise was conducted on board vessels of the Kotobuki purse seine group from 9 to 28 April 1990 in the waters of FSM and adjacent high seas areas, in which 294 tunas were tagged.

This valuable opportunity was provided by the Government of the Federated States of Micronesia through fishing access negotiations between the Micronesian Maritime Authority and the Federation of North Pacific District of Purse Seine Fisheries Co-operative Associations of Japan.

The cruise was a useful tagging experiment and a great deal was learned about this fishery. The most significant value of tagging from group seiners seems to be the opportunity to release medium-sized tuna in good condition among the high seas purse seine fleet. It also provides a unique opportunity to study tuna school associations with drifting objects.

#### **Solomon Islands In-Country Tuna Tagging Project, Cruise 4**

The Solomon Islands In-Country Tuna Tagging Project was developed jointly by the Fisheries Division, Ministry of Natural Resources of Solomon Islands and the South Pacific Commission Tuna and Billfish Assessment Programme, and is funded by the Australian International Development Assistance Bureau (AIDAB). The project is designed to provide information on skipjack population dynamics and fishery interaction that is necessary to enable the rational development of the Solomon Islands tuna fishery, currently the largest of its type in the Pacific Islands region.

The last of the four cruises originally planned for this project was undertaken from 11 to 25 June 1990 and like the previous three cruises, had as its objective to concentrate tagging effort in areas both within and outside the Main Group Archipelagic (MGA) baseline, and to release some tagged skipjack in the vicinity of fish aggregation devices. During this fourth cruise, a total of 2,506 tunas were tagged (163 yellowfin and 2,343 skipjack).

#### ***Tag Recoveries***

During May 1990, most recoveries were made from Solomon Islands releases, particularly from Cruise 3 of the Solomon Islands In-Country Tagging Project, 10–28 March 1990, and RTTP releases during March 1990. Sixty recoveries were made from releases from the Japanese group seine vessel during May, mostly by other group seiners in nearby waters.

Notable returns during May included three skipjack and one yellowfin released in Solomon Islands and recaptured north of the Equator, and six returns from fish at liberty for more than 200 days. Four tags from bigeye were returned.

During June 1990, recoveries were predominantly made from RTTP releases during March in Solomon Islands and April in Papua New Guinea. Most of the recoveries from PNG releases were attributed to purse seiners fishing in nearby waters at the time of release. A few recoveries from Cruise 1 of the Solomon Islands In-Country Tagging Project were also noted.

The most interesting return during June 1990 was a skipjack that was released off Cape Lambert, PNG, and recaptured south-east of Tinian in the Northern Mariana Islands by a small trolling boat. The fish was at liberty for 77 days and travelled approximately 1,020 km.

**Western Pacific Fisheries Consultative Committee**

The second regular meeting of the Western Pacific Fisheries Consultative Committee (WPFCC) was held in Port Moresby, Papua New Guinea, from 2 to 3 July 1990. Members of the Association of South-East Asian Nations (ASEANs) represented at the meeting included Indonesia, Malaysia, Philippines and Thailand. Pacific Island Nations (PINs) were represented by the Cook Islands, the Federated States of Micronesia, Fiji, Nauru, Papua New Guinea, Solomon Islands and the South Pacific Commission. Observers from Chile, Colombia, Ecuador, Mexico, Peru, the Permanent Commission of the South Pacific (CPPS), the Latin American Organization for Fisheries Development (OLDEPESCA) and the Forum Fisheries Agency (FFA) were present.

The Director of WPFCC, Ms Elvira Baluyut, presented a review of the activities of the organisation over the 18 months that had passed since the first WPFCC meeting, highlighting what were felt to be the Secretariat's major accomplishments:

- the successful conduct of the Tuna Research Workshop in Manila and General Santos City, Philippines, in April 1989;
- the publication of the WPFCC *Newsletter* as a means of information exchange;
- the promotion of scientific exchanges through participation of ASEAN scientists in meetings in the Pacific and vice-versa;
- assistance to the SPC Regional Tuna Tagging Project with the preparation of tagging visits to the Philippines and Indonesia.

Presentations were made with a view to identifying possible areas of co-operation between ASEAN and PINs, including fisheries research, training, aquaculture, trade and industry, and general information exchange. Among the specific proposals were the following:

- co-ordination of WPFCC's proposed 1992 Tuna Research Workshop with the establishment of the working group on yellowfin which was recommended by the Standing Committee on Tuna and Billfish;
- a workshop on fisheries education and training;
- circulation of information profiling training opportunities in the two regions;
- exchange of fisheries information through a mechanism similar to the Pacific Islands Marine Resource Information System (PIMRIS);
- a conference on aquaculture research and development;
- compilation of a compendium of joint-venture opportunities;
- sharing of information on vessel movements and fishing vessel surveillance.

Tri-regional co-operation, among ASEAN, PINs and Pacific Latin-American countries (PLACs), was also discussed, and the following areas of co-operation were proposed:

- the development of a trans-Pacific set of minimum terms and conditions for fisheries access by foreign fleets and sharing of information on tuna fisheries management;
- the promotion of statistical information programmes supporting management for artisanal fisheries;

- the development of low-cost technology in fish processing;
- the development of mechanisms for improving fisheries education and training opportunities

In a meeting immediately following the second WPFCC meeting, it was planned to establish an organisation similar to WPFCC to promote co-operation between PINs and PLACs, the Trans-Pacific Fisheries Consultative Committee (TPFCC). It was suggested that in the near future, the possibility of merging the two secretariats should be addressed.

### **Expert consultation on stock assessment of Indian Ocean tunas**

The Expert Consultation on Stock Assessment of Tunas in the Indian Ocean was held in Bangkok, Thailand from 2 to 6 July 1990 and was attended by scientists from Australia, France, India, Indonesia, Iran, Japan, Kenya, Korea, Malaysia, Mauritius, Reunion (France), Seychelles, Somalia, Spain, Sri Lanka, Taiwan (Republic of China) and Thailand. International organisations represented at the meeting included the Food and Agriculture Organization of the United Nations and the South Pacific Commission.

The meeting commenced with a review of national fisheries and research programmes. It was noted that the catch by the industrial purse seine fishery declined for the first time, from 227,655 mt in 1988 to 223,600 mt in 1989. While the catch of skipjack increased from 118,588 mt in 1988 to 149,843 in 1989, the catch of yellowfin declined from 106,283 mt in 1988 to 70,159 mt in 1989. During the first quarter of 1990, there were 54 vessels active, including 21 from Spain, 20 from France, 7 from the Soviet Union, 4 from Japan and 2 from Mauritius.

The longline fishery in the Indian Ocean consists primarily of vessels from Korea, Taiwan and Japan. Recently, an Indian company has chartered foreign vessels. Small catches are taken by longliners from coastal states operating in nearshore areas. The Taiwanese began fishing with pelagic drift gillnets in the Indian Ocean in 1983, targeting albacore and taking incidental catches of bigeye, yellowfin and bluefin. A comparison of catch rates for Taiwanese longliners and gillnetters has yet to show any empirical evidence for interaction.

In the Indian Ocean, coastal states fish for tuna using artisanal or traditional gear, including gillnets, troll lines, longlines and handlines. The increasing use of fish aggregation devices in fishing for skipjack, yellowfin and marlin in Mauritius was reported. In the Maldives, skipjack and yellowfin are taken by small pole-and-line vessels. In Sri Lanka, 90 per cent of the tuna caught in the offshore area are by gillnets, often in combination with other gears, such as longlines, handlines and troll lines. Most of the catch consists of skipjack and yellowfin. Indian fishermen using drift nets, purse seines and hook and line operate within 50 miles off the coast and land small tunas, with some skipjack and yellowfin. In Pakistan, 50 GRT vessels using gillnets of over 10 km in length catch skipjack, yellowfin and billfish. These vessels operate from Pakistan to the coasts of Oman and Somalia and make trips of up to two months in duration. In Oman, large catches of yellowfin are made with handlines off the north-eastern coast.

The total catch of yellowfin in 1988 was 180,000 mt, including 6,400 by pole-and-line vessels in the Maldives, 3,200 mt by gillnetters from Taiwan, Indonesia and Pakistan, 111,700 mt by purse seiners, 34,900 mt by longliners, and 27,000 mt by unclassified artisanal gears. While the yellowfin stock appears to be able to support the current level of exploitation, there is concern regarding the increasing catch of juvenile yellowfin taken by purse seiners in association with logs in the western Indian Ocean. Further expansion in the eastern Indian Ocean would appear to be possible in localised areas.

The total catch of skipjack increased considerably during 1984—1989 owing to the development of the industrial purse seine fishery. The total catch of skipjack in 1988 was 207,100 mt, including 116,400 mt by purse seiners, 62,700 mt by pole-and-line vessels from the Maldives and India, 3,800 mt by gillnetters, and 24,200 mt by unclassified artisanal gears. Data for the industrial purse seiners show an increase in catch rates, which levels off in 1988 and 1989. This trend occurred while catches by the industrial purse seiners and the pole-and-line vessels in the Maldives reached historically high levels, which would suggest that the stock of skipjack in the Indian Ocean is healthy.

According to the limited data available, it would appear that the stock of bigeye is in healthy condition. However, in recent years, increasing effort has not resulted in a corresponding increase in the catch of bigeye. Examination of trends in adjusted CPUE for albacore shows dampening periodic fluctuations since 1971. The albacore stock appears stable under current fishing pressure. Yield per recruit analysis indicates that the stock is currently close to optimal utilisation.

Fisheries for small tunas, seerfish and billfish were also considered. Catches of small tunas, primarily longtail, kawakawa and frigate tuna, increased from 63,000 mt in 1976 to 143,000 mt in 1988. Seerfish landings in the Indian Ocean steadily increased from 43,000 mt in 1976 to 104,000 mt in 1988. The bulk of seerfish landings consists of narrow-barred Spanish mackerel and the Indo-Pacific king mackerel. Billfish production in the Indian Ocean has increased from about 10,000 mt in 1979 to 15,000 mt in 1988. There are no major fisheries specifically targeting billfish, but significant catches of six species (swordfish, Indo-Pacific blue marlin, striped marlin, Indo-Pacific sailfish and black marlin) are taken by longliners, gillnetters and recreational fishermen.

Two tagging experiments have recently been undertaken in the Indian Ocean. The principal objective of the tagging programme in the Maldives has been to determine the movement of skipjack and yellowfin in the area bounded by the Maldives, Sri Lanka and India. Three trips of about two weeks duration were carried out in January, March and May 1990, utilising artisanal pole-and-line vessels (*masdhoanis*) and employing local staff and crew, with assistance from the FAO/UNDP Indo-Pacific Tuna Programme. A total of 3,731 tunas (2,601 skipjack and 1,130 yellowfin) were tagged and released. As of April 1990, a total of 187 tags have been recovered (178 skipjack and 9 yellowfin), several of which were recovered in the waters off the southern tip of India and to the south and south-west of Sri Lanka. Three more trips are to be conducted and it is hoped that the total number of fish tagged will reach 10,000.

Five tagging cruises during September 1987—September 1989, using a medium-sized purse seiner adapted for pole-and-line operations, took place as part of the Regional Tuna Project of the Indian Ocean Commission. Tagging was hampered by several factors, notably the inadequacy of the vessel for tagging purposes and the inexperience of the crew. Only 953 fish were tagged (419 yellowfin, 359 skipjack and 175 bigeye), mostly off the north-west coast of Madagascar and around the Comoros. Some 112 tuna (103 yellowfin and 9 skipjack) were tagged near fish aggregation devices around La Réunion. As of June 1990, 13 fish have been recovered, giving a preliminary recovery rate of 1.3 per cent.

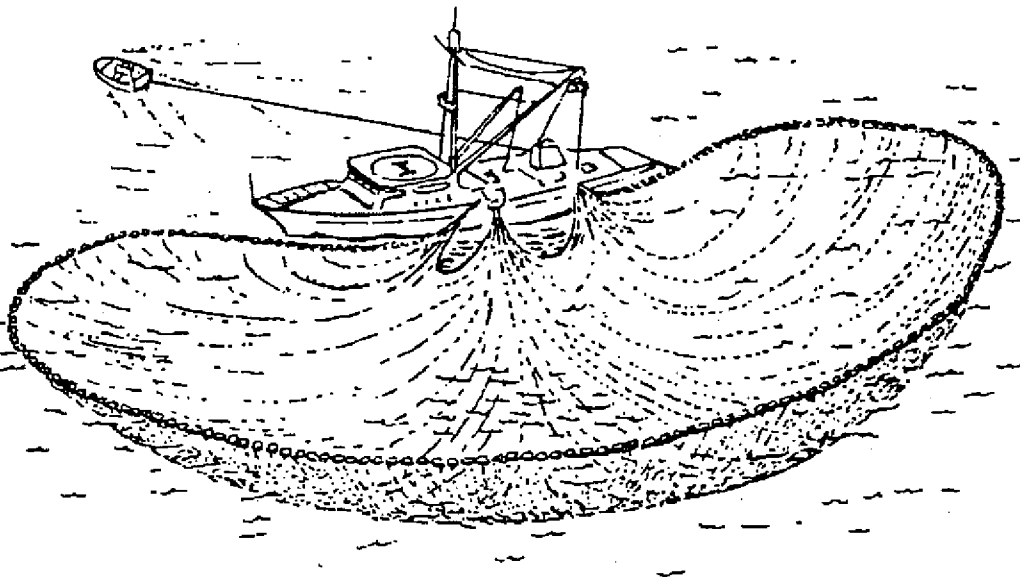
In reviewing progress in research, the meeting noted the following:

- Little is known about the stock structure of most Indian Ocean tunas. For convenience, a single stock hypothesis is routinely assumed for many of the large tunas. The participants felt that the best way to answer questions of stock structure is with well-designed tagging programmes. They also noted that recent results of the Inter-American Tropical Tuna Commission with morphometric analyses are encouraging and that the method should be considered for Indian Ocean tunas.
- Movement and migration information is becoming more important because of questions concerning fisheries interactions. However, data obtained from the tagging studies



conducted to date are inadequate for the quantitative analyses required. The participants recommended that the FAO/UNDP Indo-Pacific Tuna Programme develop a plan for an ocean-wide tagging programme to study interactions for skipjack, yellowfin and bigeye fisheries, possibly with funding by the European Community.

- There has been some progress in determining the age and growth and other biological parameters for tunas, but estimates of biological parameters are still largely unavailable for most Indian Ocean tuna species. The participants recommended that research be expanded, particularly on assessment techniques such as cohort analysis.



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**NEWS FROM IN AND AROUND THE REGION**

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**TONGAN FISHERMEN WANT FINANCIAL AID**

(Source: *The South Sea Digest*)

The Tongan Fishermen's Association is seeking donors to finance the fishing requirements of more than 3,000 members. Speaking to the *Tonga Chronicle* before leaving to assume the post of Fisheries Project Officer with the Commonwealth Secretariat in London, Mr Semisi Fakahau, Tonga's Principal Fisheries Officer, said the association has had requests from Ha'apai members for T\$ 4.5 million (about US\$ 3.5 million), from Tongatapu members for T\$ 5.0 million and for T\$ 3.8 million (about US\$ 2.9 million) from Vava'u members.

He said overseas funding was available for the Fisheries Division for development projects, but the Division lacked the manpower to develop them. Since its establishment in 1973, the Division had received T\$ 14 million (about US\$ 10.8 million) for development projects. Inadequate transport was a second major problem, but a public fishing company, Sea Star Fishing Co., will be established to assist in exporting fish and will seek finance from the Asian Development Bank to build two vessels to aid the M/V *Lofa*, which has averaged US\$ 700,000 in cargo sales every quarter. He said he will help the Tongan industry while in London by seeking finance for training and equipment in Tonga.

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**TAIWAN AND KOREA BUY KIRIBATI FISHING LICENCES**

(Source: *The South Sea Digest*)

Taiwan has paid the Kiribati Government US\$ 250,000 for a licence to operate its longline fishing boats in Kiribati's 200-mile fisheries zone for one year. The licence will cover only vessels registered with the Overseas Development Council of Taiwan. The Korean Deep Sea Fisheries Association paid Kiribati US\$ 960,000 for licences for 113 longliners.

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**PEARLS MAKE AN ISLAND WEALTHY**

(Source: *Islands Business*)

Lying more than 1,200 km north of the seat of the government at Rarotonga, the atoll of Manihiki is classed by its few visitors as being one of the most beautiful in Oceania. With a population of about 400 people, a big lagoon and not much land, Manihiki might be taken to be a poor place, dependant on copra, pearl shell and a few natural pearls found in its lagoon.

But Manihiki has struck it rich with cultured black pearls. The first pearl farms were laid down three years ago and now the Cook Islands is buzzing with stories about the way money is rolling in. The Cook Islands Fisheries Department is predicting that the pearl trade will soon be worth more than NZ\$ 20 million (US\$ 11.5 million a year) — from two to four times the value of all other exports of fruit and vegetables, clothing, copra, pearl shell and handicrafts. Manihiki's leading individual pearl farmer is said to have made one million NZ dollars (US\$ 575,000) already.

So far the business is in Manihikian hands, little affected by government intervention, and Manihikians are quite secretive about it. But Prime Minister Geoffrey Henry has little doubt about what the cultured pearl business could mean. 'I see it as one of the more exciting things happening here in the Cook Islands', he told *Islands Business*. 'It has been just one island up till now, but we want to expand the industry to the whole of the northern group.' The United States has agreed to supply US\$ 3 million — US\$ 4 million over five years for the fostering of the industry, he said. 'I hope to see legislation for a Pearl Board which would be responsible for selling or auctioning pearls and for quality.'

French Polynesia has been Oceania's centre for black pearl culture, annually exporting a harvest worth US\$ 2—3 million a year. But many of its farms have been hit by a disease which kills oysters. In Fiji, a Japanese company has operated a small farm for more than 20 years.

The Manihiki industry's evolution began in 1987 with the arrival of Yves Tchen Pan, a Chinese Tahitian businessman whose French Polynesian farm had been struck by a disease causing high mortality of oysters. Two years ago tensions developed at Manihiki involving Tchen, the island council and independent farmer Tekake Williams, who went to French Polynesia in 1981 to study pearl farming and pioneered the business at Manihiki. Rivalries and disagreement about the extent to which pearl farming could be developed without the risk of introducing disease caused a situation where, at one point, the Island Council refused to allow government ministers to land on the island. That trouble seems to have now evaporated.

Tchen's company, Cook Islands Pearls, has invested about NZ\$ 8 million (US\$ 4.6 million) at Manihiki, according to lawyer Ruben Taylor, a director. He said the company was spending NZ\$ 750,000 a year buying oysters from the islanders, with young divers making up to NZ\$ 2,000 a day.

A speck of material which causes a pearl to form is inserted in each oyster. It takes three years for a pearl to reach market size. In Rarotonga, sources said the volume and quality of pearls harvested had not quite reached expectations, but overall results were good. Most pearls were being bought by Japanese. 'The most important thing is developing an awareness of the Cook Islands as a producer of black pearls', said Taylor. 'The industry is still in its infancy'. He described the market for pearls as being 'infinite'. Cook Islands Pearls is also manufacturing pearl jewellery, a sideline the government wants to see developed.

Joan Rolls, whose company, Beachcomber Ltd., is one of Rarotonga's pearl dealers, said her father Ron, now 82, taught her the business in the days when outer islanders would offer him a natural pearl carried in a cigarette packet. Rolls said a top quality pearl might fetch up to NZ\$ 3,000 (US\$ 1,700). Her shop has in its stock a strand priced at NZ\$ 29,000 (US\$ 16,700). 'I still buy natural pearls', she said. 'The nicest thing about Cook Islands cultured pearls is that they are all exactly the same quality', she said. 'They don't look like Japanese cultured pearls. Each has an iridescence which makes it complete. It surprises me, the number of people who are interested in individual pearls'.

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## **CAN OUTER ISLANDERS DEVELOP A VIABLE FISH EXPORT INDUSTRY?**

(Source: *Pacific Magazine*)

The Japanese Overseas Fisheries Co-operation Foundation (OFCF) and the Ministry of Resources and Development in Majuro think so, and have thrown their weight behind a pilot fisheries project on Arno Atoll that is beginning to take off as it nears the end of its first year.

Part of the OFCF-sponsored pilot project is fisheries research to catalogue the volume of different reef and ocean fish, and their seasons, in Arno. The other aspect is hands-on fishing for export, an exercise that takes hard work and perseverance.

The OFCF stationed a three-man team in Majuro and Arno and has provided boats and equipment for fishermen on Arno. A key part of the project is keeping fish in marketable condition by putting them on ice before they are delivered to markets in Majuro Atoll, about 120 miles away as the sea-bird flies. Two to three times a week, a 35-foot boat delivers the fish to Majuro.

In January 1990, Arno fishermen hauled in their biggest catch since starting in August 1989. More than 10,000 pounds of reef fish and tuna were exported to Majuro to be sold in local markets.

Shozo Hitawatashi, OFCF team leader, said that while the January 1990 catch was excellent, it was still too small to generate the revenues needed to make the fishing venture able to stand on its own feet commercially. Japanese aid, in the form of boats, gas, equipment, ice and advice, will continue to be needed for the foreseeable future, he said.

Rotating groups of fishermen make use of the eight 20-foot outboard boats, which provide opportunities for more than 100 fishermen to earn cash income. Although many use them on a daily basis, it has been found that the boats are employed only about half the time because of time lost in travel to pick up the fishermen in different parts of Arno. Another difficulty is the lack of infrastructure for loading and unloading fish, ice and equipment, since there are no jetties or docks on the atoll.

The latter problem may be solved soon, however, with the start of Phase 2 of the pilot project that calls for construction of lagoon and oceanside docks and causeways linking islands together to make communication and travel easier.

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### **GRANTS MADE FOR FISHERIES PROGRAMMES**

(Source: *Honolulu Star Bulletin*)

Nearly US\$ 330,000 in grants for developing new Pacific Fisheries Development programmes in the Pacific were released in Washington by the National Oceanic and Atmospheric Administration (NOAA).

Funding includes US\$ 60,442 to study sea cucumber populations in Guam, Federated States of Micronesia and the Marshall Islands, to evaluate production trends and study potential marketing plans, and US\$ 96,250 to raise seven species of giant clams to determine which has the greatest potential for marketing.

Other grants include US\$ 78,696 to re-establish clam-rearing areas in the Marshall Islands and test new technology for promoting their growth and reproduction and US\$ 44,616 to examine marketing of Palau's deep-sea crabs.

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### **FISH VENDORS GENERATE BIG BUSINESS**

(Source: *The Pacific Sunday News*)

People in Guam love fresh fish—as much as 2,500 pounds of it a week from just one local vendor who peddles fish along various roadways. Multiply that by the number of fish and produce vendors seen around the island on a daily basis, and you're talking about a booming industry — an industry that government agencies understandably are keeping an eye on.

One of the most popular locations for vendors of fish, fruits and vegetables is along Marine Drive in front of the Sateena Mall in Dededo. Any day of the week, rain or shine, at least five different merchants can be found hawking their wares from the back of pick-up trucks and from rows of insulated coolers full of various types of seafood—from skipjack, rabbit fish, and tataga to octopus, lobster and angle crab.

Mena Brown, 40, of Vigo says she and most other Dededo vendors sell at the Harmon Market on the weekends and park in front of the mall during the weekdays. A normal day, she said, begins at 9 a.m. and ends at 6 p.m. when she loads everything up and heads for home.

Nine hours is a long time for fish to sit under Guam's hot tropical sun, a fact that makes Public Health officials a little uneasy, but most vendors seem prudent about their handling procedures. In fact, Logan Oplinger, an Environmental Health Specialist for the Department of Public Health, said fish sold at the roadside stands is generally in better condition than fish purchased

at local supermarkets. 'You can bet the fish at the store has been through a lot more handling', Oplinger said, 'and most of it has probably frozen'. Oplinger and Dededo Public Health Inspector George Muna agree that they are less concerned with the other produce than with the fish, which is more prone to spoilage. Oplinger said the Department's guidelines for selling fresh fish are basically that the fish is cleaned and chilled immediately after the catch and kept chilled until it is sold, which should be within three days. Also, the ice the fish is packed in must come from an approved source, i.e an inspected ice plant, and storage containers must be properly constructed so they can be maintained in a sanitary manner.

Public Health inspectors are required by law to inspect the vendors a minimum of once every three months, but Oplinger said they will do so more often if they have the time or if there have been complaints. He said the inspectors check the freshness of the fish by examining the quality of the flesh, the eyes and the colour of the gills.

According to Muna, inspectors from the Dededo office visit their local vendors on a daily basis out of a concern for sanitation. 'It's becoming too much like a flea-market', he said. 'These vendors have peddling licences, they are not supposed to be stationary. Where are they putting their trash? What toilet facilities are they using?'

Muna said he is considering restricting renewal of the vendors' sanitary licences until they put in toilet facilities and trash bins. He wishes other public agencies, particularly the Department of Public Safety would be more concerned about the area.

'It attracts a lot of people and creates safety hazards', Muna said. Brown said she and the other vendors are already taking steps to satisfy Public Health concerns. They have all agreed to contribute US\$ 30 toward a portable toilet, she said.

Muna admits that public complaints are rare. There were three complaints in the first three months of this year, but he said they were all related to a single shipment of fish from the Philippines. Most vendors ship their fish in from Palau.

Another government agency watchful of roadside vendors is the Department of Revenue and Taxation. According to Business Licence Division Supervisor George Cruz, unless vendors are selling only home-grown produce in its natural state, they are required by law to maintain a retail peddling licence which costs US\$ 40 per year and pay monthly gross receipt taxes. The peddling licence is separate from a regular retail licence, which is required for more permanent locations, such as the Harmon Market. The two are not interchangeable, said Cruz.

Before being issued the licences, Cruz said, the vendors are required to submit permits from Public Health and perhaps other agencies depending on where they plan to sell. The peddling licences state that goods are being sold in non-permanent, authorised locations, so vendors may be required to provide proof of authorisation.

The land occupied by the Dededo vendors is a buffer strip that belongs to the Government of Guam, according to Acting Department of Land Management Administrator Ray Aflague. He said that to his knowledge, no permits have been issued to the vendors there, but his department has received no complaints and he has no objection to their presence on the property.

Cruz said his department conducts an annual inspection of all roadside vendors and it responds to complaints or anonymous calls. Basically, though, he said, it seems to be running smoothly. Problems that arise usually concern vendors at Harmon Market who think their retail licences are good for peddling along the roadway, or vice versa, and farmers who do not apply for exemptions, he said.

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**INSTITUTE TO BUILD NEW AQUACULTURE CENTRE**

(Source: *Windward Sun Press*)

Construction of a new multi-million dollar aquaculture research centre may begin in the next few months at Makapuu Point, Oahu, a spokesman from the State Department of Land and Natural Resources said recently.

According to John Corbin, manager of the Aquaculture Division, a final Environmental Impact Statement (EIS) is now being processed by the city Department of Land Utilization, which must issue a special management permit before the project can begin. Assuming the permit is issued in the next month or two, construction will be able to begin shortly thereafter, he said.

'The center is already being planned and designed', Corbin said. I'm not sure where the EIS is right now at the Department of Land Utilization, but I've been told it's somewhere near the final stages.'

The new research centre is a central part of the Oceanic Institute master plan. The Federal Government has already appropriated US\$6,125 million through the Department of Agriculture's Cooperative State Research Service to help fund construction of the centre. And the State of Hawaii has matched the federal money with a US\$5 million grant.

According to the EIS, the centre will be equipped to provide services to the commercial aquaculture industry that previously have been unavailable from traditional sources. It will be an applied research facility supporting the development of commercial aquaculture both in Hawaii and the mainland.

'This will be applied research', Corbin emphasized. 'We won't just be doing research for research's sake. We'll be applying the research to help the industry.'

Among the new centre's operations will be the following:

- Applied research to solve operational and production problems in commercial aquaculture;
- studies on finfish and crustacean maturation, hatchery and grow-out technology development;
- Aquaculture nutrition research;
- Aquaculture information services, including design, engineering, economics and management of aquaculture operations;
- Industry assistance, including training, prototype development and effluent/discharge analysis.

Expected to be operational within two years after construction begins, the completed Center for Applied Aquaculture will include a three-building administrative complex, a general services building with storage and utilities, a laboratory/office building, nine research modules and a maintenance building.

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**USSR—PNG SIGN FISH TREATY**

(Source: *Fiji Times*)

Papua New Guinea and the Soviet Union signed a bilateral fishing treaty on 6 June 1990 which could see Soviet trawlers operating in Papua New Guinea waters before the end of 1990.

Officials said the government expected to receive A\$ 9.5—11 million annually in taxes and other payments as a result of the treaty, about the same amount it would receive this year as a signatory to the multilateral treaty between South Pacific Forum nations and the United States.

The agreement sets out broad principles of co-operation 'to be supplemented by later implementation agreements'. Provisions include joint ventures with local companies, the training of Papua New Guineans in the Soviet Union, scientific research and technical assistance and shore-based and offshore facilities.

Deputy Fisheries Minister Eugueni Shiriaev, leading the Soviet delegation, said that as a first step, a research vessel would be sent to Papua New Guinea and local scientists would be invited aboard for joint-feasibility studies. Local companies would be approached with a view to joint ventures catching lobsters and prawns using 'ecologically clean' traps. Two Soviet purse seiners would fish for tuna if it proved feasible and there was also potential for harvesting mackerel, he said.

Papua New Guinea officials said the trawlers could begin operations before the end of the year. In brief remarks, Foreign Minister Michael Somare called for a strengthening of the 'growing relationship' between Papua New Guinea and the Soviet Union.

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#### SEAWEED AQUACULTURE STUDY SET

(Source: *Pacific Daily News*)

A United States grant will be used to fund a pilot study of the economic feasibility of growing seaweed in the lagoons of the Marshall Islands.

Richard Zingmark, the Fullbright professor of marine science at the College of Micronesia in Majuro, is using a U.S. Department of Agriculture grant to develop commercially exportable seaweed. 'If the recently begun pilot study proves successful, a new and exciting industry could develop in the Marshall Islands within a year or two', he said. The seaweed, known as *Eucheuma* is grown commercially in other nations, including the Philippines, Indonesia, Malaysia, Pohnpei and Kiribati. It sells for as much as US\$ 1,000 per tonne and 15 tonnes can be grown each year in a two-and-a-half acre seafarm, Zingmark said. '*Eucheuma* produces a chemical called carrageenan, a kind of gel used in many processed foods such as ice-cream, cheese, instant puddings, whipped toppings and in toothpaste and shaving cream', he said. It is also used extensively in the medical and pharmaceutical industries for the manufacture of medicines.

Although productive farmland is now almost non-existent in the Marshall Islands, shallow lagoon areas are extensive in most of the atolls and this is where the seaweed thrives, he said. When the study demonstrates its commercial importance, Zingmark said, he plans to train interested Marshallese 'sea-farmers' how to set up their own farms to generate income for their families.

In addition to support from the United States, the project is supported by the government Marshall Islands Marine Resources Authority, which is providing the use of a boat and part-time technician to the project. A private company, Marshall Islands Aquaculture, will also be providing technical assistance.

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#### SEAWEED FARMERS RECEIVE NZ AID

(Source: *Fiji Times*)

A New Zealand Government donation of eight punts to the people of Moturiki recently should further boost seaweed farming in the Lomaiviti group, Fiji.

The donation is a part of the New Zealand government aid programme for fisheries development in Fiji. Four similar punts were given to Uluibau and Daku Villages of Moturiki for seaweed farming in 1989. The punts, costing F\$ 500 each and measuring 2.4 m were constructed locally.

A Fisheries Officer with the Ministry of Primary Industries, Filimoni Mate, recently led a government team to hand over the punts officially to the farmer. During the handover ceremony, he praised the hard work and concerted efforts of the farmers engaged in seaweed farming. He emphasised the need for proper use of the punts and urged them to continue their efforts in producing more seaweed. Mr Mate said he was impressed with the standard of the farms, although they suffered a set-back due to the devastation caused by Cyclone Ray in March 1990.

A local company, Seaweed (South Pacific) Ltd, is the sole buyer of all dried weed produced in the country. It buys seaweed from the farmers and each month gives a bonus to the highest producer of the weed.

Jone Salele of Daku Village in Moturiki was the lucky winner who produced 800 kg of dried weed during the first quarter of this year. Salele initially started farming in a group, but decided to go on his own in 1989. His sole income, about F\$ 200 per fortnight, is from seaweed farming and enables him to support his family of three quite comfortably. Salele praised the New Zealand Government for helping them to establish their seaweed farm. He also thanked the Seaweed South Pacific Ltd for providing a stable market for their produce.

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#### **JAPAN GRANTS A\$ 76,000 FOR FISH PONDS**

(Source: *Marshall Islands Journal*)

The Japanese Government has approved a grant of A\$ 76,000 for the development of fish ponds on the outer islands of Kiribati. The Secretary for Natural Resources Development says the grant will cover costs of the necessary equipment and machinery.

All islands outside Tarawa, the national capital, will benefit from this grant except Tamana and Arorae islands in the southern district, which do not have lagoons. A two-man team from JICA, the Japanese International Co-operation Agency, is currently in Tarawa discussing where to get the machinery and equipment and how to transport them to the islands.

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#### **MARKETING CLAMS BY THE THOUSANDS**

(Source: *Islands Business*)

Robert Reimers would like to work his way into the Asian clam market, and after five years of experimental work on Mili Atoll in the Marshall Islands, his company is getting closer to realising his plan. 'I saw news from Belau about clams', said Reimers of his decision of launch the Mili clam farm. 'They are cheap and easy to grow, so I said "Why not do here"?'

The clam food and shell market in Asia and the aquarium market in the United States are potentially lucrative for an island-based export industry. After a dozen years of experiments, the Micronesian Mariculture Demonstration Center in Belau began clam exports to Asia and doubled its size and production capacity with revenues from clams during the past year. When it started in the mid-1970s, the centre was the only giant clam hatchery in the Pacific Islands. Now there are 12, including the one on Mili.

'There is an aquarium market in the United States and Europe', said Gerald Heslinga, who runs the Belau clam operation. 'but the biggest market is in food in Asia. The clam is like a coconut. It is a food with a thousand uses.'



## Innovations

Robert Reimers Enterprises (RRE) has pioneered a unique innovation for producing its clam crop as it aims for production for export. The hatchery is now producing thousands of the giant clams, which can grow as large as four feet in length when they are fully mature. 'We started the clam project because we want to develop the economy of the Marshall Islands', said Ramsey Reimers, the company's chief executive officer. The Reimers company has invested about US\$ 200,000 in the clam project, he said.

Belau's Heslinga, during a recent visit to the Marshalls, said the Marshalls clam farm is improving production techniques by using innovations that no other Pacific Islands have developed. It is the first clam hatchery in the region successfully to harness solar and wind power to operate the pumps and other equipment, Heslinga said. The use of alternative energy sources has sliced thousands of dollars off the cost of running the hatchery. The clam farm also developed the first floating tanks for spawning the clams in the larval and nursery stage, as opposed to the more conventional method of growing clams in tanks on the lagoon floor or on land. Floating tanks provide better light for growth, are easier to maintain and keep the clams away from predators.

The clam industry opens up the potential for export, as well as increasing the availability of a protein-rich meat source. The reef-protected lagoons are ideal for spawning the clams, tending them requires little work, and when they are mature the clams command a high price. Heslinga observed that the RRE clam hatchery is well established and the basic elements for the business are in place. The company owns three small islands in Mili Atoll that serve as the headquarters for the clam operation.

The Marshalls hatchery has already drawn international interest. Disneyworld in Florida is among the overseas aquariums which have ordered clam species. To date, however, sales have mostly been samples. The five years of growing the clams on Mili have been a period of trial and error', said Robert Reimers. They have learned how to protect the clams from predators, and discovered the environment in which they grow best. 'In one more year we will be ready to begin selling giant clams to Asian and American customers', he said.

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## AQUACULTURE EDUCATION INITIATED IN PACIFIC ISLAND SCHOOLS

(Source: Center for Tropical and Subtropical Aquaculture (CTSA) — Regional notes)

In an effort to improve secondary agricultural education in Pacific Island schools, aquaculture is emerging as a new focus for curriculum development. Although agricultural education programmes have been active for several years, a gradual decline has occurred in the past decade. In April 1988, a delegation of agricultural educators made up of representatives from the Forum Fisheries Agency (FFA), the U.S. Department of Agriculture and the Pacific Basin Development Council visited the American-affiliated Pacific Islands. The purpose of the visit was to share information on the current status and future of agricultural education on the U.S. mainland. The group discussed some exceptional community development projects and the comprehensive programme of international agriscience, technology and business at Anderson Valley Agricultural Institute in California.

Through the support of CTSA, the University of Hawaii, the Pacific Basin Development Council, the College of the Pacific Islands, the U.S. Department of Commerce and the U.S. Department of the Interior, a project was developed to introduce aquaculture and agriculture to secondary schools throughout the American-affiliated Pacific. Headed by Jim Leasing (Agricultural Education Program, University of California—Davis) and Steve McKay (Anderson Valley Agricultural Institute), the project was completed in March 1990 with great success.

The primary goal of the project was to infuse aquaculture into the existing agriculture curricula and to motivate teachers and students to develop and maintain small-scale aquaculture farms. The project consisted of two phases. In Phase I, Steve McKay conducted a series of six workshops to assist teachers in planning aquaculture curriculum and to review aquaculture resource materials. Held on location throughout Micronesia and in American Samoa, the workshops also addressed programme goal setting, effective programme management, initiating youth programmes and supervising student projects. Phase II workshops focused on programme implementation and leadership development.

A significant achievement was the formation of programme advisory committees at each location. The committees are made up of aquaculture specialists, commercial producers, parents, school administrators and other interested community members. In addition, comprehensive plans for agricultural education were developed incorporating courses in marine biology, aquaculture, horticulture and plant and animal science.

Interaction with students resulted in the establishment of student-discussed projects. High school students from each area have developed plans for initiating an agricultural/aquacultural literacy programme in elementary schools. The students will use curriculum materials from the FFA Food for America Program. In the Commonwealth of the Northern Mariana Islands, the Saipan Marine Biology Club has organised a work group for the junior high school and is constructing and stocking fish tanks for class observation and study.

To increase information transfer, a communications network is being organised through the workshops, the ADAP computer system and PEACESAT. The work group, in conjunction with the advisory committees, is formulating plans for audio broadcast via PEACESAT. The broadcasts will centre on various aspects of aquaculture and ways to expand agricultural education programmes. Investigators hope to continue work in this area as well as in educational development and demonstration projects to ensure long-term viability of the programme.

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## PEARLING SURVEYS SHED LIGHT ON THE INDUSTRY

(Source: *Australian Fisheries*)

A recent scientific survey of pearling beds in the north of Australia could prove very interesting to members of this multi-million dollar industry.

Not much attention is directed at the Australian pearling industry, despite the fact that it will be worth an estimated A\$ 80 million in 1991. One of the main aims of two recent surveys of pearling beds in the north was to try to redress the balance, and fill in some of the information gaps in the industry.

The major problem facing the pearling industry is the shortage of shell. Pearl fishermen have to collect shell from the wild to take back to their farms, where they insert a nucleus to make the shell produce a cultured pearl. It is a very high risk industry—the animals can, and often do, die at any stage of the process. Despite a small measure of success in producing hatchery shell, industry members still rely heavily on the wild stocks.

Carried out by the Fisheries Resources Branch of the Bureau of Rural Resources (BRR), the pearl bed surveys were designed to provide detailed information about the pearling grounds in Torres Strait and the Northern Territory.

Data were collected using divers, underwater video cameras, and sediment and benthic (ocean bottom) samples. Kathy Colgan, from BRR, headed up the project. Before she even ventured out near pearling beds, Kathy had to spend a number of months researching possible sites, talking to members of the pearling industry, and organising a diving team and boat. But Kathy believes the end result will prove very worthwhile to the pearling industry. 'I think we've got

some tremendous results', she said. 'We hope the survey will answer a number of questions about pearling and the pearl resource'. We need much more information — you can't make informed decisions about the fishery unless you have the basic biological knowledge about the species.'

Kathy's project was broken into two parts: a survey of Torres Strait pearling beds, carried out between March and June 1989, and a survey of the Northern Territory pearling beds, carried out between October and December 1989.

### **Torres Strait**

Funded by the Government, the Torres Strait survey was designed to find out whether there was still shell on old pearling grounds. These grounds were listed in historical records as being very productive for shell. 'We weren't sure whether the people involved in looking for shell in Torres Strait weren't finding it because they weren't going out and looking for it, or because it just wasn't there. I targeted areas which in the past had been productive for shell, visiting and filming the area, and collecting samples', Kathy said.

Before going out to survey the beds, Kathy talked to as many people as she could, including islanders who had been involved in the pearling industry in the past. One valuable source of information proved to be Vern Wells, master of the *Paxie*, the ship that surveyed the pearl beds during the 1950s and 1960s.

Kathy also visited the CSIRO archives in Canberra to gain access to a large amount of previously unpublished information from the now deceased scientist Stan Hyde, who had been based at the CSIRO pearling research station on Thursday Island for 12 years, from 1949 to 1961. A major part of her survey work included organising the gear she would use in the surveys. This involved buying and learning how to use a video camera, organising a diving team and a vessel, and arranging the construction of a sled and housing for the camera, based on a CSIRO design.

The underwater equipment Kathy used in the surveys included a remotely operated video camera, and a grab and dredge to collect sediment and ocean bottom organisms. The camera ran along the bottom of the ocean on a sled and was connected to an on-board monitor via a video cable. According to Kathy, one of the major advantages of video is that it can be used to correlate the information received by divers.

'The advantage of video is that you can use it to compare what the diver sees and what is actually there', she said. 'Divers' estimations of what is on the bottom are very subjective, and depend on the experience of the diver. By enlarging the frames on the video we can get a correlation between the two sets of information.'

Kathy and her team successfully visited and filmed a number of different sites during the three months they spent in the area. When the results are analysed, the survey will provide valuable current information about the status of the stocks on the 'old grounds'—an area to the west of Badu.

### **Northern Territory**

The Northern Territory bed survey was jointly funded by industry and Government, following a decision in 1986 by the Northern Territory and Commonwealth Governments to establish and develop a farm-based Northern Territory pearling industry.

With the benefit of a bigger boat, an 'A' frame to swing the equipment out over the side, and two cameras—a forward-pointing one and a downward-pointing one—Kathy hopes she will have some interesting results from her field trip in this area.

The survey focused on two main areas, the eastern fishing grounds centred around the Crocodile Islands, and the western fishing grounds west of Bathurst Island. These areas were assessed as being the most likely to contain shell, particularly the gold-and silver-lipped pearl shell *Pinctada maxima*. The aim of the survey was primarily to determine the geographical extent of the beds.

'I think I've done that, in part', Kathy said. 'Although I'm sure there will be room for argument', she added, laughing.

The survey results will be used in management decisions, including the assessment of current quota levels. The results will also help pearling industry members target shell collection. 'The question that really interests me is the type of bottom where shell is found, and whether we can speed up the fishing process and be of assistance to the fishing industry', said Kathy. 'For example, we could say that if you get certain conditions, you're likely to get shell, or you're not likely to get shell. The commercial side of it really is the ultimate aim.

'I think this research is a starting point for the pearl fishermen. I'd like to see further research where science and industry get together to determine what questions need to be answered.'

### Survey results

Kathy returned to Canberra with an enormous amount of data from the two surveys, including a large quantity of sediment and benthic samples, which are currently being analysed by various organisations, and 300 hours of video film.

The results of the surveys will be released in the form of two preliminary reports late this month. The reports will contain preliminary data, some mapping, and initial thoughts based on the results. Katy will present the reports to pearling members at workshops to be held during May this year.

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### MARSHALLS' FISHERIES VENTURE EXPANDS

(Source: *The South Sea Digest*)

The Marshall Islands Government and an American company, its partner in a joint fisheries venture, have bought for US\$ 7 million a purse seiner vessel, the 1200-ton *Bold Fleet*. The United States Government, through the U.S. National Marine Fisheries Service, provided US\$ 5 million in a long-term loan, with the Marshall Islands Development Authority adding US\$ 1.5 million and partner David Franklin the balance.

The Marshall Islands Government bought a tuna boat just over a year ago, and the two boats will be used in a tuna trans-shipment operation involving the American market.

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### STUDY TO IMPROVE SEAFOOD MARKETING

(Source: *Australian Fisheries*)

A study aimed at identifying impediments to the efficient marketing of seafood is to be undertaken by the Australian Bureau of Agricultural and Resources Economics (ABARE).

The Minister for Primary Industries and Energy, Mr John Kerin, said A\$ 127,500 would be made available to ABARE. The research funds are to come from the Fisheries Development Trust Account and a report is expected in about 18 months. Mr Kerin said the marketing of seafood in Australia had not undergone the changes reflected elsewhere in the industry. As with so many other Australian primary commodities, marketing had been the poor cousin of production.

'Over the past decade we have witnessed a significant growth in the value of output, development of new management regimes and advances in marine research', said Mr Kerin. 'Marketing, on the other hand, has remained relatively unchanged and conspicuous for the absence of fishermen from the marketing process and decision making.'

The study will examine and report on impediments and distortions to efficiency, the role of governments both in Australia and overseas and whether there is a need for an industry-wide co-ordinated promotion effort. The report will make recommendations on the role of governments in bringing about those necessary changes.

The study will complement recent studies undertaken on the marketing of under-utilised fish species and on post-harvest technologies and opportunities in the fishing industry.

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### **LOGLINERS FOR KIRIBATI**

(Source: *Marshall Islands Journal*)

The European Community (EC) has agreed to provide funds for the building of two longliner vessels for the State's fishing company, Mautari Ltd. The Deputy Secretary of Finance said the project was planned many years back when Kiribati first joined the Lome Convention, but the Community was reluctant to support it because of its reservation on the vessels' viability in Kiribati.

The EC finally agreed last month during informal discussions with the Kiribati delegation to the ACP/EC meeting in Suva. It is not known at this point where and when the ships are going to be built. Figures involved are not available yet. Two of Mautari's latest fishing boats were built in Suva and funded by EC.

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### **AID FOR ISLANDS**

(Source: *The South Sea Digest*)

The Asian Development Bank (ADB) has approved a US\$ 380,000 regional technical aid grant to support a regional study and workshop on fish disease control and development of a regional fish health management system. The programme is expected to assist developing member countries (DMCs) in protecting their aquaculture investments. The regional approach could facilitate research, development and information exchanges as well as a monitoring and reporting system for fish disease prevention, diagnosis and treatment for use by the bank's DMCs.

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### **PACIFIC FISHERMEN'S FORUM HELD IN GUAM**

(Source: *Pacific Daily News*)

The Western Pacific Regional Fishery Management Council held a fishermen's forum at the Public Market in Agana in April 1990. William W. Paty Jr., Council Chairman, said one of their concerns is accurate assessment of the number and types of fish being taken in the various fishing operations.

The Council, which is a quasi-federal government programme, looks for better ways to manage fishery resources in waters near Hawaii, the Northern Marianas, American Samoa and Guam. Much of the forum focused on tuna and other pelagics. Within the 200-mile zone, the Council has no authority to obtain information on the numbers or types of fish caught—something important to management of the resource, Paty said.

Under the federal Magnuson Act (legislation created to protect fish resources), tuna is considered a migratory species and is outside the management purview of the Council, Paty said.

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#### **WESTERN SAMOA PLANS SHELLFISH INDUSTRY**

(Source: *The South Sea Digest*)

More than 100,000 oysters have arrived in Western Samoa from California to be used in a pilot project to establish a shellfish industry. The oysters, of the Pacific Oyster species, the largest of the oysters, will be farmed in a sheltered bay on the south coast of Upolu, the main island. Japan and the United Nations Food and Agriculture Organization are the project sponsors.

**FISHERIES SCIENCE AND TECHNOLOGY****EMERGENCY POSITION-INDICATING RADIO BEACONS (EPIRBs)**

(Source: R.Gillett — FAO/UNDP)

An EPIRB (see figure 1) is basically a radio transmitter activated in an emergency which gives position information to a receiving station. These emergency transmitters in various forms have been in use for 30 years, primarily by vessels and aircraft in distress.



**A 121.5/243 (old style) EPIRB**

The system presently in use relies on units which broadcast signals in the frequency of 121.5 and 243.0 Mhz. The lower frequency is routinely monitored for distress signals by civilian aircraft while the military listens to 243 Mhz. In addition, these signals activate a transponder on one of four satellites in the COSPAS/SARSAT satellite system. The signal is then re-broadcast to one of six earth stations, providing that a station is in view of the satellite at the time of broadcast.

Although EPIRBs have been effective in assisting with thousands of search and rescue operations, a number of difficulties have been associated with the system. Accidental activations of EPIRBs are common. In North America only three per cent of the activations result from actual emergencies — the remainder are false alarms. Because of the nature of the system, locational ambiguity can occur — two possible locations are given on each side of the satellite track. In addition, because the broadcast frequencies are not dedicated exclusively to distress signals, other radio traffic may mask the EPIRB signal.

In order to overcome these difficulties, a new EPIRB system has been developed. In 1979 the frequency band of 406 to 406.1 MHz was dedicated to exclusive use by satellite emergency position-indicating radio beacons. The new system, sometimes referred to as simply '406', offers many advantages. The quality of the signal enables greater precision in establishing a position relative to that offered by the 121.5 EPIRBs. When the satellite receives the 406 distress signal, it both re-transmits it immediately and stores it in memory for sending at an optimal period. The broadcast signal can be encoded to identify the vessel and type of emergency. Some of the new units will simultaneously use the lower 121.5 MHz to enable aircraft to home in on the signal.

These improvements, however, will be somewhat costly. Prices have been quoted in trade magazines ranging from US\$ 1,900 to US\$ 3,500 per unit, substantially more than the older 121.5 models. Regulations in North America and Europe will result in a phasing out of the 121.5 units over the next few years. For example, only the 406 EPIRBs will satisfy United States Coast Guard rules after 1994.

In anticipation of their obsolescence, some suppliers have further reduced the relatively low cost of the older 121.5 units. A California manufacture recently quoted a wholesale price of US\$ 176 per EPIRB.

To determine the future usefulness of the older 121.5 units in the Pacific Islands, discussions were held with regional search/rescue officials. I spoke to Bob Fong (Director of Operations and Safety of the Civil Aviation Authority of Fiji), Jone Tuliatu (Chief of Air Traffic Services), and Captain Tuisue (Manager, Air Pacific Flight Operations). None of these individuals were aware of any plans to phase out the monitoring of 121.5 Mhz for distress signals. This suggests that the older EPIRBs will be useful in the region for the foreseeable future.

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### COAST GUARD GOES FISHING FOR INPUT ON DANGEROUS JOB

(Source: *The Honolulu Advertiser*)

The Coast Guard is asking commercial fishermen nation-wide for their opinion on a series of proposed regulations to make commercial fishing a less dangerous occupation, and the reaction in Hawaii seems to be generally favourable.

The only misgiving some local fishermen have is about a regulation already scheduled to take effect in May 1990 requiring that they carry an Emergency Position-Indicating Radio Beacon (EPIRB) device. When activated manually or automatically, when up-ended, the device signals its vessel's location to passing planes, ships and satellites.

Some Hawaiian fishermen who work within sight of the Islands say they don't need the device, which can cost as much as US\$ 2,000. Others say every fisherman should have one. The Coast Guard says commercial fishing is one of the most dangerous occupations in the United States, with a death rate nearly seven times the U.S. industry average. Each year, an average of 84 fishermen die and 250 vessels are lost. The proposed safety, design and operational regulations, which would not apply to sport fishermen or charter fishing boats, vary according to the size of the vessel.

One set of proposals would require all commercial fishing boats to have fire extinguishing equipment, life preservers, backfire flame arresters for gasoline engines, ventilation of enclosed spaces, visual distress signals, a buoyant apparatus for the crew to hang onto if the ship capsizes, and an EPIRB.

But most commercial vessels in Hawaii would be subject to these and more stringent regulations, including requirements to have lifeboats or life-rafts, radio communication equipment, first aid equipment, and navigation equipment, including compasses, radar reflectors, nautical charts and anchors.

The EPIRB requirement—applicable to all commercial fishing boats except those not having a galley and sleeping berths—has already been adopted. After 17 May 1990, commercial fishing vessels operating more than three nautical miles offshore—which would include almost all of Hawaii's commercial fishing boats—will have to carry a 'Category One' EPIRB, which transmits a signal that can be picked up by planes, ships and satellites. In fact, if the receiving satellite is not near a receiving station on earth, it will store the signal and send it later when within range of an earth station.



If a fishing boat already has a 'Class A' EPIRB, which does not send a signal that can be stored by satellites, that EPIRB will be allowed if it was installed before 1 October 1988. But after 1 August 1991, a 'Category One' EPIRB will have to be aboard. James Cook, who has three boats that do longline fishing as far as 800 miles from Hawaii, thinks all fishing boats should have an EPIRB. 'I wouldn't go out on any boat without one', he says. 'I have three on each of my boats.'

Steve Kaiser, a lobster fisherman, agrees. He has an EPIRB on his 26-foot boat, and he says he knows of two commercial fishermen who were saved by their EPIRBs. 'One had an electrical fire, lost all his power, couldn't operate his radios, was in water too deep for anchoring and just drifted. He turned on his EPIRB and about 14 hours later a Coast Guard plane circled him and dropped him a small radio', Kaiser said.

Clarence 'Maka' Hookala, a bottom fisherman whose 46-foot sampan operates out of Kewalo Basin, thinks an EPIRB is going to be a big investment for smaller-scale fishermen. 'Life is more valuable than that, of course, but I don't think an EPIRB is necessary for folks fishing commercially within sight of the islands', he said.

Jim Witten, a retired Amfac executive who fishes for sport, but sells most of what he catches, agrees that the more expensive EPIRB will be too costly for some fishermen. 'The Coast Guard is saying that sooner or later you are going to have a 'Class A' EPIRB, which is much more expensive and sophisticated than the little US\$ 300 ones that only beep to passing planes and ships. So many of the commercial boats here in Hawaii are really small, only about 20 feet long, and don't go out far. I question whether they need a sophisticated EPIRB on board.'

Public hearings on the proposed regulations will be held on the Mainland but are not scheduled for Hawaii, according to Commander Art Atkins, fishing-vessel safety co-ordinator for the 14th Coast Guard District here. 'But we encourage Hawaii fishermen to send in written comments on these proposed regulations', Atkins added.

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## **TAGGED SCHOOL SHARK SETS WORLD RECORD**

(Source: *Australian Fisheries*)

A tagged school shark, *Galeorhinus galeus*, recaptured in waters off southern Australia, has set a new time-at-liberty world record of 36.6 years for any species of tagged fish. The previous record was held by another tagged school shark recaptured in 1986 after 35.4 years at liberty. The school shark, tagged internally and released by CSIRO in March 1953, was recaptured in October 1989 by Port Lincoln gillnet fisherman, Mr J. Andresen. The internal plastic tag, 50 mm long by 20 mm wide, was still legible despite having been in the body cavity for so long.

From records of the tagging programmes carried out by CSIRO in the 1950s, and continued by the Southern Shark Assessment Group based at the Marine Science Laboratories, Queenscliff, Victoria, this male school shark had grown nine centimetres in total body length from 144 to 153 centimetres. It is estimated that the shark was about 13 years of age when first captured. The school shark was recaptured 75 km from its point of release, south of Kangaroo Island.

Recovery of tags contributes to information on growth, mortality and movement of the species. This information is used in assessment of the fish stocks of a fishery producing annually 5,000 tonnes, live weight, valued at more than A\$ 20 million to fishermen.

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**LOGLINING WITHOUT BAIT**

(Source: *Fishing News International*)

A Canadian project to determine the catching efficiency of feather hooks using moored monofilament longlines has shown that this gear provides financial and time-saving benefits to inshore fishermen.

An important advantage is that no costly bait is required. Also, hauling feather hooks is quicker, making it possible to increase catches by hauling more hooks in the same time period. In addition, feather hooks continue to fish when in the water, whereas baited hooks fish only as long as the bait remains hooked, or until the bait spoils. Feather hooks are relatively inexpensive and fishermen can make their own.

**Substitute**

In all the areas of Newfoundland where the project was conducted, feather hooks proved to be an acceptable substitute for baited hooks. Over the 42-day period of the project, the feather hook outfished the baited hook, taking 57 per cent of the total catch. Although feather hooks did not consistently perform during the second haul in the same day, catches still proved to be better than for baited hooks.

'The project proved that time, cost and effort are considerably reduced by using feather hooks', says Larry Yetman of the St John's-based Fisheries Development Division of the Department of Fisheries and Oceans. 'These factors translate into substantial savings and increased benefits to fishermen.' Larry Yetman explains that, in an effort to offset significant drops in fish catches by Newfoundland inshore fishermen in recent years, innovations are being introduced.

Many Newfoundland inshore fishermen have abandoned traditional longline methods using baited hooks and nylon groundlines, having switched to feather and monofilament moored groundlines. The Department of Fisheries and Oceans' (DFO) Fisheries Development Division selected three areas for its trials to assess feather hooks: Portugal Cove South, Renew's and Lumsden. Fishermen from these locations had demonstrated a keen interest and had previously fished this type of moored longline gear on a limited basis.

In all, 41,100 hooks were fished for 42 days in the three areas, with an equal number of feather hooks and baited hooks being used. Each area was studied separately. Information was recorded on the number of fish caught and the average weight of the catch on each hook type. Skippers taking part used a different number of hooks, but they fished equal amounts of the two hook types. This allowed comparative data to be accumulated in each location. The gear was set in waters from 15 to 26 fathoms in depth.

Larry Yetman explains that all groundlines were 180 kg (400 lb) test monofilament lines rigged with swivels and 45 to 55 kg (100 to 120 lb) test monofilament gangions (snoods). Gangions were left to each skipper's discretion and ranged from 1.10 to 2.00 m.

Hooks used in Portugal Cove South and Lumsden were No 15 traditional 'J' hooks, while those in Renew's were No 12 circle hooks. Two 127 mm (5 in) torpedo gill-net floats and a 1.5 to 2.5 kg (3—5 lb) weights were attached to the groundlines at varying lengths to keep the gear two or three fathoms off the seabed.

Hooks were attached in consecutive arrays of 50 feather hooks and 50 baited hooks (mackerel or squid). Lines were anchored at both ends using the weights described. As indicated in Table 1, for each fish caught on the baited hooks, 1.32 were caught on feather hooks.

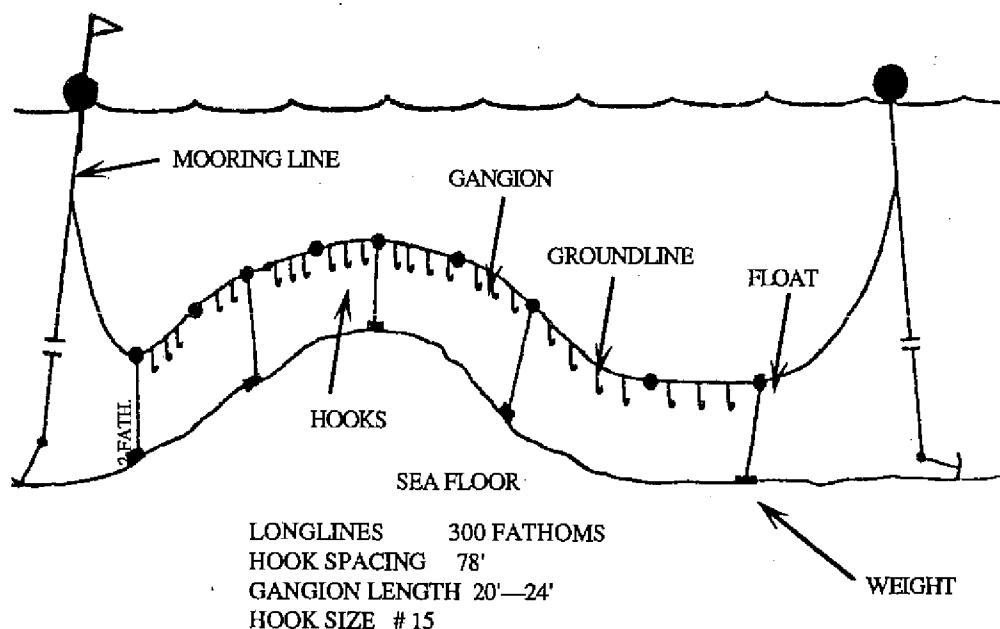
Table 1. Catch comparison

Fishing area	No. of hooks	Weight of fish (kg)		Average catch/hook (kg)		Feather hooks % of catch
		Feather	Baited	Feather	Baited	
Portugal Cove S.	14,600	3967	2112	0.54	0.29	65
Renews	13,500	3494	2853	0.52	0.42	55
Lumsden	18,000	2474	2394	0.28	0.27	51

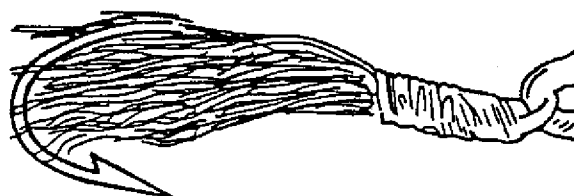
Catch rates for the feather hooks and baited hooks were one fish every 3.79 hooks and every 5.01 hooks respectively.

About 120 more baited hooks would be required to catch 100 fish, in comparison to the feather hooks. Higher catches were also made on feather hooks after several nights' continuous fishing. In the sections where the feather hooks and the baited hooks joined, fishermen found a greater number of fish caught by the feather hooks.

In Lumsden, many different colours of feather hooks were tried by skippers, including red, green, blue, yellow and black. Red and blue provided the best catch rates, while the lowest catches were produced by yellow.



Moored longlines (fishing mode)



Feather hook

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**FIFTH INTERNATIONAL CONFERENCE ON ARTIFICIAL HABITATS FOR FISHERIES**  
(Source: Natural History Museum of Los Angeles County — Section of Fishes)

The Fifth International Conference on Artificial Habitats for Fisheries will be held in the Natural History Museum of Los Angeles County, United States, in November 1991. The Conference goals are to promote international interest in fishery resources and their enhancement through the use of artificial habitats in the world's marine and freshwater ecosystems. Scholarly achievements will be published and priorities for research, technological improvements, and management issues related to artificial aquatic habitats recommended to the general and scientific communities. The science and workmanship of artificial habitat systems will be evaluated and the linkages between artificial and natural habitat systems will be assessed. Theoretical and practical advances in science and technology will be addressed through:

- Plenary sessions: scientific, policy, regional programme reviews and debates of key issues;
- Technical sessions: applications of artificial reefs and fish aggregating devices and other habitat enhancement technologies;
- Special sessions: specific technological and research issues of current interest.

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**TYRES AND CONCRETE MAKE FISH HAPPY**  
(Source: *Honolulu Advertiser*)

A new type of artificial reef that makes use of a very common waste product—old tyres is showing some success in building fish populations.

Brian Kanenaka, co-ordinator of Hawaii's artificial reef programme, is cautious in declaring success. He said biologists will need to continue regular surveys of artificial reefs established off Oahu and Maui.

But 2,000 'modules' made up of old tyres set in concrete have led to a dramatic increase in fish population in waters off Keawakapu in Kihei over the past year. In October 1988, a survey of the artificial reef about 400 yards off Keawakapu found 10 fish species and an estimated 8.6 lb per acre. The modules were placed in two stages last year. A survey in January found 28 species and an estimated 1,098 lb per acre. The tyre modules were created after a previous attempt to build artificial reefs in Hawaiian waters rusted away.

In the early 1960s, the State tried dumping old car bodies into selected areas to form artificial reefs, Kanenaka said. The car bodies made good hiding places for fish that populated the areas, but the metal rusted and did not allow for coral growth. Another experiment involved concrete pipes, he said. The round pipes tended to roll around in the strong currents and were broken or lost. The State began to look at numerous designs. The Japanese have some effective artificial reef projects, but their designs are costly.

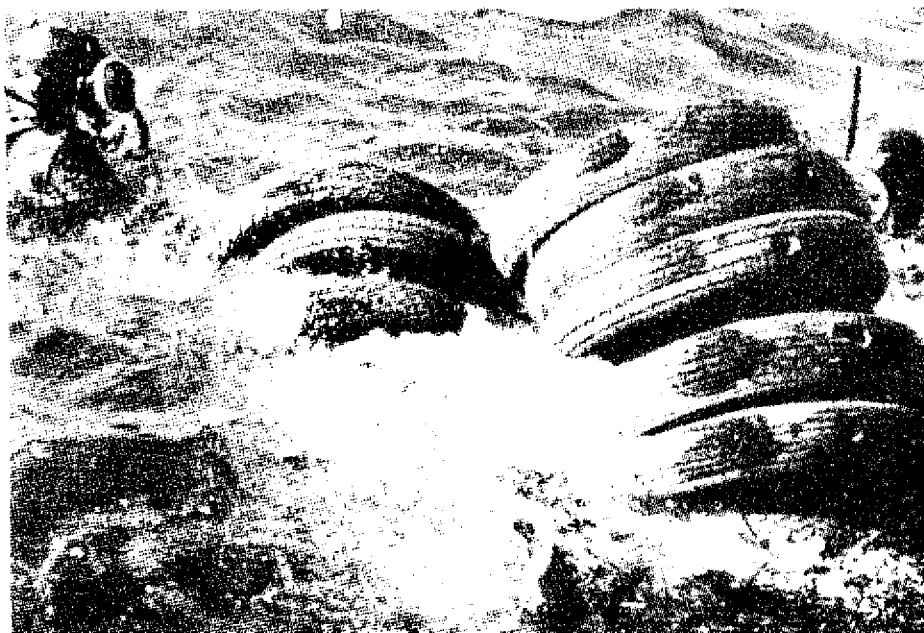
Somehow, the idea of embedding old tyres in concrete developed. They have now been placed in sites in Maunalua Bay, off Kualoa on Oahu's windward coast, off Waianae and off Keawakapu. The four artificial reefs are in 60 — 70 ft of water, deep enough not to be a hazard to navigation, but shallow enough not to endanger divers who visit them. The fish seem to like them, especially when they are placed on top of each other, Kanenaka said. The artificial reefs serve several purposes. They provide places where small fish can dart away from predators. They also provide a solid base for growth of algae, coral and other marine plants and animals.

According to Kanenaka, over the year that the Keawakapu reef has been in place, they were finding more species and more mature species. Curiously, the artificial reefs in different areas

are developing different kinds of populations. At Keawakapu, the dominant species is the blue-lined snapper. In Maunalua Bay, the dominant species is surgeon fish.

Kanenaka warned against divers and fishermen trying to build their own artificial reefs. 'We'd rather people made donations to our program and let us do it properly. There are many factors that must be studied before a reef site is selected. The site must not eventually turn into a navigational hazard. Currents have to be considered. A strong current could push a module around, causing it to be lost or even to be washed ashore.'

He added that artificial reefs should not be placed where there already are reefs and healthy fish populations. 'They can't be too deep, where the depth poses a hazard to divers and you wouldn't want one in an area that is known to be used by sharks', he said.



**Tyre bundles being sunk**

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**ABSTRACTS**

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**COMMERCIAL FISHERIES IN THE FEDERATED STATES OF MICRONESIA**

(Source: National Fisheries Corporation)

The National Fisheries Corporation has produced a brochure on commercial fisheries in the Federated States of Micronesia (FSM). The production of this brochure was funded by the Market Advisory Service of the Department of Foreign Affairs and Trade under the Australian Aid Program, with assistance from the South Pacific Trade Commission.

It presents various aspects of the fisheries in FSM, including information on the National Fisheries Corporation, marine resources and commercial fishing, marketing of marine products, and opportunities for foreign investment and co-operation.

*Contact address:* National Fisheries Corporation, P.O. Box R, Kolonia, Pohnpei, Eastern Caroline Isl., 96941, Federated States of Micronesia.

# COMMERCIAL FISHERIES

## IN THE FEDERATED STATES OF MICRONESIA



FEDERATED STATES OF MICRONESIA

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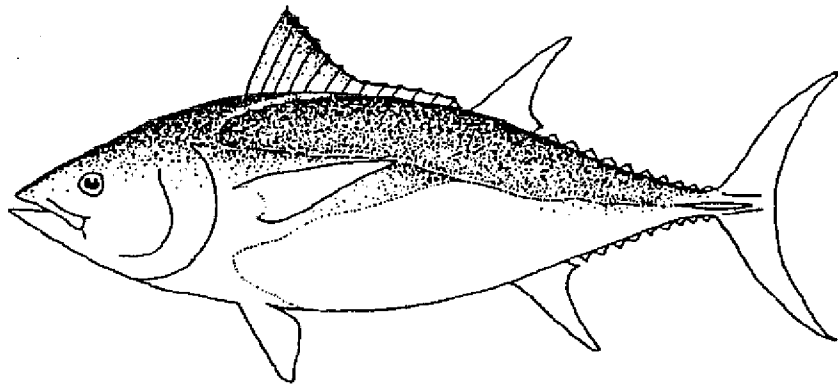
**SCIENTIFIC FACTS ON SOUTHERN BLUEFIN TUNA DEBATE**

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It is only in the last decade that the true extent of the valuable southern bluefin tuna (SBT) stock problem has come to light, prompting three nations—Australia, Japan and New Zealand—to curtail catches to safe levels.

The Bureau of Rural Resources (BRR) in Canberra has published a report following its concern that the public debate surrounding the decline in the SBT fishery had often lacked a clear understanding of the phases of the fishery, the extent of scientific knowledge about the fish and the fishery and the role of Australian scientists in unravelling the story.

'At times, the debate has appeared to focus strongly on points of uncertainty in our knowledge, thus directing attention from the major areas of agreement', says the Executive Director of BRR, Gardner Murray, in the preface. 'To better inform the debate, the present account was drawn together from several sources, the written elements of which are included in the reading list at the end.'

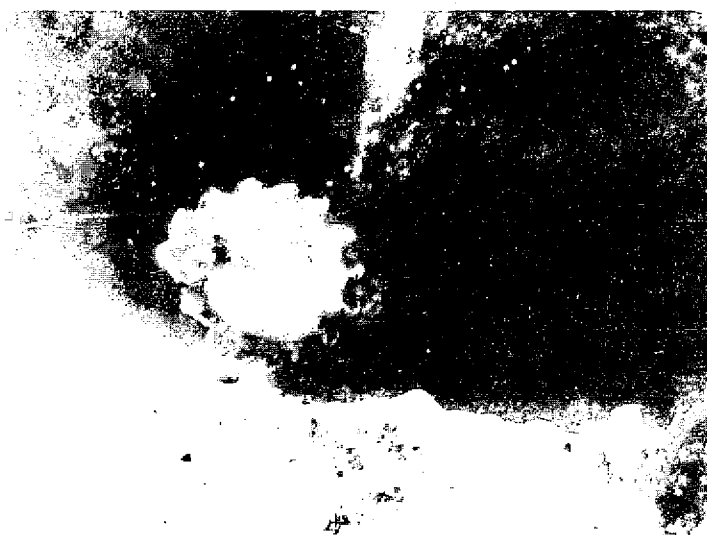


## INTRODUCTION OF AQUACULTURE-REARED JUVENILE TROCHUS (*TROCHUS NILOTICUS*) TO LIFOU, LOYALTY ISLANDS, NEW CALEDONIA

by

Christian Hoffschir  
Centre ORSTOM, Noumea, New Caledonia

Intensive gathering of trochus (*Trochus niloticus*) in New Caledonia had led to a sharp decline in stocks; IFREMER and ORSTOM therefore carried out spat production trials, with the aim of reseeded over-fished reefs or areas where the species does not currently occur. During the breeding season, from October to May, a breeding stock was collected and placed in a breeding pond where spawning regularly occurred. A number of attempts were necessary to achieve production of juveniles because of the very high mortality occurring between the larval stages and the first settled stages. Despite these difficulties, 5,700 specimens were successfully reared up to the average size of 19 mm.



Juvenile trochus in breeding ponds

As requested by the Islands Province, transplanting was carried out on Lifou because trochus were lacking there. The trochus were air-freighted from the breeding pond to the island in water in an insulated container with an aerator. Twenty introduction sites were selected, on the basis of factors which appeared favourable to growth and which would assist relocation of the sites when the transplanted juveniles were due for subsequent inspection.

Six subsequent visits to recapture specimens made it possible to monitor developments regarding number and size. A severe cyclone, which occurred two weeks after the introduction took place, severely disturbed these activities, widely dispersing the juveniles and probably killing many. During the last visit, the year after transplanting, 19 trochus measuring 64 mm on average were recaptured, with the smallest measuring 49 mm and the largest 74 mm. Mean growth that year in the natural environment was 45 mm, which is considerable in relation to the 33 mm average growth obtained in breeding ponds over the same period.

Despite the low number of recaptures, no doubt due to their wide dispersal caused by bad weather and the difficulties of exploring extensive reef around each site, this result is promising for the suitability of juvenile trochus for Lifou reefs. The average size at sexual maturity is 54 mm in New Caledonia and reproduction is 100 per cent effective for specimens of 57 mm.



Of the 19 trochus found, 16 or 84 per cent were big enough for breeding. It may therefore be that these trochus spawned early in 1990, 12 months after transplanting and 23 months after birth. This may provide the foundation for a future commercial stock. This resource will not develop, however, unless the island's inhabitants refrain from catching and eating adult trochus, which has already happened to some introduced specimens.



Introduction of juvenile trochus in the natural environment



First recapture 15 days after transplanting

**OBSERVATIONS MADE FROM THE SUBMERSIBLE CYANA  
IN NEW CALEDONIA'S EPIBATHYAL ZONE  
(17 FEBRUARY—14 MARCH, 1989)**

The CALSUB expedition set up and supervised by Professor M. Roux of the Laboratory of Earth Sciences of the University of Reims took place in New Caledonia from 17 February to 14 March 1989. The submersible *Cyana* which operated from R.V. Suroit performed 22 dives, of which the authors of this report took part in three. The goal of this expedition was twofold: to study the carbonaceous sedimentation in the Loyalty Islands basin for purposes of comparison with the Jurassic and Cretaceous series found in the Rhone Valley and Franche-Comté, which were laid down in comparable climatic conditions, and also to observe *in situ* the very rich benthic fauna revealed during previous expeditions.

This document is not a scientific report; its aim is to present a set of observations and remarks of potential use for future observers as well as biologists and fisheries specialists interested in this zone. With the experience of extensive exploration using standard gear such as dredges, trawls, longlines and traps, the authors fully appreciate the crucial contribution that the use of this exceptional craft can make to our knowledge of the bathyal sphere. After years of collecting blind, the marine biologist can at last and with indescribable enthusiasm observe this fauna in its habitat and inspect its environment, which he had previously had to imagine with difficulty through clumsy specimen collection and laboratory descriptions based on stationary equipment!

### **The submersible**

The submersible appears in Figure 1. Despite the limited diameter (2 m) of its spherical observation cabin, this small submersible can carry three crew (pilot, co-pilot, observer) down to a depth of 3,000 m. Its relative lightness (8.5 t out of water), its range and its excellent manoeuvrability make it an ideal tool for the biologist.

Two flat portholes in the lower forward part of the sphere give the pilot and observer, both lying flat on their stomachs, an excellent view of the bottom with a fairly wide field of vision, comparable to that obtained by a diver wearing a mask. The fine degree of discernible detail surprised all the biologists taking part in the cruise. Indeed, visible on a sediment bottom were the tests of some pteropods less than 5 mm in length, while some small crustaceans (*Chirostylidae*) perched on branches of gorgonian coral were also easy to identify.

In contrast, the mediocre quality of the photographic record and the video film recordings is surprising; with the current photographic and filming arrangements, there is little chance of distinguishing clearly any organisms less than 5 cm in length (*Stylasteridae*, Mollusca, Crustacea). Most of the information gathered during such descents in fact relies on the very quality of the photographs and films and these could therefore be expected to be perfect. This is, however, far from being the case and a number of factors are responsible.

The whole dive, once the bottom is reached, is filmed using a VHS camera which is not a very high performance design. Only the best sequences are double-filmed using the excellent Umatic professional system. If the latter, which is slightly more costly than the VHS system, were used continuously, the extra cost involved would remain insignificant relative to the overall cost of such dives and especially to the immense gain in scientific value which would be obtained. For obvious reasons, the pilot's and observer's fields of observation and the photographic field of the two video cameras and the still camera are not in perfect juxtaposition; this makes the centring of the photos, all of which are taken by the observer, a very hazardous process. Some fine tuning of the camera mountings and the installation of two additional spotlights converging in the middle of the field of view at the correct focusing distance might

bring about a great improvement. Lastly, the development on board the mother ship of the many photos taken during each dive is a method which must contribute to their poor quality.

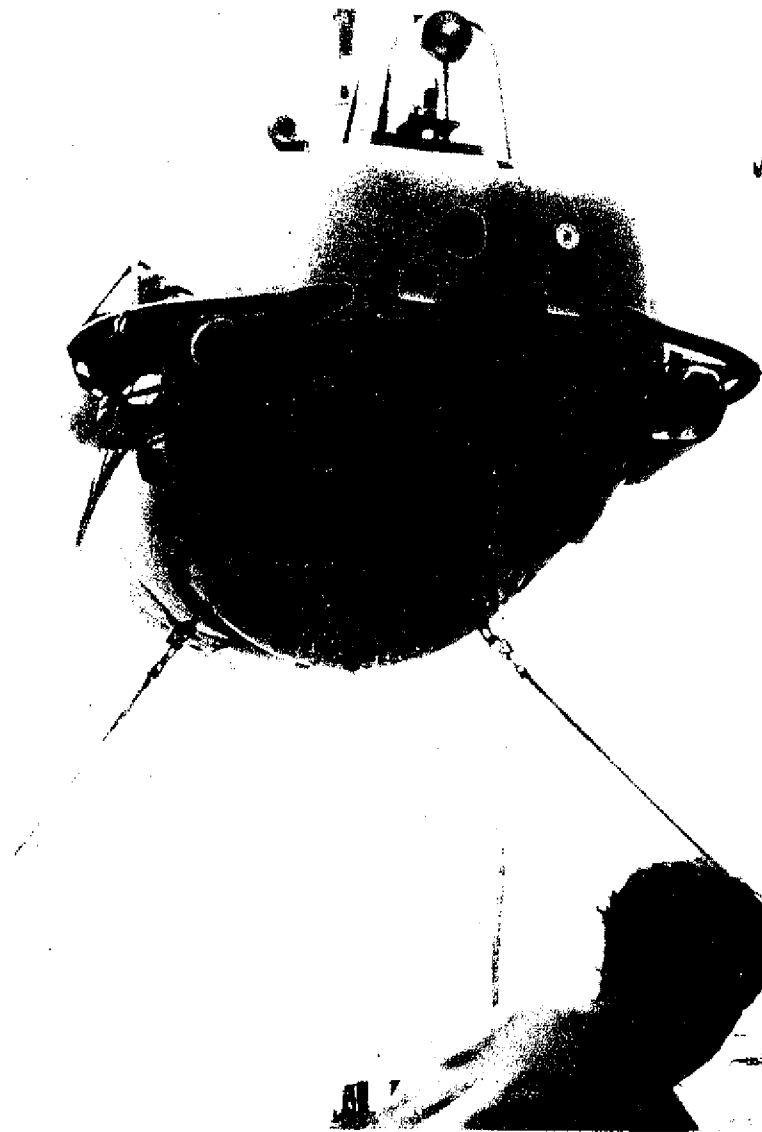


Figure 1: Submersible *Cyana*

An articulated arm fitted with a pincer, operated by the pilot, is used to gather benthic organisms and rock fragments. These are then placed either in the submersible's marsupial, or in a special container carried by the pincer and set down when the sample is gathered, or in a lift sent down on request from the vessel on the surface. This lift descends under ballast and its position, which is determined from a signal transmitter, is communicated to the submersible. It is raised by an acoustic signal from the surface which releases the ballast. Two types of lift are used: one is large and contains three drawers one above the other, while the other, smaller one, is split into two compartments. The opening and closing systems for these devices are operated by the pincer on *Cyana*. Each sample is collected by an intricate procedure which requires the submersible to be stabilised (in practice it is difficult to collect samples along a vertical wall). Where a container carried by the pincer is used, the bottom on which it is placed before picking up the sample should be as flat as possible.

### What happens during a dive ?

The submersible can dive only where the site bathymetry is known with accuracy (marine charts must be available or preferably a Sea Beam survey). Three sound signal transmitters are then submerged at the three points of a triangle within which *Cyana* will operate; these are designed to receive the signals sent by the submersible and relay this data upwards to the surface vessel so that it can track the submersible's position constantly; on the basis of previously agreed movements, the surface vessel is in this way able to guide the submersible in its manoeuvring on the ocean floor.

The submersible is only launched if the weather conditions permit (wind speed under 20—25 knots) and if the forecast is for no change over the next 6—7 hours. There have in fact been occasions during previous dives when the submersible has had to stay either on the bottom or at the surface because the weather was so bad that it was impossible to winch it aboard the mother ship using the crane.

After the *Cyana* has been launched, the team of divers releases the floats which buoy it up at the surface. The dive then commences, induced by ballast consisting of lead or iron shot. The vessel dives with a marked forward tilt (20°—30°) in a narrow spiral at a speed of around 1,000 m per half hour. All the lights are extinguished, which allows the observer to monitor the ebbing light readings. In the waters concerned, the light would appear to disappear altogether for the human eye at between 500—600 m depth. During dive PL 5, the submersible's descent was stopped at a depth of 600 m and the spotlights switched on. Despite the highly relative bathymetric stability of the submersible (the ballast-induced descent is offset by the vertical thrust of the engines), the crew were able to observe a number of pelagic organisms, including crustaceans (euphausiids? sergestids? peneids? or mysids?) and fish of the families Sternoptychidae and Gonostomatidae. The latter, in a vertical head-down position, would appear to belong to species *Cyclothone pallida* (approximately 6 cm long). A large Gonostomatidae, 15 to 20 cm long, was also observed in the same position a few metres before touching bottom at the end of the descent.

After detecting the bottom with *Cyana's* sonar, a slow approach is made with the spotlights on. The descent ballast is released, the submersible is stabilised and exploration begins with the vessel tilted according to the relief. The degree of tilt is achieved by transferring mercury between two containers, one situated at the front and one at the rear. The dive generally follows a schedule of decreasing depth, gradually climbing the slopes. The scientific observer, his eyes glued to the porthole, is fitted with a microphone connected into the VHS video system which is permanently switched on and a camera operating button for flashlit photography on transparency film. When so requested, the navigator starts the second video camera, the Umatic professional system, which has higher resolution. During the dive, it is essential that as much information as possible be gathered on the nature and relief of the ocean floor and on the organisms and their behaviour. Any detail likely to be of interest to biologists, geologists or sedimentologists should be photographed unhesitatingly. The samples taken will differ substantially according to the specialisation and knowledge of the observer. Some will prefer to gather samples of organisms while others will favour rocks or crust.

At the end of the dive, after the pellet ballast has been jettisoned, *Cyana* rises gradually to the surface through the buoyancy of a kind of polyester foam which envelops the submersible under its outer hull and which contains small spheres of hollow glass capable of resisting a pressure of more than 300 kg/cm<sup>2</sup>. At the surface, the divers assist in securing the submersible and then winching it aboard. This is the trickiest part of the operation and certainly the least pleasant one for the passengers.

**Processing of data collected from a dive**

At the end of each dive, the observer endeavours to make his personal observations accessible to others by processing the video sound-tracks and the slides and by inspecting and cataloguing the samples. This process usually takes a day or two because the recordings and the photos need to be viewed several times to draft the dive report. The identifications offered in such reports are often tentative and are subsequently reviewed by specialists.



