

FISHERIES NEWSLETTER

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This issue

Following on the heels of the SPC 15th Regional Technical Meeting on Fisheries, this issue includes a good deal of material which stems directly from its results and recommendations, or which relates to subjects of particular interest raised during discussions. Two articles (numbers 3 and 5 on the contents list below) were produced in response to specific requests for information made by the meeting.

Our regular selection of 'News from around the Region' is steadily expanding and gaining broader coverage, largely thanks to the efforts on the part of readers and correspondents who have sent in notes, reports, press clippings and other details of items of interest. The editors sincerely appreciate any material received, and we thank all those who have contributed so far.

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ACTIVITIES

SPC 15th Regional Technical Meeting on Fisheries

This year's technical meeting, attended by 42 official delegates and 38 observers, ran well despite a very full agenda and heavy workload for many participants.

The first day saw the completion of opening formalities and a review of SPC activities related to coastal fisheries. Of particular interest were the activities of the Deep Sea Fisheries Development Project in the development of small scale fishing gear and techniques, and the SPC/Nelson Polytechnic Fisheries Training Course, which was once again commended as an outstandingly valuable, practically orientated training programme.

Monday also saw the commencement of the presentation on the SPC study of fish aggregation devices, carried out by consultant Lt. Richard Boy and SPC Fisheries Adviser Barney Smith earlier in the year. The presentation, which concluded late on Tuesday morning, focused on many aspects of FAD design and function and stimulated a great deal of discussion around the floor. The meeting was unanimous in its appreciation of the valuable work done by Lt. Boy and Mr Smith, and many delegates announced their intention to implement the recommendations of the study closely.

Discussion then moved to oceanic fisheries, and a review of progress with priority items of the SPC Tuna and Billfish Assessment Programme by the Programme's coordinator Dr Robert Kearney. This was followed by a discussion, which lasted until Thursday morning, of the future requirements for the conservation of the tuna resources of the region, and the role of the Tuna Programme in this field. The meeting noted that most of the present knowledge about skipjack in the Western Pacific had been obtained through the activities of the Programme and its predecessor, the Skipjack Survey and Assessment Programme, and recommended its continuation for 2 years in the first instance, with priority accorded to the collection and evaluation of catch and effort data, and the assessment of interaction between fisheries. It was further recommended that the SPC explore ways and means of obtaining input into the programme from the distant water fishing nations which operate in the Pacific, in an effort to close some of the gaps in the catch and effort data currently available to the Programme.

Most of Thursday was taken up by a one-day 'Workshop on Aspects of Fish Handling and Processing'. Following the presentation of two SPC training videos showing proper onboard and onshore methods of fish handling and processing, SPC Master Fisherman Lindsay Chapman gave a brief demonstration of some of the major points covered, using fresh fish. Brief presentations by invited speakers followed on quality control in freezer systems, simple processing and preservation techniques, economic factors influencing marketing and distribution systems, and training in fish handling and processing. These presentations, and the discussions they generated, led to the meeting recommending that the SPC either expand the present Deep Sea Fisheries Development Project or establish a similar project to make available practical specialists in fish handling and simple processing to provide in-country training in this area.

Friday's session covered other business not included under earlier agenda items, and the formal adoption of the report of the meeting.

Deep Sea Fisheries Development Project Notes

SPC Handbooks on fishing techniques in preparation

The period following the SPC 15th Regional Technical Meeting, which was attended by all three master fishermen, was allocated to a number of joint projects requiring the collaboration of all the SPC coastal fisheries staff. Major among these was the preparation of drafts for two handbooks on fishing techniques, one on deep bottom fishing and one on trolling, which will combine the practical experience of the three master fishermen into well illustrated basic manuals detailing the major factors to be considered in these types of fishing. Predictably, detailed group discussions involving all the coastal fisheries staff produced extensive notes which have now been distilled to a first draft of each handbook, but which still require further work before finalisation.

Cook Islands

Master Fisherman Paul Mead commenced his assignment in the Cook Islands in February this year and concluded it at the end of July, immediately prior to attending the SPC 15th Regional Technical Meeting on Fisheries.

While in the Cooks, Paul continued work on a variety of fishing techniques, with priority given to the development of suitable methods of catching fish associated with FADs. Unfortunately, shortage of suitable bait hampered this work in the first weeks of the project visit, and most time was spent deep bottom fishing. Strong currents gave continual difficulties and Paul tried both bottom longlines and drift-fishing with a parachute anchor to overcome these, the latter with considerable success. Bottom fish around Rarotonga tended to be small, a feature noted during a previous Project visit there in 1982. The largest Etelis carbunculus (short-tailed red snapper) caught during Paul's stay weighed 2.6 kg, with most being less than 1kg.

After the arrival of a consignment of frozen saury longline bait from American Samoa, some time was spent in vertical longlining, ika-shibi fishing and trolling around the FAD off Rarotonga. However, the limited time remaining did not allow much experimentation with variations in the gear and methods used, and coincided with a period of extremely poor fishing. Apart from by trolling, catches were low.

Palau

After completing his training programme with the Palau Government demonstration team, Master Fisherman Pale Taumaia has been moving from area to area to give training and advice to state fishing cooperatives. A number of these fishing groups have recently benefitted from Japanese aid in receiving 35-foot fibreglass fishing vessels, and Pale has been fishing with their crews to conduct practical demonstration and training sessions under working conditions.



(Photo: P. Taumala)

The *Mesekiu*, one of several 35-foot fibreglass fishing boats used by Master Fisherman Pale Taumaia during the Deep Sea Fisheries Development Project's visit to Palau.

Pale's programme was suspended for several weeks in August when he travelled to Noumea to attend the SPC 15th Regional Technical Meeting on Fisheries, and subsequently assist with other projects at headquarters. Pale returned to Palau early in September to resume the Project visit.

Vanuatu

Master Fisherman Lindsay Chapman concluded his assignment to Vanuatu in July prior to travelling to Noumea for the SPC 15th Regional Technical Meeting on Fisheries. Lindsay had been working with rural fishing groups set up under the Fisheries Departments' Village Fisheries Development Project until mid-July, advising on fishing regimes and the technical difficulties faced by the groups. For the last two weeks of his stay, however, Lindsay returned to Port Vila to assist the staff of the newly opened Government fish market. During this period, Lindsay helped establish good quality standards in the market by demonstrating simple handling and processing techniques aimed at maximising quality and product value. Lindsay reports that the market is running well and attracting considerable custom, as anticipated.

Ponape

After leaving Noumea in early September, Master Fisherman Paul Mead travelled to Ponape for a one-month assignment with the SPC Mobile Training Unit, which has been operating there for several months. Paul's contribution will be an intensive training course in a number of aspects of deep bottom

fishing, centering around the construction and proper use of the Western Samoan handreel and basic seamanship and safety for small boat fishermen. About 20 trainees with the unit are expected to join Paul in groups of four or five for fishing trips and lectures.

Tuvalu

After spending August working with the other Fisheries staff in Noumea Lindsay travelled to Tuvalu to commence a new country visit based in Funafuti but taking in many of the outer islands. The Fisheries Division has a very full timetable for Lindsay during his stay, which includes assisting with the deployment and utilisation of FADs, and travelling among the islands to demonstrate fishing and fish handling techniques.

Deep bottom fish species list in preparation

A recurring difficulty in Deep Sea Fisheries Development Project country visits has been the accurate and consistent identification of the fish caught. While many of the most sought-after species present no problem, there are still major difficulties in identifying some of the secondary species, which in many countries make up a large part of the catch. This particularly applies to the genera Epinephelus, Cephalopholus, Plectropomus and Variola in the family Serranidae, Carrangoides, and, to a lesser extent Caranx in the Carangidae, and Gymnocranius and Lethrinus in the Lethrinidae. The uncertain and, in some cases, rapidly changing taxonomy of some groups compounds this problem.

Successive SPC Regional Technical Meetings on Fisheries recommended that the SPC place high priority on the collation of its own collected information on deep-bottom fish stocks in an attempt to produce regionally applicable information for management purposes, and to assist the countries of the region in similar projects. In view of these instructions, the need to ensure accurate identification of the major portions of the catch has increased. With this in mind, the coastal fisheries staff combined a re-examination of past catch records with a study of available photographs and keys to standardise the names and descriptions used by the master fishermen. A complete coded list of all the species taken by the project is now in preparation prior to computerisation of past catch records to enable a broader synthesis of available information to take place.

Tuna and Billfish Assessment Programme

The Tuna and Billfish Assessment Programme has been publishing concluding reports of the Skipjack Programme's work in the waters of all of the member countries and territories of the South Pacific Commission. Seven of these have so far been printed and distributed and four more are presently in press. The conclusions of the first three of these reports are summarised as follows:

An Assessment of the Skipjack and Baitfish Resources of Fiji,
by R.E. Kearney.

Despite reservations on the accuracy of resource estimates, it is apparent that skipjack catches in Fiji could be sustained at several times the

present levels. Recruitment into the Fijian fishery shows a significant north-south component with up to 25% of fish coming from around New Zealand. There is, however, no evidence to suggest that fishing activities in other countries are having any significant deleterious effect on recruitment to the Fijian fishery.

The development of a purse-seine fishery and the deployment of large numbers of fish aggregation devices since the Programme's work in Fiji now permits assessment of the interaction between purse-seine and pole-and-line gears, and the influence of FADs on skipjack behaviour. Further tagging work to enable these assessments is recommended.

Past concern about a long-term decline in baitfish abundance as the local fishery develops appears unfounded at current and anticipated levels of exploitation. Variations in catches and catch rates are likely to be seasonal or short-term, and are attributable both to seasonal variations in climate and the composition of the baitfish community, which contains species which are susceptible to local fishing pressure. The many unfished lagoons and bays are likely to harbour baitfish resources which will form a buffer to long-term decimation by fishing. Overall yields could probably be improved by better co-ordination of bait fishing effort during the fishing season.

An Assessment of the Skipjack and Baitfish Resources of the Cook Islands,
by T.A. Lawson and R.E. Kearney.

Prospects for the establishment of skipjack live-bait fisheries in the southern Cook Islands appear poor due to the scarcity of baitfish and suspected low abundance of skipjack. There appears to be adequate skipjack to support a limited fishery in the northern Cook Islands, but lack of baitfish, distance from overseas markets, high local fuel costs and lack of vessel maintenance facilities will be major obstacles to the development of even a small-scale local fishery. It is possible that overseas based purse-seiners could operate successfully in this area, particularly of fishing in association with FADs. However, although this activity may produce significant revenue for the Cook Islands, the potential interaction between purse-seiners and both local fisheries, and the fisheries of other nations of the region, should not be overlooked.

An Assessment of the Skipjack and Baitfish Resources of Solomon Islands,
by A.W. Argue and R.E. Kearney.

The present pole-and-line fishery is only harvesting a fraction of the available resource and it is clear that there is potential for greatly increased skipjack catches from the waters of Solomon Islands.

There currently appears to be little interaction with either locally-based or distant water fisheries operating in neighbouring waters. However, such interactions can be expected to increase as neighbouring fisheries expand, and could become significant if a large skipjack fishery was to develop in waters immediately adjacent to Solomon Islands, particularly to the west or southwest.

Increased purse-seine activity in and around the Solomon Islands 200-mile zone is likely, either locally based or by distant-water vessels. While these operations may produce significant revenue for Solomon Islands, they will undoubtedly result in increased interactions with the local pole-and-line fishery and with other fisheries of the region.

The Programme's baitfish catches in Solomon Islands were excellent, and in general baitfish were found to be more abundant than in any other country or territory visited, with the possible exception of Papua New Guinea. Many potential baiting sites are not fished at present, and these should give an expanded pole-and-line fleet sufficient options to compensate for localised bait depletions. The three major Santa Cruz islands differed in that bait resources appeared limited, and a cautious approach is suggested for the development of pole-and-line fishing activities in this area.

NEWS FROM AROUND THE REGION

Trochus transplants carried out in the Cook Islands

July issues of the Cook Islands News report the successful transplantation of 500 trochus shells from Aitutaki to the islands of Mangaia and Mauke by Acting Secretary for Marine Resources Development Julian Dashwood and Research Officer Bob Kiwala. With the help of Island Councillors, 250 shells were distributed along exposed reef areas in each of the two islands, the aim being to establish local populations for subsequent exploitation by the islanders. It is planned to transplant further shells to bring the total up to 1000 in each locality.

The use of light inter-island planes to transport the animals also led to a third, unplanned transplantation. Over 700 trochus shells were initially harvested at Aitutaki and brought into Rarotonga on the way to Mangaia and Mauke, but limited cargo space meant that about 200 had to be left in Rarotonga, where they were placed in the lagoon. Further transplants are planned to some of the Northern islands, but cannot be carried out until more sophisticated transporting facilities are built for the longer journeys involved.

While harvesting the trochus at Aitutaki, Messrs Dashwood and Kiwala also carried out an examination of the status of local fish and shellfish stocks, particularly trochus and paua clams. Following the survey, and discussions with the Aitutaki island council, Minister for Marine Resources Mr Tupui Henry announced that plans to lift current restrictions on paua and trochus harvesting may have to be deferred, as the sizes and densities of the animals were not encouraging. The Minister also discussed with the Island Councillors and the local fishing fraternity the possibility of declaring the mangrove areas in the northern end of the lagoon a marine reserve, in view of the areas' value as a fish breeding ground. The discussions were positive and led to the formation of a Marine Resources Review Committee, made up of people from Aitutaki, with which the Marine Resources Department will consult prior to any action being taken.

'Manta Cat' fishing boat from American Samoa

According to information from the Director of the American Samoan Office of Marine Resources, Mr Henry Sesepasara, the local company Samoa Fiberglass Inc., has been enjoying a recent boom in its sales following the successful development and marketing of two versions of a fishing catamaran, called the 'Manta Cat'. The boat is available in a trailerable 22-foot model, or the more popular 28-foot version which has been constantly improved on since the introduction of the basic design to Samoa three years ago. The Manta 28

Model IV (pictured below) incorporates the latest changes. Its basic specifications are:

Length Overall	27ft 10in (8.58m)
Breadth Overall	9ft 6in (2.9m)
Displacement	3100 lbs (1406 kg)
Capacity	3800 lbs (1724 kg)

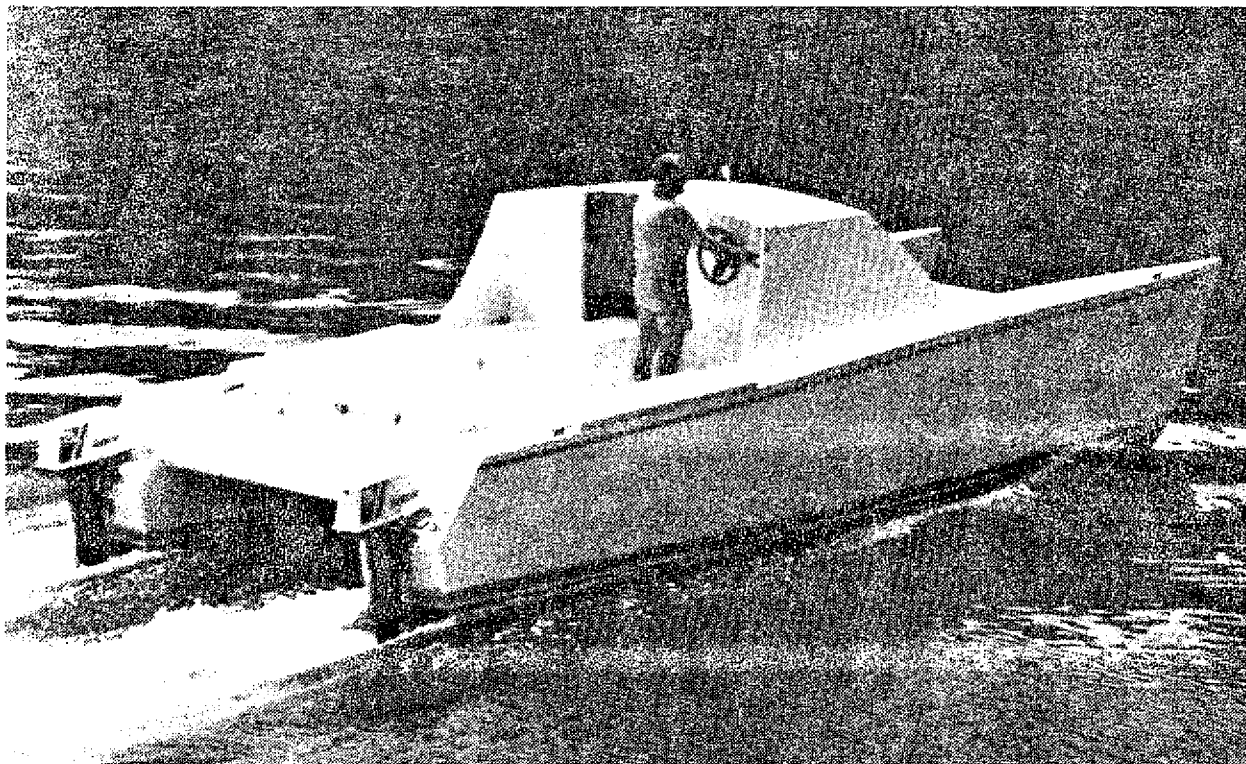


Photo: Samoa Fiberglass Inc.)

The *Manta Cat* fitted with twin 25 h.p. motors.

The hulls are of foam sandwich construction, laid up on a female mould and laminated with fibreglass. Decking is of marine plywood saturated with epoxy and dynel laminated. Bronze and stainless steel fastenings, a 10 cu.ft. ice box, running lights and other basic equipment are included in the standard hull price of US\$12,775. Engines are extra, and cost from US\$2,968 for twin Suzuki 40 h.p. outboards, to US\$13,360 for twin inboard Yanmar 30 h.p. diesels, with outdrive units. Engines are mounted on or through the transom of each hull, an arrangement which is said by the manufacturers to eliminate some of the cavitation problems found in catamarans with centre-mounted motors, and which reduces the chances of complete engine failure at sea. The manufacturers quote the following performance figures for the engine options they provide as standard:

Engine	Estimated max. speed
Twin 40 h.p. outboards	20 m.p.h.
Twin 65 h.p. outboards	26 m.p.h.
Twin 30 h.p. inboard diesels	16 m.p.h.

Construction time for the standard models is 6-8 weeks. A variety of optional extra equipment is available, ranging from extra ice boxes to dual hydraulic steering stations, and custom orders are also encouraged. Further information can be obtained from Samoa Fiberglass Inc., Box 505, Pago Pago, American Samoa 96799.

Fifth International Coral Reef Congress announced

The International Coral Reef Committee of the International Association for Biological Oceanography has recently issued a preliminary announcement of the dates and venue for the Fifth International Coral Reef Congress. The Congress, subtitled "The Reef and Man", will further develop the multidisciplinary approach taken by the fourth meeting held in Manila in 1981, and is scheduled to take place in Tahiti, French Polynesia in May/June 1985.

Among the specialists invited to attend the Congress will be various members of the natural science fields (biology, geology, paleontology, etc.), social scientists, economists, pollution and environmental management specialists, and others specialising in such diverse subjects as human health problems (e.g. fish poisoning), exploitation of coral reef resources and the rational use of ecosystems.

A number of field trips, both before and after the conference, are also planned, to visit the coral reefs surrounding the high volcanic islands of the Society archipelago, and the atolls of the Tuamotu group.

The meeting will be hosted in Tahiti by the Research Centre of the Museum Nationale d'Histoire Naturelle and the Ecole Pratique des Hautes Etudes in French Polynesia. Further information can be obtained from: Antenne Museum - EPHE, Congres Recifs Coralliens 1983, B.P. 562, Papeete, Tahiti, Polynesie Francaise.

Village fisheries meeting held in Port Vila

A four day meeting was held in Port Vila from the 8th to 11th of August to review the progress and achievements of the Vanuatu Village Fisheries Development Programme (VFDP). The meeting was the first of its kind in Vanuatu and brought together village fishermen from many parts of the Republic, village fisheries advisers, Fisheries Department and other government staff and observers from overseas. The meeting was held at the newly opened Centre for International Relations, and was jointly organised by the Canadian volunteer service CUSO and the Vanuatu Fisheries Department, and sponsored by CUSO. We are grateful to Chief Fisheries Officer Jim Crossland for the following summary report.

Opening the meeting, Mr Iolu Abbil, First Secretary of the Ministry of Land and Natural Resources, spoke of the need for Vanuatu to develop its marine resources and stated the government's strong support for the Village

Fisheries Development Programme. He noted that 8 village fishing companies had been set up since the beginning of the programme.

The chairman of the National Council of Chiefs, Chief Willie Bongmatur, also addressed the meeting. He stressed the importance of cooperation between different fishing groups, especially over the question of fishing rights.

The meeting then went on to review the status of each of the village fishing companies and looked at the problems facing village fishing groups in Vanuatu, a country which, before the programme commenced, had no artisanal



(Photo: L.B. Chapman)

A Canadian volunteer and Ni-Vanuatu fisherman, both participants in the Vanuatu Fisheries Department's Village Fisheries Development Project, display part of their day's catch.

fishery and very few subsistence fishermen. It was agreed that there were many problems but that where Village Fisheries Advisers had been working in the villages for extended periods, most of these had been overcome. Practical demonstrations on fish catching around Fish Aggregation Devices (FADs), and handling and processing of fish were held during the week, with illustrated talks on fish preservation, conservation and management of fish stocks and outboard motor maintenance. The importance of proper financial management and control was stressed in the meeting as the village groups were repaying loans to the Development Bank for at least three years.

Observers at the meeting contributed greatly to its success with technical advice, demonstrations and sharing of experiences. The organisers are grateful for the participation of FAO, the Tropical Development and Research Institute (London), the British Development Division in the Pacific, ORSTOM and Papua New Guinea.

The meeting commended the Fisheries Department and CUSO for their assistance in setting up the programme and noted that the eight projects started in the first nine months of the programme had produced over twenty three tonnes of fresh fish with a value in excess of three million vatu. This represented a significant increase in rural income in Vanuatu.

Summing up the meeting, one of the observers gave as his strongest impression the friendliness of the meeting and the spirit of cooperation between all participants. He also remarked that the progress of the VFDP was being watched with considerable interest in other parts of the Pacific.

A second meeting is proposed in 1984 to further review the programme and the progress of Vanuatu's newly formed artisanal fishing industry.

Reef Replenishment Areas established off Queensland coast

In an experimental approach to the management of fish stocks the Great Barrier Reef Marine Park Authority (GBRMPA) has declared two reef patches in the Capricornia section of the Australian Great Barrier Reef as Replenishment Areas. North Reef and Boulton Reef were closed to fishing and any other activity involving the removal of living reef resources (except trolling for mackerel from 1st May - 31st August) on 1st July 1983. The closures will remain in effect for three years in the case of North Reef, and two years for Boulton Reef, and in both cases the fishing bans, which extend 1 km seaward from the reef-edge, are enacted under legislation which provides for fines of up to \$5,000 for offences in relation to the closures.

The closure of certain reef areas to allow the recovery of fish stocks is a traditional management concept found in many Pacific countries, and recent research carried out in Australia and the Philippines supports the validity of this approach. For instance, surveys conducted by the GBRMPA at various reefs in the Capricornia section indicated that the number and sizes of coral trout (*Plectropomus* spp.) in areas off Heron Island which had been closed to fishing for seven years, were greater than at anywhere else covered by the survey. Further survey work will be conducted before, during and after the closure periods by the GBRMPA and the Queensland National Parks and Wildlife Service, and will assist in establishing the necessary recovery periods and levels of extractive use appropriate to the living resources of the reefs in question.

ICLARM commences research programme on Indo-Pacific Giant Clam stocks

Although very little quantitative information exists, giant clams are known to be under very heavy fishing pressure in a number of areas, both for subsistence purposes and by commercial vessels, often fishing illegally for sale to the lucrative Asian market which exists for dried clam muscle. Recent developments in tridacnid culture techniques, notably in Palau and Papua New Guinea, indicate that it may become possible in the near future to replenish depleted natural clam stocks and perhaps farm these animals in commercially profitable ventures.

The International Centre for Living Aquatic Resource Management, ICLARM, has now embarked on a major research programme on various aspects of the biology, ecology and culture of tridacnid clams. The programme includes studies of the economics of clam farming and marketing, design and development of pilot-scale clam hatchery facilities, and an assessment of the status of Indo-Pacific clam stocks.

Initial work on this latter project has already commenced with the distribution of a brief questionnaire by Dr R.F. Ventilla of ICLARM, relating to the local abundance of various clam species and current clam-fishing activities.

Further information on ICLARM's work in this field can be obtained from Dr J.L. Munro, ICLARM, MCC P.O. Box 1501, Makati, Metro Manila, Philippines.

The Third International Artificial Reef Conference

The Third International Artificial Reef Conference, noted in last quarter's Fisheries Newsletter, is now scheduled to be held at Newport Beach, California, from 3rd-5th November 1983. The organisers have recently circulated additional information on the conference and called for the submission of papers and abstracts for possible presentation at the meeting. The stated objectives of the conference are to:

- Provide a forum for exchanging valuable information on engineering, biological productivity and fishery management aspects of artificial reef enhancing and fish attracting device technology.
- Present available scientific data supporting artificial reef technology.
- Define the state-of-the-art for artificial reefs and fish attracting devices.
- Make recommendations for current and future research needs and establish an international communication network.

The conference will bring together researchers concerned with recreational and commercial applications of artificial reefs in the United States, Japan, China, Israel, Australia, Europe, the Philippines and the South Pacific.

Further information from: Dr J.S. Stephens, Occidental College, Department of Biology, 1600 Campus Road, Los Angeles, California 90041.

Spiny lobster culture research programme accelerated after encouraging experimental results

The Central Marine Fisheries Research Institute, Cochin, India, has stepped up its ongoing research programme on the technical aspects of spiny lobster culture following the development of a promising technique which greatly increases the animals growth rate.

The Institute's publication 'Marine Fisheries Information Service', No. 43, contains two articles claiming very encouraging experimental growth rates obtained in specimens of Panulirus homarus from which the eyestalks had been cauterised. In many crustaceans the eyestalk serves as a centre for hormone production or control in the antagonistic hormonal system which controls moulting, reproduction and growth. Suppression of one hormonal process can be used to encourage over-expression of another, and variations of the eyestalk ablation technique have long been used in experiments on crabs, prawns and lobsters to variously promote or inhibit moulting, reproduction and growth and thus gain an understanding of the processes involved.

In the Cochin experiments groups of eyestalk ablated P. homarus were measured for growth against 'control' groups of lobsters which were not treated, were given an excess of food and housed in the same way. Growth in lobsters is a function of the frequency of moulting and the weight increase which occurs at that time, and eyestalk ablation increased both these factors. A three to sevenfold increase in weight was obtained in eye-ablated lobsters relative to the controls. Growth rate is dependent on size, larger animals showing a higher daily weight increment. Thus juvenile eyestalk ablated lobsters recorded an average increase of 1.02 g/day, increasing to 2.50 g/day in maturing and mature lobsters. Equivalent figures for the control animals were 0.35 g and 0.36 g/day respectively. The maximum weight gain of 4.6 g/day was obtained in an ablated individual.

Panulirus homarus is present throughout the SPC region, but is probably the least common of the five species to be found here. However, the technique may be applicable to other species. The Institute has met with success in similar preliminary experiment carried out with P. ornatus, the largest of the species of the SPC region, and P. polyphagus, but P. argus and P. cygnus did not give similar results.

Announcement of the experimental results in India led to a spate of letters and articles, with titles such as 'Lobsters Are Human Too', in India's national daily papers, questioning the ethics of such experiments, which were considered against the country's traditions. The researchers defend their work as comprising only standard experimental methods, and point out that eyestalk ablation is an investigative technique and perhaps a step towards enabling growth rate acceleration by hormonal treatment.

Researcher seeks information on Hawksbill Turtle poisoning

Following a report of a possible case of poisoning from eating a hawksbill turtle (Eretmochelys imbricata) in Tonga, researcher George Balazs of the U.S. National Marine Fisheries Service, Hawaii, is seeking information on other known or suspected cases of turtle poisoning in the Pacific. Dr Balazs, who works at the South West Fisheries Center, Honolulu Laboratory, P.O. Box

3830, Honolulu, Hawaii, would be very grateful to hear from anyone who has any knowledge of incidents of turtle poisoning in any locality.

The following notes on turtle poisoning are extracted from the FAO Synopsis of Biological Data on the Hawksbill Turtle, by W.N. Witzell.

"Hawksbill meat is generally eaten throughout its range, although the meat is often reported to be of poor quality, being dark and oily with a strong flavour. The hawksbill is reportedly poisonous in many areas throughout its range, but often without documented cases. In many instances the hawksbill has been accused of being poisonous, possibly because of its strong flavour, which is believed to vary according to diet.

Hawksbills are not eaten, or are reluctantly eaten because of their reputed toxicity, in the following locations: Gulf of Guinea, Australia, Sri Lanka, Gulf of Siam, Colombia, India, Mauritius, New Guinea, Mexico, West Africa, Seychelles, Senegal, Sudan, Oman. Documented cases of hawksbill turtle poisoning are relatively rare, having been reported from the following locations: Taiwan, Gilbert Islands, Ryukyu Islands, Philippines, Australia, Solomon Islands, New Guinea, Sri Lanka and India.

In reviewing the cases of turtle poisoning and summarizing all pertinent information, one research worker found that poisoning was seasonally sporadic with a geographically intermittent distribution, and could result from eating either the meat, fat, viscera or blood. Symptoms generally appear from within a few hours to several days, depending upon the amount ingested and the person. Major symptoms are: nausea, vertigo, vomiting, diarrhoea, severe gastric pain, sweating, coldness of the extremities, and a dry, burning sensation of lips, mouth and throat. Additionally the tongue develops a white coating with tiny pustules, and victims may suffer from headaches and general lethargy. There are no antidotes, consequently treatment is symptomatic. The overall case fatality rate is 28 per cent, with the oldest and the youngest persons reportedly being more susceptible. Prevention is difficult, since toxic turtles are impossible to differentiate from non-poisonous turtles, the best method being to feed a sample to a dog or cat and wait at least 24 hours. The origin of the toxin is not known but it is believed to be caused by ingestion of poisonous algae, jellyfish or even sea snakes".

Turtle headstarting scheme in Palau

The Government of Palau is currently sponsoring a headstarting programme for hawksbill turtles. Three technicians work within the programme, hatching about 1000 turtles per year and releasing them after 6 months.

FAO World Fisheries Conference announced

The Food and Agriculture Organization (FAO) of the United Nations (UN) have scheduled a major fisheries meeting, entitled the World Conference on Fisheries Management and Development, for June/July 1984, in order to examine the technical, economic and social problems raised by the new regime of the ocean, and the future potential and needs of the fishery sector. The conference, open to all member nations of FAO, the UN and its specialised agencies, and the IAEA (International Atomic Energy Agency) will be held in Rome from 27th June to 6th July.

The need for the conference is dictated by the changing nature of world ocean jurisdiction. The principle that coastal nations have exploitation rights over fish resources in a zone typically extending 200 miles from their shores has gained worldwide acceptance, and more than 100 coastal states have now extended their jurisdiction in this way. The traditional freedom of the seas, and the corresponding predominance in world fishing of a handful of maritime nations is rapidly becoming a thing of the past. Almost 99% of the marine fishery resources presently exploited now fall under national control.

Because of this latter factor, there is now the opportunity to conserve and develop the oceans' fish resources in a way that proved impossible when access to most of them was free and uncontrolled. Coastal states have greater opportunities to reap the full benefit from the living resources off their shores, but they also face the weighty responsibility of deciding how they might best be used. However, this new situation occurs at a time when the nature of world fishing is undergoing a dramatic change. The rate of increase in the world fish catch has dropped sharply, from over 5% annually during the 1950's and 1960's to less than 1% in 1982 (when the total catch was 75 million tonnes) and many stocks of fish are now fully or overexploited. The cost of commercial fishing has also risen substantially, partly due to increases in fuel costs, adversely affecting the economics of many fisheries. Nevertheless, the demand for fish for direct human consumption continues to increase steadily, and is predicted to be 93 million tonnes in the year 2000 as opposed to 50 million tonnes at present.

Within this context, FAO has organised the World Fisheries Conference, which will focus on three specific areas:

- developing individual and joint strategies and action programmes to increase the contribution of fisheries to the world's food supplies and to nutritional, social and economic goals;
- improving the ability of developing countries to manage and develop their fisheries;
- promoting international collaboration in obtaining these benefits through better cooperation between developing and developed countries, and between developing countries themselves.

In preparing for the conference, FAO organised a series of seminar and consultations to investigate the technical matters affecting fish resources and their use. Five of these meetings dealt with technical and economic issues, (e.g. regulation of fishing effort, fisheries management principles) and five with scientific topics (e.g. management of stocks in near shore tropical waters, problems and prospects for aquaculture). This technical preparation will culminate in an extended session of the FAO Committee on Fisheries, to be held in Rome from 10th to 19th October 1983. The conclusions from the Committee on Fisheries will be reported to the final policy phase of the World Conference on Fisheries Management and Development.

Further information can be obtained from Mr J.E. Carroz, Secretary-General, FAO World Conference on Fisheries Management and Development, Food and Agriculture Organization of the United Nations, 00100 Rome, Italy.

Solar powered fridges for the islands?

The Renewable Energies Programme, being jointly conducted in French Polynesia by the Territory of French Polynesia, the French Atomic Energy Commission, and the French Agency for Energy Management, has recently been testing refrigeration systems suitable for use with solar power. The Programme has experimented with absorption and compression refrigeration cycles and the innovative Peltier effect, in which the welds which are used to construct the refrigeration unit serve as centres for the absorption and release of heat. For reasons of economy and efficiency the classic compression cycle has finally prevailed, using a suitable source of direct current such as a storage battery. In this situation, photocells are an efficient way of recharging such batteries.

The Programme has adopted two approaches in its efforts to introduce this technology to local communities. One is to adapt selected models of household refrigerators to solar power before sale in order to render the technology as similar as possible to models already on the market, and thus not discourage potential buyers who may be wary of an unfamiliar product. The second is to encourage private enterprise to participate in the production of a specially designed solar powered fridge/freezer, locally constructed and tailored to local conditions. This initiative has resulted in two craftsmen, one a refrigeration specialist and one a polyester specialist, joining forces to produce and manufacture in Tahiti an insulated box unit that can be equipped either as a refrigerator or a freezer. Volume production of the 'Tahiti model' began in January 1982, and has met with such a response that demand is expected to reach 1,000 appliances by 1984.

One of the main features of the 'Tahiti model', which has a capacity of 310 litres (approx. 11.5 cu.ft.), and is constructed entirely of polyester to withstand corrosion, is its enhanced insulation, which is 15 cm (6") thick. A factor often overlooked, the 2.5-7.5 cm (1-3") insulation found in ordinary domestic refrigerators or freezers is simply not enough for efficient operation in tropical conditions. Combined with the facts that domestic models are costly to transport because of their volume and generally not durable enough to withstand the harsh, low-maintenance treatment to be expected in remote rural locations, the sense of manufacturing heavy duty insulated boxes locally is clear.

The 'Tahiti model' comes in several versions depending on the local power supply, or lack of it. The solar version runs from a 12V or 24V storage battery which is charged by solar panels. If the box is used as a freezer, 10 to 12 33-watt panels are needed to generate the 1100 watt-hours/day power requirement. As a refrigerator only, 700 Wh/day are needed, which can be supplied by 6 to 8 panels. The battery version runs from a similar storage battery system which is recharged periodically from a small generator or a very infrequent or irregular power supply. Finally, the mains version runs directly from constant or intermittent AC mains power, without storage batteries. With this model, if the power supply is known to run regularly for a certain number of hours each day, this can be taken into account and extra insulation incorporated at manufacture to ensure adequate holding during the powerless period.

Further information can be obtained from M. J.C. Paulet, SPC Rural Technology Officer, Noumea.

A solar powered refrigerator has also been installed on a trial basis at the Erakor Village dispensary on Erakor Island, Vanuatu, according to the Vanuatu government newspaper 'Tam Tam'. The refrigerator was donated by a U.S. company, Western Solar Power, and installed by the World Health Organization for a total cost of some US\$3,500-4,000, and is now being monitored for reliability and potential weaknesses before being used for the storage of the dispensary's vaccine stocks and other medical supplies. The South Pacific Commission has recently completed a similar installation at Binu village clinic in the Solomon Islands.

Prawn Culture Course at University of Hawaii

The University of Hawaii's College of Tropical Agriculture and Human Resources and its College of Continuing Education and Community Service, in cooperation with the East-West Center and Aquatic Farms Ltd, is offering a training programme in the Biology and Culture of the Freshwater Prawn, Macrobrachium rosenbergii from October 3 to December 12, 1983, with further courses planned for subsequent years. The intensive ten week course is open to all but is aimed at middle-management level personnel involved in planning and managing prawn aquaculture facilities. The programme consists of theory, laboratory sessions and practical fieldwork, conducted at commercial hatchery and production facilities.

Further details are available from Dr S.R. Malecha, Training Programme Director, University of Hawaii College of Tropical Agriculture and Human Resources, 3050 Maile Way, Honolulu, Hawaii 96822.

M.Sc Course in Sea-Use at London School of Economics

The London School of Economics and Political Science, of the University of London, has recently announced a new M.Sc course in Sea-Use Law, Economics and Policy-Making. The programme is designed primarily for the University training of government servants, naval officers and others concerned in advising and administering national policies towards the exploration, exploitation and other uses of the sea, the seabed and their resources. The programme consists of three elements:

i) A compulsory background course in Marine Biology, Ecology and Resources, which includes such topics as environmental management and quality control, target animal population studies, and the development of utilisation models. Some of this course is conducted at the University's Marine Biology Laboratory at Millport in Scotland.

ii) Two courses chosen from:

- a) International Law of the Sea
- b) Economics
- c) Problems in Sea-Use and Policy-Making.

iii) A special project on a subject approved by the course managers and chosen by the individual student.

Applicants should have at least a second-class degree or its equivalent in Economics, Law, History, Politics, Geography, Environmental Sciences, Marine Biology, Ecology, Engineering or Oceanography, although applications from persons with other appropriate qualifications or backgrounds will be considered on their merits. Course fees are 3,100 sterling, with further costs anticipated for travel associated with field courses. The course is among those recognised by the UK Overseas Development Administration as eligible for studentships administered by the British Council.

Further information can be obtained from the Secretary of the Graduate School, London School of Economics and Political Science, Houghton Street, Aldwych, London WC2A 2AE.

Coral reef survey methods compared at Thai centre

A brief report in the United Nations Educational, Social and Cultural Organization's (UNESCO) International Marine Science Newsletter (#34, 1983) describes a five-day regional workshop held in Phuket, Thailand, in December 1982 which brought together scientists from Southeast Asia and the Pacific to compare methods of sampling and assessment used in coral reef surveys in their respective countries. Participants included scientists from Thailand, the Philippines, Guam, Indonesia, Malaysia and Singapore, as well as observers from Thailand, UNESCO and the United Nations Environment Programme (UNEP).

After presentation of their methods and group analysis of components for an integrated assessment scheme, the participants travelled to Phi Phi island, near Phuket, where various survey and sampling techniques were applied on nearby coral reefs. Using scuba equipment and working along fifty metre transects across the reef, the participants put to test the principles and techniques which had been discussed.

A report, communicating the organisational details, results and recommendations [of the workshop], can be obtained from the Marine Information Centre, Division of Marine Sciences, UNESCO, 7 Place de Fontenoy, 75700 Paris, France.

SPC Fisheries Newsletter No. 26 July-September 1983

THE SENSE OF SMELL AND THE FEEDING BEHAVIOUR OF TUNA

by
Kim Holland, Ph.D.
Hawaii Institute of Marine Biology
Honolulu, Hawaii, U.S.A.

This is a brief, informal report of ongoing research that the Hawaii Institute of Marine Biology and the National Marine Fisheries Service are conducting at the Kewalo Research Facility involving the feeding behaviour of tuna. This report does not contain all the details of the data we have acquired but gives an overview of some of our results. More information can be obtained by contacting the author.

We have established that tuna have well developed olfactory organs that give them an excellent sense of smell by which they can detect very low concentrations of some chemicals dissolved in sea water. Our most recent research has been designed to determine if tuna normally use their sense of smell to detect food in the wild. If they do, it may be possible to use the smell of food (prey odours) to improve the effectiveness of fish aggregation devices (FADs) and it may be possible to use odours on pole-and-line boats to increase or extend the effectiveness of live bait.

In order to determine the role of smell in the feeding behaviour of tuna we have conducted experiments both with fish in captivity and in the open ocean. The captive tuna were maintained and tested at Kewalo Basin. Great care was taken not to erroneously condition or "teach" the animals to respond to odours. The tuna were fed a variety of natural foods so they did not develop a preference for a particular kind of food odour. The prey odours that were tested were made from "rinses" of the external surfaces of intact prey animals (i.e., they were not chopped up or homogenised). These rinses were then freeze-dried into a powder before being redissolved for use in the tests. The behavioural responses of the captive tuna to the introduction of prey odours into their tanks were carefully recorded and analysed. Two kinds of tests were conducted. First, several tests were conducted with each batch of fresh caught animals to test the effectiveness of the prey odours on completely naive fish. Second, the animals were exposed to repeated testing of various prey types accompanied by occasional food reinforcement. This "preference series" format was designed to enable enough repeated experiments to see if one kind of prey odour was consistently better than another.

Our work with captive yellowfin (*Thunnus albacares*) and kawakawa (*Euthynnus yaito*) at the Kewalo Research Facility of NMFS has shown that prey odours are definitely important natural cues in the feeding of tuna. The presence of small amounts of the odour of intact food can cause strong food searching in naive animals. Figure 1 is an example of the change in swimming behaviour induced by odours, and Table 1 shows the effectiveness of the different prey types on naive fish. In the wild, tuna probably use their sense

of smell to detect schools of bait before they come within visual range and the tuna then change their swimming behaviour to try and visually locate the source of the smell.

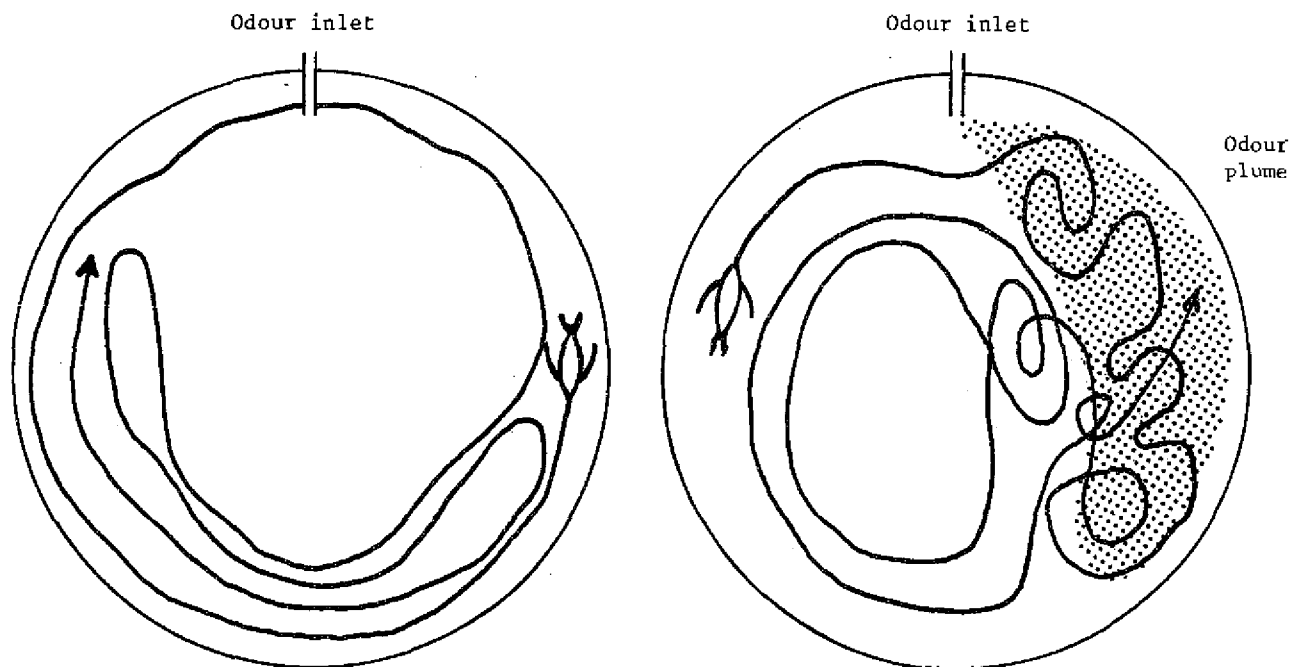


Figure 1:

Swimming patterns of tuna in response to prey odours. Swimming patterns (schematised) are shown for one minute before (left) and one minute after (right) the introduction of an effective odour stimulus. Regular lapping and figure-of-eight swimming changes to tight turning and circling, sometimes restricted to the area of the invisible odour plume. The tank water inlet and drain are not shown.

Table 1. Responses of Naive Captive Yellowfin to Various Prey Odours

OPELU				SQUID		NEHU	AKULE	KRILL
CR	BR	FD	AA	FD	AA	FD	FD	FD
7.1	6.8	6.9	1.3	6.1	2.1	4.2	3.0	3.0
+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
0.6	1.2	0.8	2.3	0.8	1.6	1.4	0	0

25 fish were used in 78 separate tests. The responses were scored on a scale of 0 to 9, where 0 is 'no response' and 9 is a "very strong" response, such as tight circling accompanied by "feeding colours". Thus, a score of "7" would be a strong behavioural response. F.D. refers to freeze-dried whole odour and values are available for all prey species. A.A. refers to the amino acid mixtures found in opelu and squid rinses. B.R. refers to the storage brine that opelu are stored in at the wholesale market. C.R. is whole, non freeze-dried odours.

Our preference testing shows that yellowfin respond more strongly to some prey odours than to others. The best odours were opelu and squid, the least effective was nehu. The results of the preference series tests are shown

in Table 2. It is interesting that nehu odour was the least preferred and this may indicate that the effectiveness of this baitfish could be improved if it was accompanied by a more effective (e.g., opelu) odour. Amino acids are the "building blocks" of animal tissues and are strong feeding stimulators for some species of fish. The amino acid components of the tuna prey odours have been analysed and tested but were not very effective. We are now testing other compounds.

Table 2: Prey Odour Preferences of Yellowfin and Kawakawa

a) Preference hierarchy for four schools of yellowfin

Prey Odour Type	Preference			Ranking		
	1st	2nd	3rd	4th	5th	6th
Opelu	**	*		*		
Squid	*	**	*			
Akule	*		**	*		
Krill		*	*	*	*	
Nehu				*	***	
Blank						****

b) Yellowfin preference series

Opelu	Squid	Akule	Krill	Nehu	Control
(5.4+2.1)	(5.3+2)	(4.8+2.1)	(4.4+1.4)	(3.3+2.1)	(0.7+1)

$P \leq .05$ $P < .001$
 $Krill > Nehu > Control$

c) Kawakawa preference series

Opelu	Krill	Nehu	Akule	Squid	Control
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$P < .001$
 $Squid > Control$

a) Responses of four schools of yellowfin to repeated presentations of various odours are shown. Thus, opelu rinse was most preferred by two schools, was second strongest for one school and fourth strongest for another school.

b) Analysis of the actual scores shows no statistical difference between the top four rinses but nehu rinse is distinctly less effective than the others but still much stronger than control (blank) water.

c) Kawakawa responses do not show any distinct differences among prey types.

Considerable effort was spent on conducting open ocean trials to verify that our captive results reflected the responses of tuna in their natural habitat. Divers observed the responses of tuna around FAD "F" off Kona to the introduction of opelu and squid odours. The experimental set up is shown in figure 2. The opelu odours were storage brine obtained from a fish wholesale market and the squid odours were made by soaking 560 lbs of whole squid in 100 gallons of sea water. The odours were pumped to a depth of 70 feet through a weighted hose and the responses of fish passing through the odour curtain were recorded by divers stationed at 30 feet.

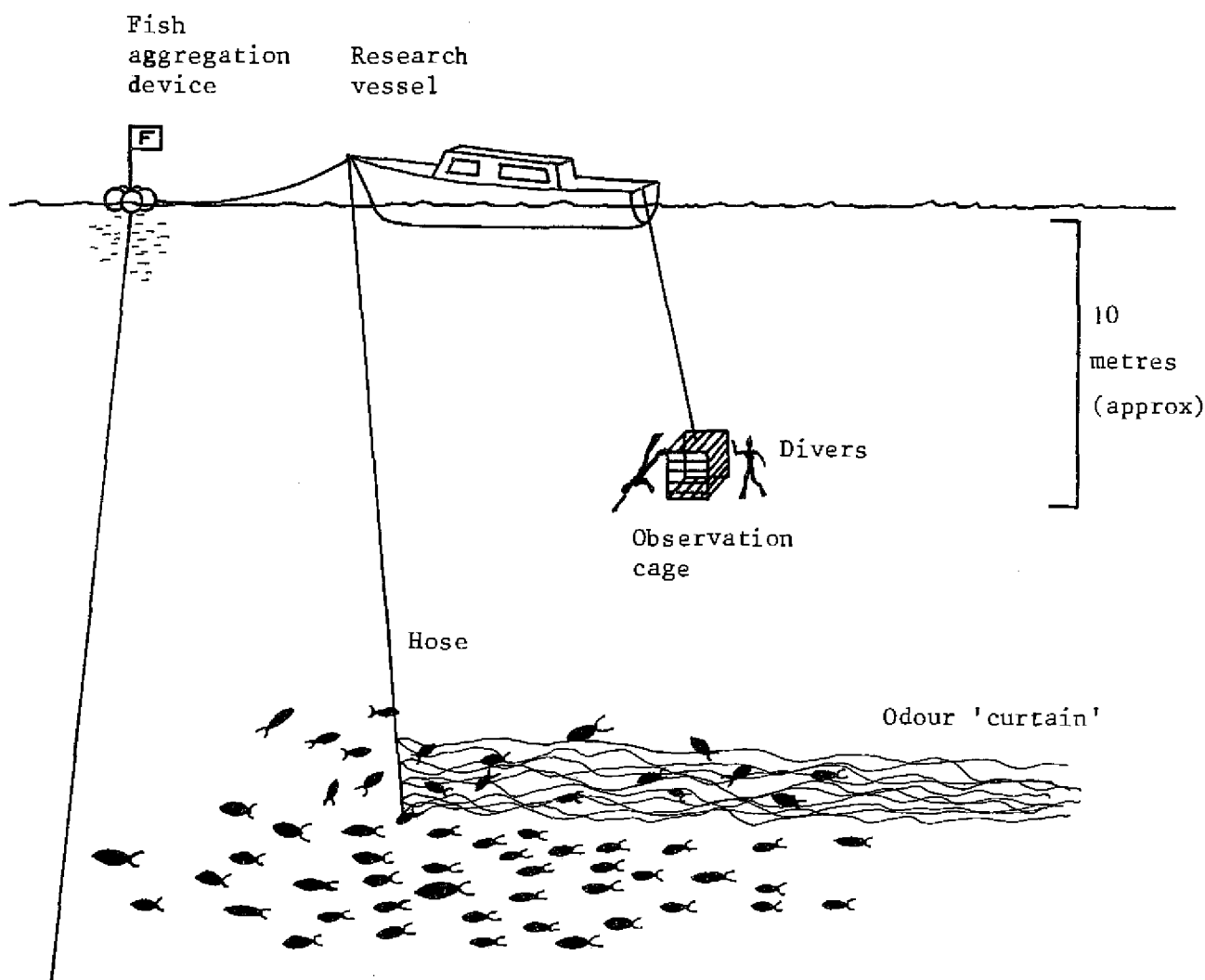


Figure 2:

Field testing of prey odours. The research vessel was moored about 25 feet (7.5 metres) from 'F' buoy off Kona. Prey odours were pumped down to 70 feet (21 metres) through a hose where they were dispersed in a 8-foot (2.5 metres) tall 'curtain' which was carried downstream by the current. Divers stationed around a shark-proof observation cage at 30 feet (9 metres) observed the responses of tuna passing through the odour plume.

Briefly stated, yellowfin tuna showed moderate to strong food search responses which sometimes included swimming up the plume to the odour hose and circling around it. Schools of opelu were also attracted to the hose both by squid and their own odour. Skipjack schools passing through the plume showed mostly only very mild responses. This may be because when they encountered the odour at 70 feet they were deeper than they normally are when they are feeding. As a result of these field tests we are confident that our captive data reflect what is happening in the real world.

Our future research will involve continuing to try to determine if a particular group of chemicals is responsible for the activity of the intact odours and identifying what they are. Also, we will be evaluating practical ways of acquiring and storing large volumes of odour stimuli (for example, opelu storage brine). We are experimenting with binders to slowly release odours over long periods (perhaps to use on newly deployed FADs to reduce start-up times) and hope to test incorporating odours in the water sprays of pole-and-line boats. Adaptations of our experimental odour hose system may be useful to handline fishermen who currently use more traditional chumming techniques.

Acknowledgements: This research has been supported by Sea Grant College, U.S. Department of Commerce; Office of Marine Affairs Coordinator, Hawaii DPED; Federation of Japan Tuna Fisheries Cooperation Association; Hawaii Institute of Marine Biology and National Marine Fisheries Service. Preliminary studies leading to the current research were conducted in collaboration with Drs John Bardach and Jelle Atema and Mr Walter Ikehara. Thanks also to Jerry Kinney, Volcano Isle Fish; Charley Spinney; Brooks Takenaka, United Fishing Agency; and Dr Richard Brill, NMFS.

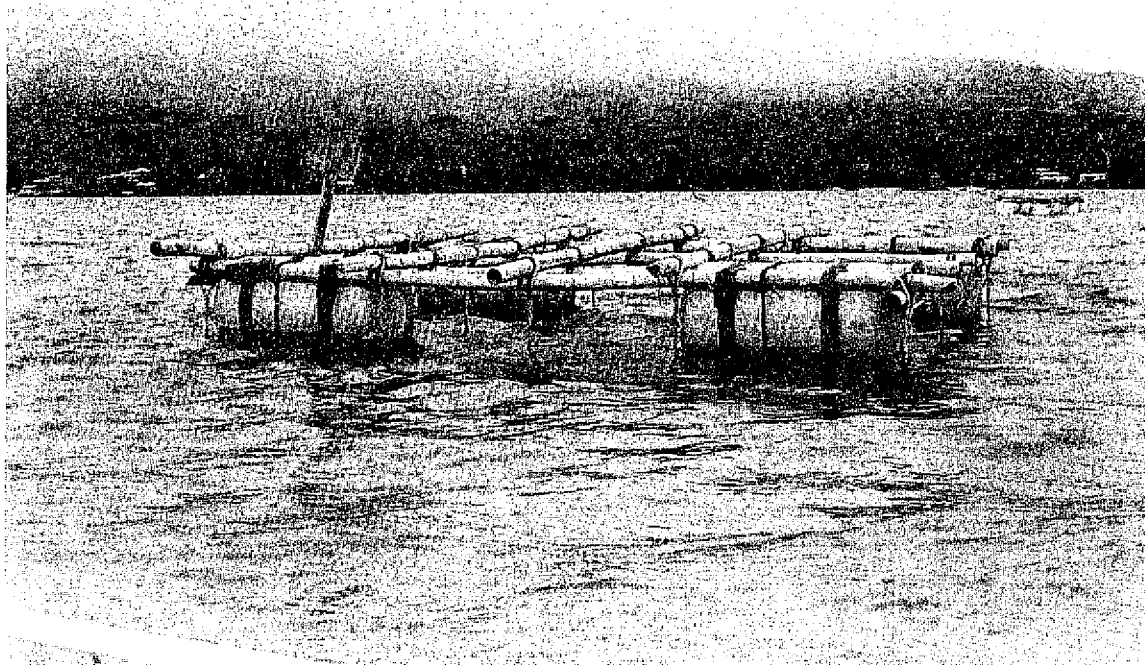
SPC Fisheries Newsletter No. 26 July - September 1983

The last issue of the Newsletter (No. 25) contained an article entitled "April 1983 Progress Report on the Green Mussel Culture Project in Western Samoa" by Lui Bell and Jane Albert, which detailed the methods used and preliminary results obtained in Western Samoa's mussel culture project up to April 1983. Since that time, further very encouraging results have been obtained which are briefly summarised in an update report presented below. Just prior to this issue going to press in early October, a Radio Australia news bulletin announced a harvest of 400 kg of mussels from the project's culture facilities. According to Western Samoa's Chief Fisheries Officer Mr Alphonso Phillipp, all was sold via Apia market in a matter of hours and the Fisheries Department now plans to concentrate on the development of village-level mussel-farming activities.

UPDATE REPORT ON THE GREEN MUSSEL CULTURE PROJECT IN WESTERN SAMOA

by
Lui A.J. Bell, E. Jane Albert and Jackie Schuster,
Fisheries Division, Apia, Western Samoa

As of April, 1983, there were three mussel culture sites in Western Samoa, at Apia, Safata, and Asau where mussel spat imported from Tahiti had been grown on attached to ropes suspended from floating rafts, and, at one site, in trays fixed onto racks placed on the seabed.



(Photo: E.J. Albert)

Figure 1: One of the mussel culture rafts, constructed from bamboo and fishing floats, used during this project.

Site 1: Fisheries Harbour, Apia

The mussel rafts anchored behind the Fisheries Centre in Apia were taken out of the water and dismantled on 22 June 1983, since only about 220 mussels remained from the 30,000 spat placed on the rafts in June 1982. In a sample of 175 mussels, the growth rate had averaged only 0.3 cm/month. The wet flesh averaged 27% of the whole unopened mussel by weight, and the shell to wet flesh weight ratio was 2:1. There was little visible sexual differentiation, less than 10% of the sample being recognisable as male or female. Among those which could be distinguished, the female to male ratio was 4:1.

Site 2: Safata Bay

The water temperature is currently 29-30°C in the bay at Safata, with salinity changing according to the tides: on one occasion at low tide in 1m of water, the salinity was measured at 24ppt on the surface and 29ppt on the bottom. Copepods dominated an early June plankton sample.

There are two rafts in the Safata bay in about 2-2.3 metres of water. Approximately 500 mussels remain on raft 1 and 3,000 on raft 2, from the 30,000 spat originally attached. Losses have been attributed to poor attachment and to human intervention. Since the arrival of these mussels from Tahiti in February, 1983, the growth rate has averaged 0.9 cm/month (see Figure 2). Their average length

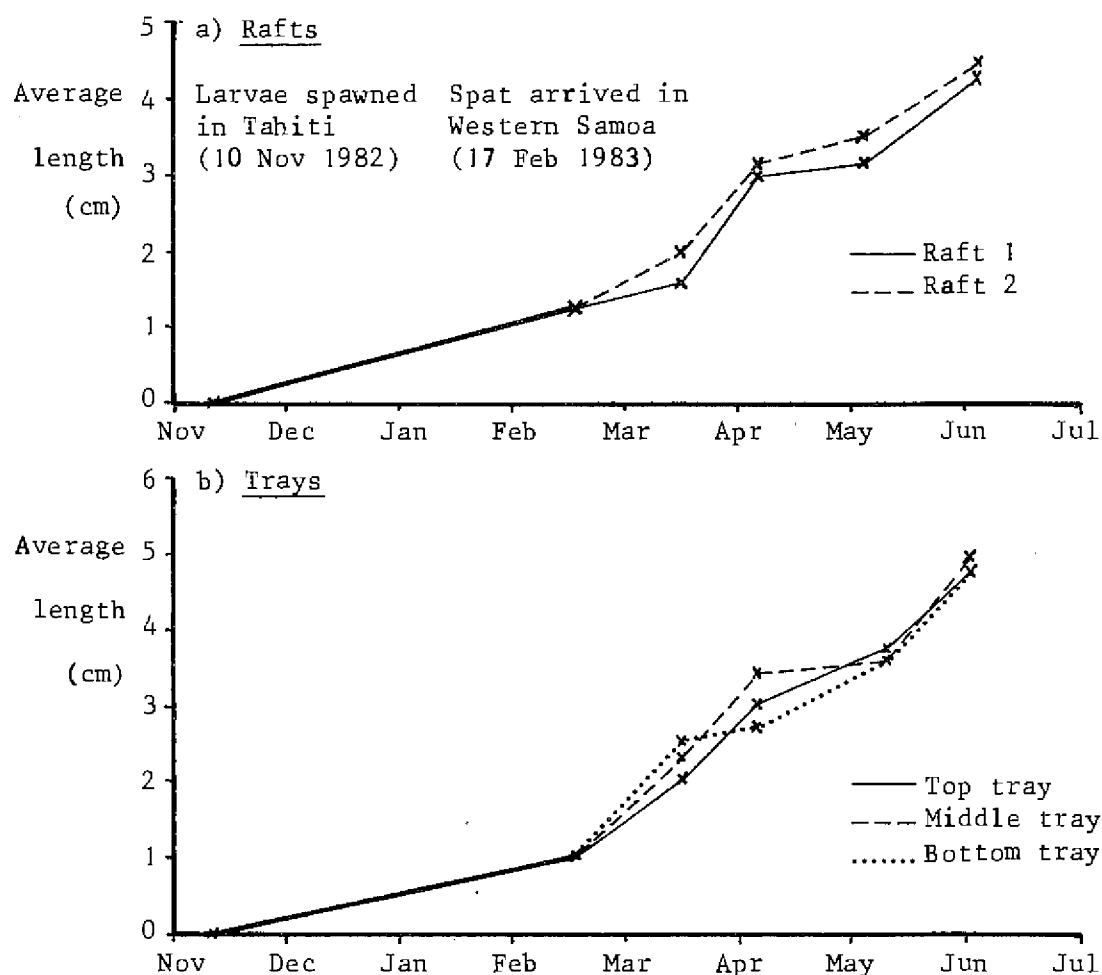


Figure 2: Average mussel (*Perna viridis*) growth rates at Safata, February - June 1983.
a) on rafts, b) in trays.

length in early June was 4.6 cm, and their wet flesh weight averaged 41% of the whole mussel weight. The sexes of these mussels are distinguishable, but the gonads are not yet ripened for spawning.

A further sample of mussels is being cultured in Safata Bay in trays set in 1 metre of water. The average size of the mussels on the three 12 x 1.5m trays is 4.9 cm, which represents a growth of 1.0 cm/month since the spat arrived in February (see Fig. 1). The meat content averages 44% (wet flesh), and again the sexes are distinguishable but not ripe.

Safata Bay shows a good potential for village-based mariculture projects of this type, and it is felt that the tray method is most appropriate for the area, which is very productive but not very deep. However, predatory crabs (*Thalamita* sp. and *Scylla* sp.) and settlement of silt on the trays continue to present problems which can hopefully be dealt with in future tray designs.

Site 3: Asau Bay

The Asau site continues to show outstanding results. Water temperatures have been lower in the past month with a surface reading as low as 26°C recorded in mid-June (surface temperatures had previously been in the 28-31°C range). A dinoflagellate bloom also occurred in mid-June, but no ill effects were observed on fisheries personnel who consumed raw mussels sampled at this time. Other components of the plankton population were diatoms, copepods, barnacle larvae, some unidentified bivalve larvae, crustacean larvae, and fish eggs and larvae.



(Photo: E.J. Albert)

Figure 3: A string of mussels (*Perna viridis*) are hauled up for inspection and measurement.

Of the two culture rafts in Asau Bay, one was originally anchored close to a shipping lane, and was thus moved near to the other raft in early May. The two rafts currently bear an estimated total of 20,000-25,000 mussels, whose average length is 6.9 cm. Growth has been exceptional at 1.4 cm/month, a rate which, although lower than that previously reported (Bell and Albert, 1983), is still higher than those obtained in other Asian and Pacific countries (Davy and Graham, ed., 1982).

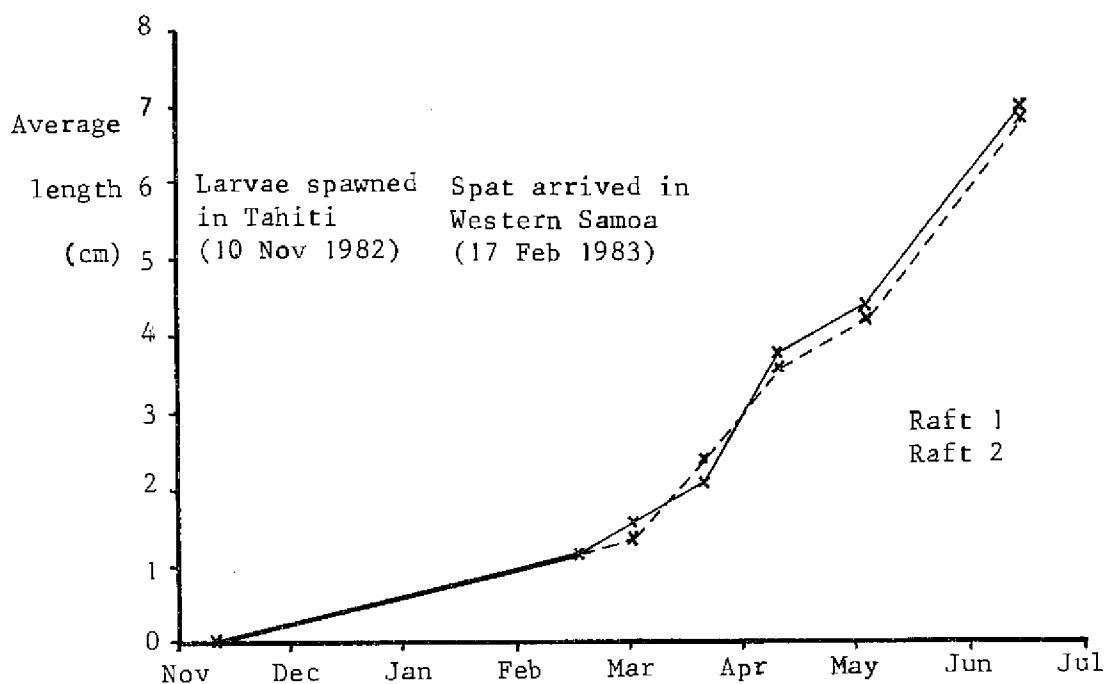


Figure 4: Average mussel (*Perna viridis*) growth rates on rafts at Asau, February-June 1983.

These mussels are now at a marketable size, and show a meat quantity comparable to those obtained in other countries. The wet flesh averages 36% of the whole unopened mussel weight which is slightly lower than values from the Philippines. The average wet flesh weight is 7.9g, and the average unopened mussel weight is 21g or 22 mussels per pound.

The average shell to wet flesh ratio is 1:1 the same ratio as green mussels cultured in India. The cooked flesh averages 20% of the whole mussel weight with a range of from 16% to 28% as compared to the Philippines where the range is from 12% to 33%. (Figures for other countries from Davy and Graham, ed., 1982).

The gonads of the mussels were full and ripe, with contents which flowed when pricked open. Microscopic inspection of the contents showed vigorous sperm and apparently ripe eggs. Some of the mussels in the sample spawned on the trip from Asau to the laboratory in Apia. It is not certain at this point whether they have received sufficient stimulation in Asau Bay to spawn naturally. Spat collector rafts were placed in the bay on the first of July to see if, in fact, any spat can be obtained in this way.



(Photo: E.J. Albert)

Figure 5: A spat collector raft, carrying strings of coconut husks as settlement sites, immediately prior to deployment.

Future plans call for a harvest later in the year for marketability testing. Another importation of mussel spat is also being planned to better establish the mussels in Asau Bay.

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SPC Fisheries Newsletter No. 26 July-September 1983

IMPORT REQUIREMENTS FOR AIR SHIPPING FRESH FISH TO HAWAII

by
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U.S. National Marine Fisheries Service
Honolulu, Hawaii

The principal Federal agencies responsible for regulating the importation of seafood products into Hawaii are the U.S. Customs Service and the U.S. Food and Drug Administration (FDA). All fish products which enter the United States must comply with certain product standards established by the Food, Drug and Cosmetic Act. An article prepared by Mr Jim Brooker of the National Marine Fisheries Service (NMFS) which appeared in the March 1982 issue of the INFOFISH Marketing Digest summarises the major requirements for importing fish into the United States.

The air shipment of all fish to Hawaii from SPC member countries is subject to FDA inspection upon arrival in the United States, as with all imported food substances. In many cases a shipment of fresh fish will be sampled and immediately released to the marketplace while laboratory tests are under way. If the samples are determined to exceed allowable levels of any harmful substance the shipment from which the samples were taken will be detained or recalled from the marketplace.

In the case of fresh bottomfish shipped to Hawaii there have not been any significant quality or safety problems (e.g. ciguatera contamination). However, in the case of mahimahi there has been a serious problem with scombroid poisoning resulting from excessive levels of histamine. As a result, in 1980 the FDA issued an import alert for mahimahi entering the United States. All shipments of fresh mahimahi entering the country are sampled and subject to laboratory testing for histamine. It is the practice of FDA to release shipments of fresh mahimahi as soon as samples have been taken. If a shipment is found to be contaminated outstanding supplies must be returned to the importer and all subsequent shipments from that supplier will be detained pending the completion of laboratory tests. The tolerance level for histamine is 50 mg per 100 grams.

In the extreme case where shipments of mahimahi have consistently exceeded the established tolerance levels all shipments of mahimahi from the country may be refused entry unless accompanied by a certification of acceptability from a laboratory approved by the FDA. Currently, mahimahi from Taiwan (with the exception of two suppliers) and Ecuador are refused entry into the United States. Shipments from all other areas are regularly sampled and released.

Although the State of Hawaii has the authority to regulate the importation of seafood into the State, we are advised that the State's Health Department and Agriculture Department have no additional regulations governing the import of shellfish (i.e. clams, mussels, oysters) and live seafood

products. The State of Hawaii's Department of Land and Natural Resources requires that any person desiring to sell a seafood product in Hawaii must obtain a commercial marine license.

Bulk sale of fish is commonly via the Honolulu Wholesale Auction or a wholesaler. The NMFS Honolulu laboratory has compiled the following price list for the major species sold in Hawaii's fresh fish market, based on the results of a recent survey.

AVERAGE PURCHASE PRICE FOR MAJOR SPECIES IN HAWAII

<u>Species*</u>	<u>Form</u>	<u>Price</u> <u>(\$ per lb.)</u>
Bigeye tuna (<u>Thunnus obesus</u>)	Whole	\$3.68
Bigeye tuna (<u>Thunnus obesus</u>)	Whole/Gutted/Gilled	2.76
Skipjack tuna (<u>Katsuwonus pelamis</u>)	Whole	1.44
Skipjack tuna (<u>Katsuwonus pelamis</u>)	Whole/Gutted/Gilled	1.60
Yellowfin tuna (<u>Thunnus albacares</u>)	Whole	2.69
Yellowfin tuna (<u>Thunnus albacares</u>)	Whole/Gutted/Gilled	1.78
Ehu (<u>Etelis carbunculus</u>)	Whole	3.08
Opakapaka (<u>Pristipomoides</u> spp.)	Whole	3.21
Onaga (<u>Etelis coruscans</u>)	Whole	3.96
Uku (<u>Aprion virescens</u>)	Whole	4.28
Mahimahi (<u>Coryphaena hippurus</u>)	Whole	4.60
Mahimahi (<u>Coryphaena hippurus</u>)	Whole/Gutted/Gilled	3.53
Ono (<u>Acanthocybium solandri</u>)	Whole	2.27
Ono (<u>Acanthocybium solandri</u>)	Whole/Gutted/Gilled	2.65

* All species sold fresh

Results of a survey conducted by the NMFS Honolulu Laboratory of 95 wholesale dealers in the State of Hawaii covering the period of October 1981-May 1982.

METHODS OF STUDYING GROWTH IN HOLOTHURIANS (BECHE-DE-MER), AND PRELIMINARY RESULTS FROM A BECHE-DE-MER TAGGING EXPERIMENT IN NEW CALEDONIA

by

Chantal Conand
ORSTOM, Noumea, New Caledonia

Various species of tropical holothurians (sea cucumbers) have been exploited in the Indo-Pacific region for centuries past. After being cooked and dried, and sometimes smoked also, they are marketed under the name of "Beche-de-mer" or "trepang", and are much appreciated as a food in eastern Asia. However, very little is known about the biology of these species. Few resource assessments have been made and their exploitation is not managed, as is the case for other marine resources, but usually remains at the level of an artisanal fishery. In the western tropical Pacific region there is now a renewed interest in "beche-de-mer" which warrants more advanced study of the biology and abundance of the main commercially valuable species.

Research to this end by ORSTOM in New Caledonia comprises three main projects. These are: a study of the distribution, density and biomass of holothurians in the different habitats of the reef complex; determination of the biometric relations and the reproductive cycles of the eight commercial important species; and an evaluation of the growth pattern of six of these species.

The principal methods that are usually used to study the growth of a marine organism are:

- tagging
- study of individuals in cages or in the aquarium
- observation of the growth of size classes over a period of time
- counting growth rings on pieces of the skeleton.

All these methods are difficult to apply to holothurians and our knowledge of their growth therefore remains somewhat limited.

1. TAGGING

Tagging experiments provide information about growth and migration in respect of the individuals that are recaptured. But recapture rates are also of great interest in estimating a population's numbers and mortality rate.

Different types of tags have been tried, both in the aquarium and in the sea, for the purpose of numbering individuals or identifying a group. The tagging methods used consist of any of the following: securing with glue to the integument, making superficial scratches or scarifications, using vital stains, burning with dry ice (carbon-dioxide snow), or fixing labels by means of a thread through the integument. In most cases external tags have been rejected by the integument or have caused a more or less extensive necrosis. For instance, tagging experiments conducted by Shelley (1981) were unsuccessful and after a month or so it was impossible to find the tagged individuals.

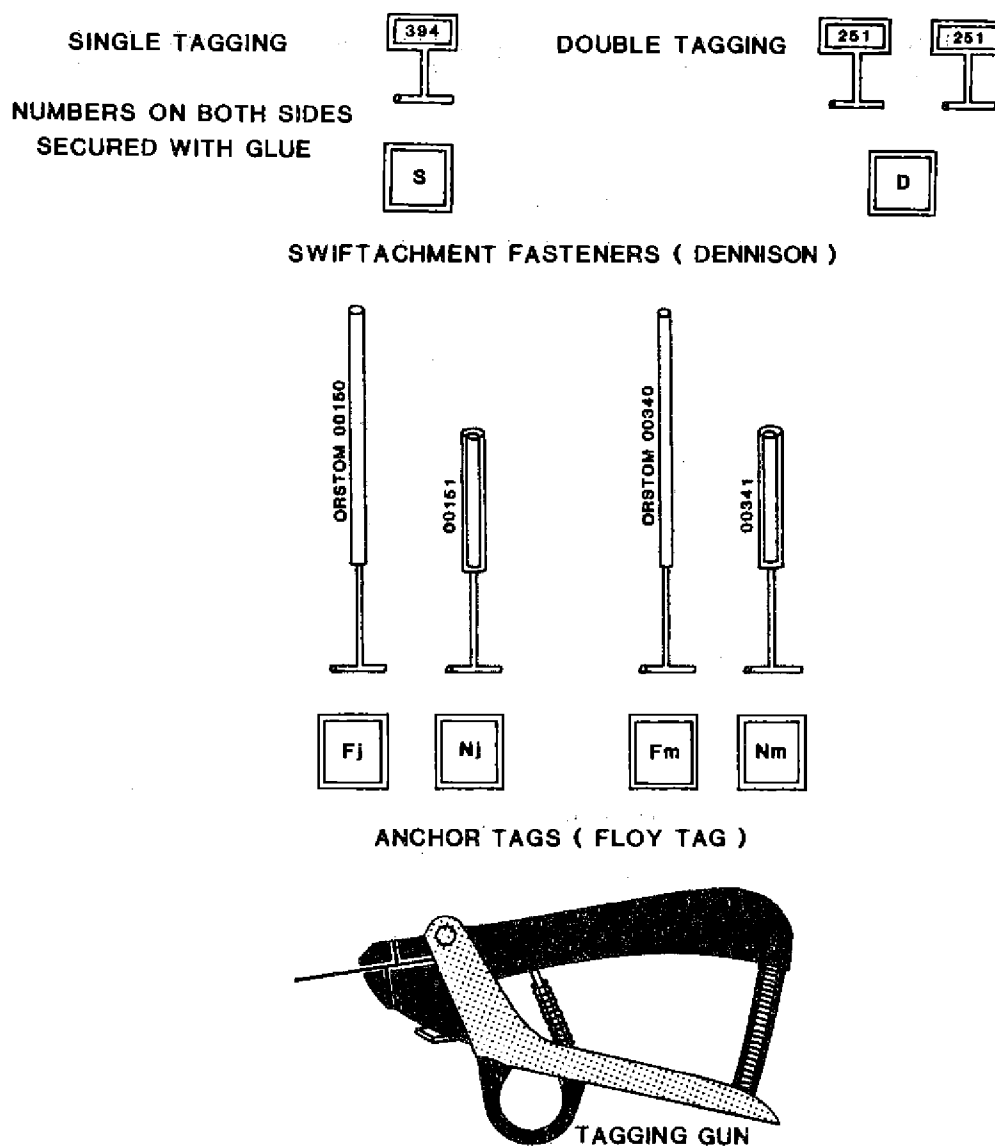


Figure 1: Tagging Equipment.

Another technique (Muscat, personal communication) involves using a tagging gun to attach Swiftachment fasteners similar to those used in the clothing industry (1) on which a small self-adhesive label bearing a number is stuck (2). Single and double tagging has been carried out by ORSTOM using these fasteners and also with Floy Tags (3) of different lengths and colours (yellow and brown) (Fig. 1). Our experiments have been conducted both in the Noumea Aquarium and in the sea.

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- (1) Dennison tagging gun and Swiftachment fasteners (Sofadi, 43 rue de Stalingrad 93106: Montreuil-sous-Bois - France).
 - (2) Self-adhesive numbered labels (Brady, 727 West Glendale Avenue, Milwaukee, WI 53 219, USA).
 - (3) Floy Tag anchor tags FD67 and FD68 (4616 Union Bay Place NE - Seattle - Washington 98105, USA).

1.1 Aquarium tagging

Tagging experiments in the aquarium have been carried out on *Actinopyga echinites* in order to establish to what extent the type of tag used and the size of individual affect tag loss. Figure 2 shows that during the first 18 weeks there was very little loss of Swiftachment fasteners, while 30 per cent of Floy tags were lost. But from that point on, the rate of loss of both kinds of tags increased more quickly, which may be explained by the fact that holothurians do not feed much in aquarium where their natural habitat cannot be accurately recreated. Loss of tags is higher for Floy tags, but loss of the self-adhesive number label on Swiftachment fasteners considerably reduces the efficiency of this method. Nevertheless in the double tagging trials carried out in the aquarium it did produce better results.

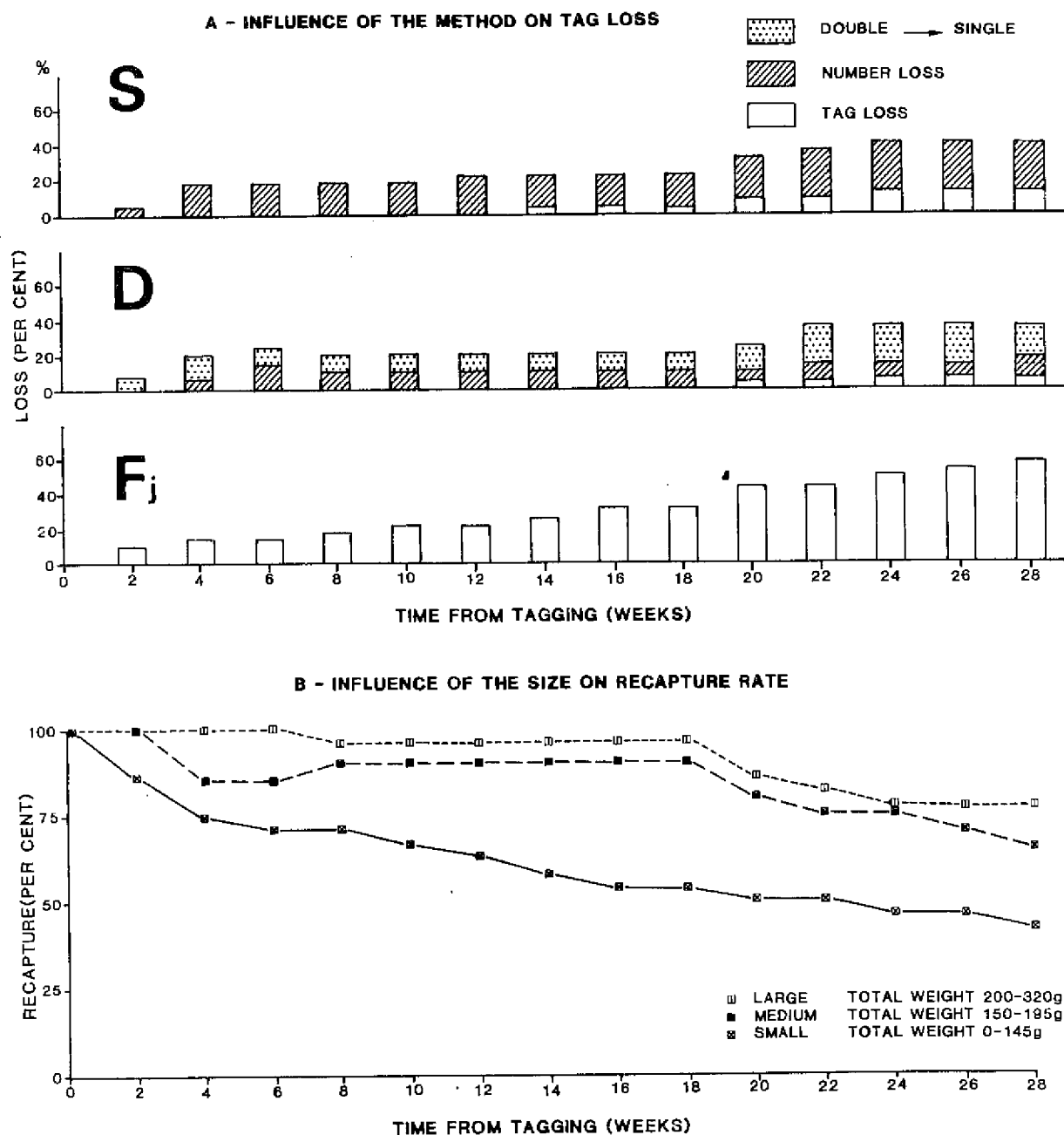


Figure 2: Tagging of *Actinopyga echinites* in aquarium.

- Influence of method used on tag loss
- Influence of individual size on recapture rate

Individuals were divided into three size classes. In the first 18 weeks the recapture rate of tagged individuals was very high for the large and medium size classes, and declined steadily for the small class. After the 18th week this decline slowed down in respect of the small individuals but appeared in the other classes. After 7 months, less than 50 per cent of small individuals still had their tags, whereas more than 70% of the medium and large individuals still had theirs. This experiment shows that one may expect an additional difficulty in tagging young holothurians: not only are the small ones hard to find, as observed by Conand in 1981, but their tolerance of tags is less good.

1.2 Tagging of specimens in the sea

Two thousand five hundred individuals, belonging to 6 species, have been tagged in their natural habitats in the New Caledonian lagoon. Two kinds of operation were carried out, depending on the density of the populations and their distribution in the tagging area, thus:

- on reef flats where a species is abundant, tagging is done at low tide within 100 metre squares marked out by pegs. Recaptures are made every two or three months within the same squares. Tagged individuals are also sought in the area around the squares and when found, are put back inside and untagged individuals found inside the squares are removed. This method has been used for tagging Actinopyga echnites and A. mauritiana;



Figure 3: *Actinopyga echnites*: a double-tagged individual on a reef-flat.

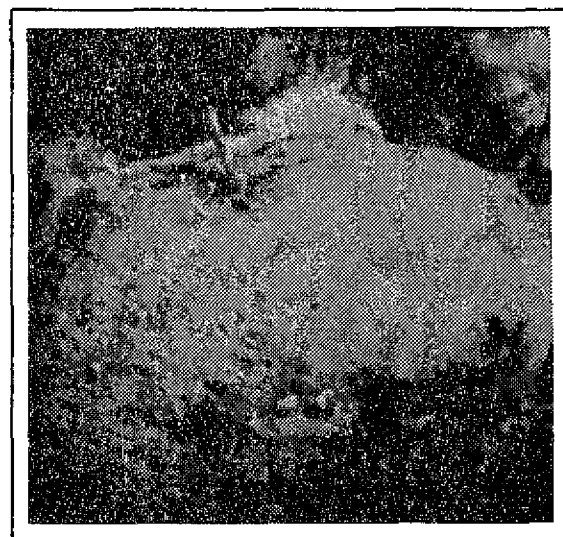


Figure 4: *Holothuria nobilis*: individual carrying a floy tag, among coral heads.

(Photos: ORSTOM)

- on reef flats where the population density is low, and on the reef slopes and the lagoon floor, individuals are collected by people free diving or diving with an aqualung. They are tagged and then put back.

Recaptures are made by divers who collect all the individuals they find of the species concerned, and bring them back to the vessel, where those not already

marked are tagged. This method thus consists of successive tagging in the same area.

Figure 5 shows the recapture rate for different species. During the first five months after tagging, the species Actinopyga echinites and A. mauritiana show the highest recapture rates. No tagged Stichopus variegatus or Holothuria scabra (variety) were recaptured in the reef flat area, although a few tagged specimens were found in the deeper area.

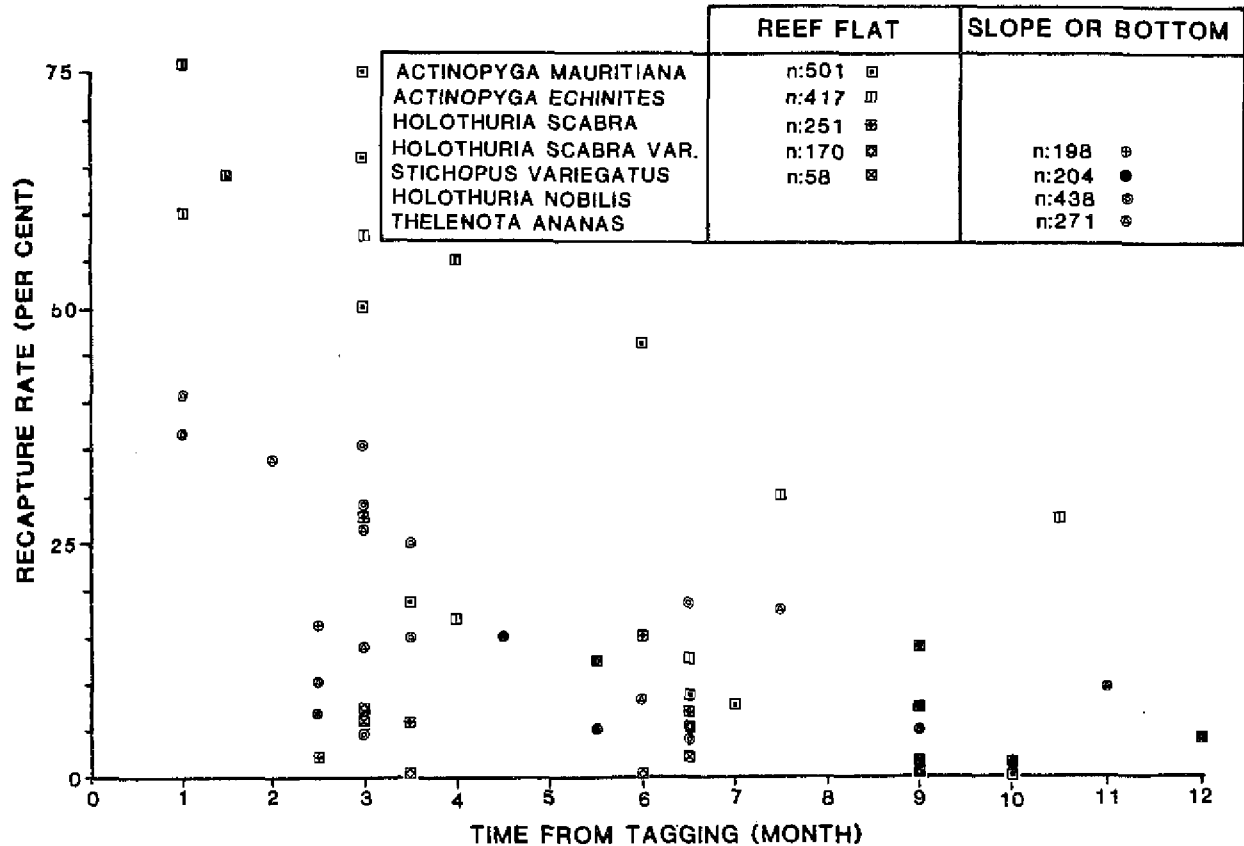


Figure 5: Recapture rates of tagged bêche-de-mer.

By the end of the first year, rates of recapture of tagged individuals were low for all species. However, the additional data that will become available from the experiments currently being carried out should make it possible to draw some conclusions regarding the methods tried, and to set forth findings regarding growth.

2. OBSERVATION OF INDIVIDUALS IN THE AQUARIUM

Growth in juveniles of the species Holothuria floridana (Edwards, 1908) and in young individuals of the species Stichopus japonicus (Choe, 1963) has been studied in aquaria or in enclosures built in the natural habitat. It was noted that large individuals of the latter species cease to feed in the aquarium. A similar phenomenon of weight loss was observed during the experiment on Actinopyga echinites. Figure 6 shows total weight loss in individuals, according to their size and the type of tag used. After seven months, the average weight of small individuals was not more than 58% of their weight at tagging, and 70% for medium and bigger specimens.

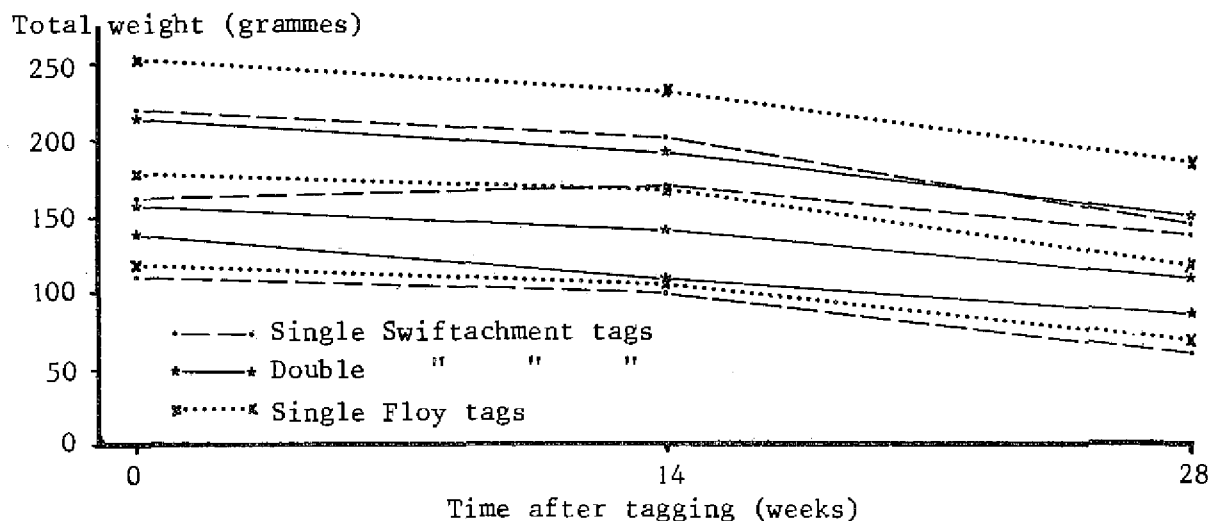


Figure 6: Weight loss in aquarium tagged bêche-de-mer.

3. PROGRESSION OF SIZE MODES

It is difficult to define size classes for a holothurian population, because their soft and contractile bodies contain varying degrees of liquid in the body cavity and of sand in the digestive tract. This variability depends on the phase of activity (i.e. nutrition, movement, or rest) and it gives rise to great inexactitude in measurements of length and total weight. However a study of changes in size, distribution, and the associated progression of the modal, or most popular, size groups, based on monthly samples has produced good results in respect of certain species such as *Stichopus chloronotus* (Franklin, 1980) and *Actinopyga echinites* (Shelley, 1981). These authors were however unable to apply the method to *Holothuria leucospilota* and *H. scabra* because of the lack of clearly defined modes in the size distribution. Fish (1967) takes the lack of any notable change in modal size in the course of the year as evidence of slow growth in *Cucumaria elongata*. He therefore plotted the growth curve for this species from the distribution of weights at a number of stations over a period of several years. Choe (1963) carried out a very detailed study of *Stichopus japonicus*, a species which has been consumed, raw or boiled, in Japan since ancient times. Calculation of its growth parameters is complicated by the fact that individuals' habitats change with age, as the intertidal sea grass flats can accommodate only individuals smaller than 40 g (integument weight). Furthermore, the growth period is only from November to May and in the hot season there is even a "summer dormancy" during which individuals over 2 years of age lose weight.

4. COUNTING GROWTH RINGS

The holothurian's skeleton is very small. It consists of minute calcareous spicules scattered through the integument and the walls of some organs, and a calcareous peripharyngeal ring. This is generally made up of five radial pieces and five inter-radial pieces the size of which is proportional to the size of the individual. Thin sections were cut through these organs in individuals of several different species but no growth rings were observed.

Ebert (1978) marked the species Holothuria atra with tetracycline. He was then able to calculate the growth equation parameters from the presence of fluorescent lines observed in the peripharyngeal rings of recaptured individuals. Harriot (1980) repeated the experiment on the same species and we have performed it on A. echinites but no fluorescence was observed.

5. CONCLUSION

It appears that at the present time we have only partial knowledge, relating to a very small number of species, of growth in holothurians. Each of the methods of study described above has its own particular difficulties which have not yet been completely overcome. These difficulties are:

- absence of growth rings in the peripharyngeal ring,
- lack of clearly defined modes in the size and weight distribution and scarcity of juveniles,
- cessation of growth, or even weight loss, in individuals kept in an aquarium,
- shock and lesions caused by tagging and rejection or loss of external tags.

This latter fact may considerably bias the interpretation of recapture rates for the study of mortality and size of populations.

In addition, there is in every case, the difficulty of measuring size and weight exactly.

Nonetheless, "Floy Tag" external tags and the fasteners used on species in the New Caledonian lagoon have been retained in the integument of some individuals for more than a year after tagging. It should therefore be possible to obtain more data about the growth and the movement of certain holothurian species if this experiment is continued.

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