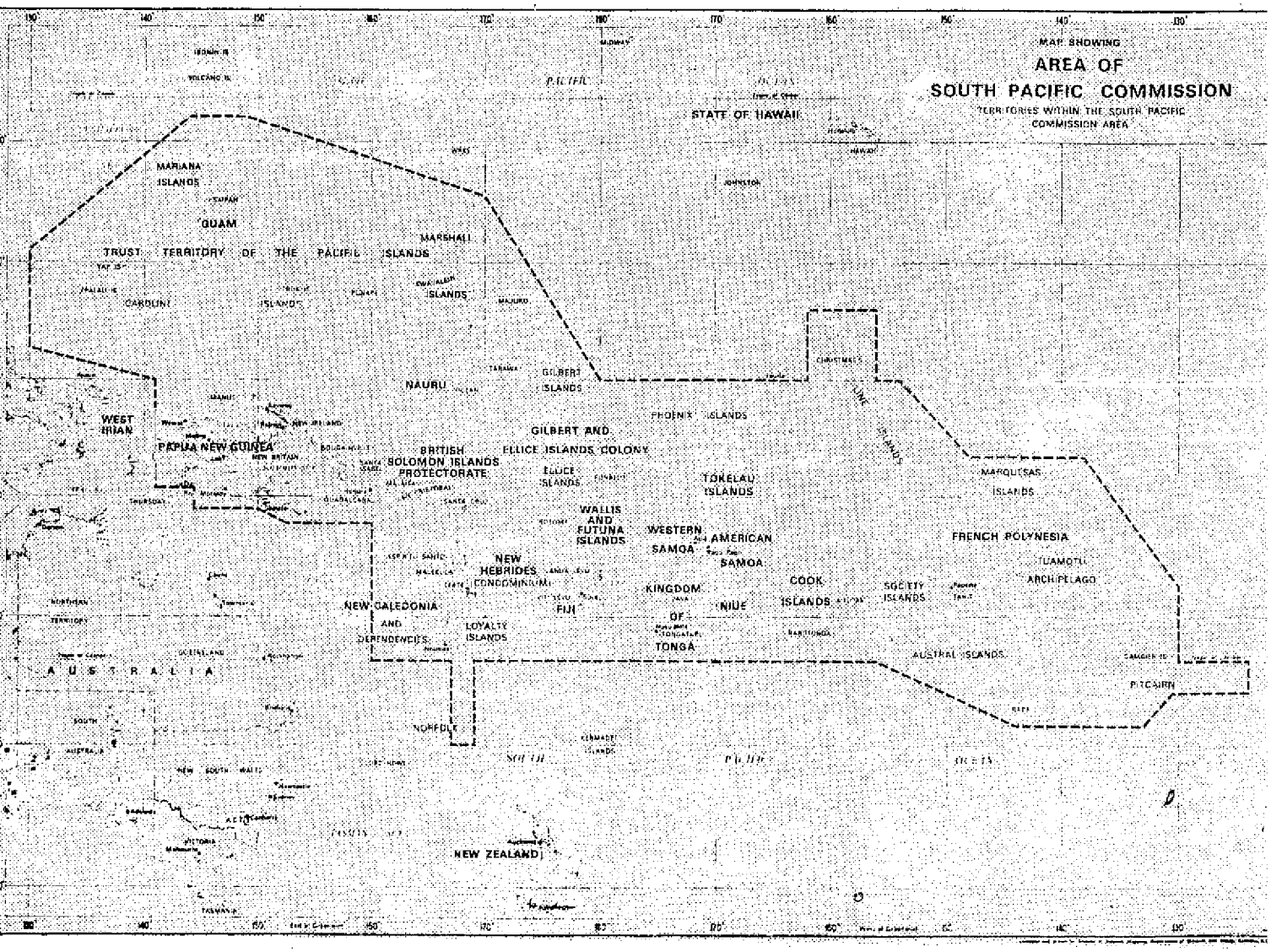
No 12

THE SOUTH PACIFIC COMMISSION

FISHERIES NEWSLETTER



THE SOUTH PACIFIC COMMISSION FISHERIES NEWSLETTER

Editor
R. H. Baird
Fisheries Adviser
South Pacific Commission

No. 13 June 1975

CONTENTS

EDITORIAL

It almost seems to be editorial policy to begin the editorial with an apology. However, we regret and apologize for the delay in the appearance of this Newsletter. Home leave, attendance at meetings, travel and sickness have all contributed to this delay.

In the meantime the International Center for Living Aquatic Resources Management (ICLARM) is now in operation with the appointment of Dr Philip Helfrich as Director (see Newsletter No. 12 editorial) with effect from January 1st. ICLARM headquarters for the moment are P.O. Box 3830, Honolulu, Hawaii 96812. Cables ICLARM, Honolulu, telephone 946-7848, 947-1373. Phil Helfrich has been joined by Steve Ritterbush, who has spent some time in the islands - in Western Samoa as Assistant Fisheries Officer and in American Samoa as Assistant Director of Marine Resources. He has also worked in Indonesia with the Directorate General of Fisheries to work on the FAO Fisheries Development programme. An ICLARM Technical Advisory Committee meeting was held in Honolulu in late February 1975. Following this meeting an outline and an expository statement were prepared which appear on page 9.

Progress on the turtle work in both Fiji and the Cook Islands appears in this issue of the Newsletter. Uday Raj is conducting his research at the University of the South Pacific aided by funds from the South Pacific Commission and Don Brandon is a direct SPC volunteer. It is interesting to note that in both Fiji and the Cook Islands there is an ultimate aim of domestic breeding of two species, Green Turtle (Chelonia mydas) and Hawksbill Turtle (Eretmochelys imbricata).

Simon Bewg, the SPC undergraduate volunteer who was working on live lobster storage problems in the British Solomon Islands returned to his veterinary science studies at Queensland University in February 1975. He has been succeeded by Mr James Prescott and his wife Debbie, who both have considerable experience of marine biology work in the Pacific. Phase II of the lobster project will extend the live storage aspect and also make a start on the natural history and population parameters of local stocks of Panulirus spp.

It is sad to record that Hubert Squires, Peter Holness and John Spottiswoode are all leaving Fiji this month. Hubert is returning to Canada and hence we believe to take up another post with CIDA in Barbados. Peter Holness will almost certainly be returning to take up a post in the Solomon Islands after home leave in the United Kingdom, and John Spottiswoode has returned to New Zealand for the moment. We wish them all very good luck in their future posts and work. Dr Derek Robinson will be in administrative charge of Fisheries for the time being.

The three programmes, which were initially started by the South Pacific Islands Fisheries Development Agency (SPIFDA), are now doing well. The fish ponds at 'Baie de St. Vincent', in which various semi-commercial trials were made with mullets, rabbitfish and shrimps (see Newsletters No. 8 and No. 9), is now run by the 'Association pour le Développement de l'Aquaculture en Nouvelle-Calédonie' (AQUACAL). This association is set up under the French law of 1901 for the purpose of research and development and is a non-profit making body. Administration is by a Council of up to nine members. Mr Michel Autrand, formerly Fisheries Officer for the French Administration in the New Hebrides, is the manager. The complex at 'Baie de St. Vincent' is rapidly expanding. Considerable technical input from the 'Centre National pour l'Exploitation des Océans' (CNEXO) in Tahiti has allowed for establishment of a hatchery facility and considerable extension of tanks for controlled conditions for growth of shrimps. It is hoped that a paper describing the complex will be available for the Eighth Technical Meeting on Fisheries in October 1975.

A paper by Dan Popper, T. Lichatowich, R. T. Pine and N. Gundermann appears on pages 16-19. Dan Popper was originally a member of the SPIFDA team. This very useful work on the control of overcrowding of Tilapia mossambica in ponds by predators has considerable promise for many of the ponds of the Pacific where stunted Tilapia occur due to the high fecundity of T. mossambica and subsequent overcrowding.

Ted Ritchie, also originally a member of SPIFDA, has made great strides with the culture of oysters in Fiji (see Newsletter No. 12). He has now obtained specimens of the Philippines oyster Crassostrea iredelei and the green mussel Mytilus smaragdinus. Both these species have considerable potential for high yields in the tropical Pacific. It does now appear that we must start to think of establishing a mollusc hatchery in the Pacific for production and distribution of mollusc seed.

Also joined UN fisheries staff in the Pacific are Harry Sperling, who has taken over from Erling Oswald as UNDP Fisheries Co-ordinator in the Pacific, Mr Cyril Edwards from Australia who has become FAO Fisheries Adviser in the Cook Islands and Mr Richard Wabbersen, FAO consultant on snapper fishing, who will be in Apia for three months.

Increasing use is being made of PEACESAT for fisheries discussions. Hubert Squires had set up monthly discussions on "Ocean Management" with New Zealand, Fiji, the Cook Islands, the Kingdom of Tonga, Papua New Guinea (Lae and Port Moresby), Saipan, Niue, the Solomon Islands, the Gilbert and Ellice Islands (Tarawa) and the SPC at Noumea participating. On pages 27-29 appears an interesting proposal by Hubert Squires for the formation of an International Commission for Southwest Pacific Fisheries (ICSWEPF). It might well be worth considering whether such a Commission could play a useful role in Fisheries Regulation in the Central and South-west Pacific.

The SPC Expert Committee on Tropical Skipjack will meet in Noumea on 16-17 October 1975 and their report will be available to the Eighth SPC Technical Meeting on Fisheries which follows on 20-24 October. ICLARM is sponsoring a "Small Boat Workshop" which follows the Technical Meeting on Fisheries - 27-28 October. It is hoped that all participants of the Technical Meeting on Fisheries will be able to stay on for the workshop. Such a workshop is of particular importance at the present time as so many island territories are developing village and artisanal fisheries.

The SPC Expert Committee on Tropical Skipjack has also this year a particularly vital role. The Rockefeller Institute has made funds available for employment by the South Pacific Commission of a Pacific Skipjack Stock Assessment Programme Co-ordinator for a preliminary six-month period. It is proposed that the Expert Committee act as a guiding committee for the Skipjack Stock Assessment Programme. Dr Bob Kearney has accepted the post of Programme Co-ordinator and joins SPC staff on 15 September 1975. Bob Kearney is at present on an FAO consultancy on skipjack with FAO in Rome. Prior to his Rome stint he was leader of the skipjack research team in Papua New Guinea and has seen production there grow from zero to 30,000 tons of skipjack per year in a four-year period.

R. H. Baird

TROPICAL PACIFIC SKIPJACK STOCK ASSESSMENT PROGRAMME

by
R. H. Baird

Potential

Skipjack tuna is currently considered to be one of the very few remaining under-exploited fish stocks of the world. "The annual yield of skipjack tuna landed by the several fisheries operating in the Pacific Ocean exceeds 250 thousand tons. Assessment studies indicate that the yield can be increased several fold without damage to the resource base. Such increases could have an ex-vessel value of from 100-500 million dollars Aust. per annum." (1)

The skipjack in its schooling and surface feeding around and among the island groups has long played an important part in the lives of island people in Polynesia and Micronesia, making a very important contribution to the protein requirement of the islanders. It has been much less important historically in Melanesia, although now, paradoxically, the main commercial production in the tropical Pacific is by joint venture companies in Melanesia.

While the skipjack is an oceanic fish the only commercial fisheries in the tropical Pacific are coastal, the fish being caught by trolling, pearl-shell lures or - most effectively - by live bait pole and line fishing while the schools are actively feeding on the surface in coastal waters (the oceanic long-line fleets are fishing for the larger tunas).

Developments

Many countries - Japan, the United States of America, France, New Zealand and Australia - have a growing interest in the exploitation of these large Pacific skipjack stocks. Joint venture companies have already been established in some of the island territories; Palau in the Trust Territories (9,000 tons p.a.), Papua New Guinea (30,000 tons p.a.) and the Solomon Islands (12,000 tons p.a.). French Polynesia has a substantial fishery prosecuted by up to 150/200 h.p. boats producing up to 2,000 tons of skipjack per annum. New Caledonia, under the "MER" Commission Seventh Plan, is considering the possibility of establishing a fishery producing up to 40,000 tons per annum by live bait pole and line fishing and purse seining.

In view of the general support at the "Law of the Sea Conference" by the island territories for the archipelago or envelope principle for fisheries limits, many island territories may, in the future, have sole control over the fishing rights of vast areas of ocean. Should there be a very substantial increase in landings from the non-tropical northern or southern Pacific or in any particular area of the Pacific, it is not possible, at present, to predict what the effect might be on the stocks around the islands in the tropical Pacific nor upon the fishing already established or potentially capable of being established in a particular area.

---

(1) 1974 Report of the SPC Expert Committee on Tropical Skipjack.

Decisions

In order that the countries and territories of the Pacific may be in a position to make the correct decisions on the management of this vast mobile fish resource, it is urgent and essential that a proper understanding be obtained of the movements and population parameters of the stock or stocks. In order to make right decisions it is necessary to know much more about the magnitude of the stock, the range of movements and the growth rate so that agreement can be reached to allow the best possible resource management and maximum yield.

To begin to effect this understanding, the SPC Expert Committee on Tropical Skipjack (see Appendix 1) recommended a combined survey and tagging programme be carried out over a 3-year period. Basically the programme would consist of the charter of a suitable live bait pole and line vessel. This vessel would survey live bait and skipjack resources in the island territories and would tag up to 60,000 fish during this period. At the same time, countries with the resources to do so, e.g. Australia, Japan, New Zealand and the United States would be requested to undertake some tagging in their own coastal waters, if possible. Recaptures of tagged fish will give information on movements and migrations of fish, on growth rates, on total stock and subdivision of stock and an indication of existing fishing pressures on the stock or stocks and upon area of potential development.

The concept of this stock assessment programme has been supported by the Seventh SPC Technical Meeting on Fisheries and by Fisheries scientists from Australia, France, New Zealand, the United States and the United Kingdom. It was endorsed by the Indo-Pacific Fisheries Council representing countries of South-East Asia and Japan, by FAO, UNDP and ICLARM.

It must be emphasised that this programme will not of itself produce more fish for the islands in the immediate future except in so far that it will survey live bait and skipjack resources and demonstrate live bait and skipjack fishing techniques in each territory (local fisheries staff will be invited to participate in cruises in their areas). The survey information will be immediately available to island governments in order to assist them in developing skipjack fisheries. It will also, however, add very considerably to the understanding of a very important common regional resource. This understanding will help to prevent development that could substantially damage the potential yield of this resource in the region.

Management and Funding

The required level of funding - A$300,000 per annum for three years - may seem high, however, it is a very small investment proportional to the potential value of the resource.

The Expert Committee and the Technical Meeting on Fisheries considered that this programme could best be managed by the South Pacific Commission in that the Commission,as an international body representing the interests of all the island peoples, would have the confidence of and responsibility to the governments of all the island countries and territories. The ship would have access to the national waters and support of each territory in the SPC area. It was, however, emphasised that funding

for the programme should be sought from outside the normal contribution to the SPC Budget and that the project should be self-supporting in back up services. It is not envisaged that any of the cost of the project would fall upon the island territories but that funding would be sought from the major metropolitan countries and from interested agencies and institutions (see fund flow diagram Appendix 2).

This proposed programme was approved by the Fourteenth South Pacific Conference. At a Technical Advisory Committee meeting of ICLARM in Honolulu in February 1975, the programme was discussed and supported. The Rockefeller Foundation immediately made funds available for the appointment of a Project Co-ordinator who will be taking up his post for an initial six-month period in September 1975.

The attached appendices give background information on the programme, but detailed costing, contributions and service requirements will be determined by the Programme Co-ordinator. It is proposed that the programme will be run by the Programme Co-ordinator, himself a skipjack specialist. The programme will be guided by the SPC Expert Committee on Tropical Skipjack which consists of specialists of world renown (see Appendix 1).

Appendix 1: List of members of the SPC Expert Committee on Tropical Skipjack.
Appendix 2: Funding diagram showing the proposed funding structure of the programme.
Reference Paper : FAO Commissioned Report on "A Proposal for a Skipjack Survey and Tagging Programme in the Central and Western Equatorial Pacific Ocean", by Dr R. E. Kearney.

Appendix 1

Members of the SPC Expert Committee on Tropical Skipjack - 1975

Dr David Eggleston
Fisheries Research Division
P.O. Box 19062
WELLINGTON
New Zealand.

Dr James Joseph
Director of Investigations
Inter-American Tropical Tuna Commission
c/o Scripps Institution of Oceanography
LA JOLLA, California 92037
United States of America.

Dr R. E. Kearney
FAO Skipjack Tuna Consultant
FAO
Fisheries Division
Via delle Terme di Caracalla
00100 ROME
Italy.

M. R. Grandperrin
Océanologue
Office de Recherche Scientifique et
Technique Outre-Mer (ORSTOM)
B.P. A 5
NOUMEA-CEDEX
Nouvelle-Calédonie.

M. Gérard Loubens
Océanologue
Office de Recherche Scientifique et
Technique Outre-Mer (ORSTOM)
B.P. A 5
NOUMEA-CEDEX
Nouvelle-Calédonie.

Dr Garth Murphy
Senior Principal Research Scientist
Cronulla Fisheries Laboratory
CSIRO
P.O. Box 21
CRONULLA, N.S.W. 2230
Australia.

Mr Richard S. Shomura
Director, Honolulu Laboratory
Southwest Fisheries Center
P.O. Box 3830
HONOLULU
Hawaii 96812, U.S.A.

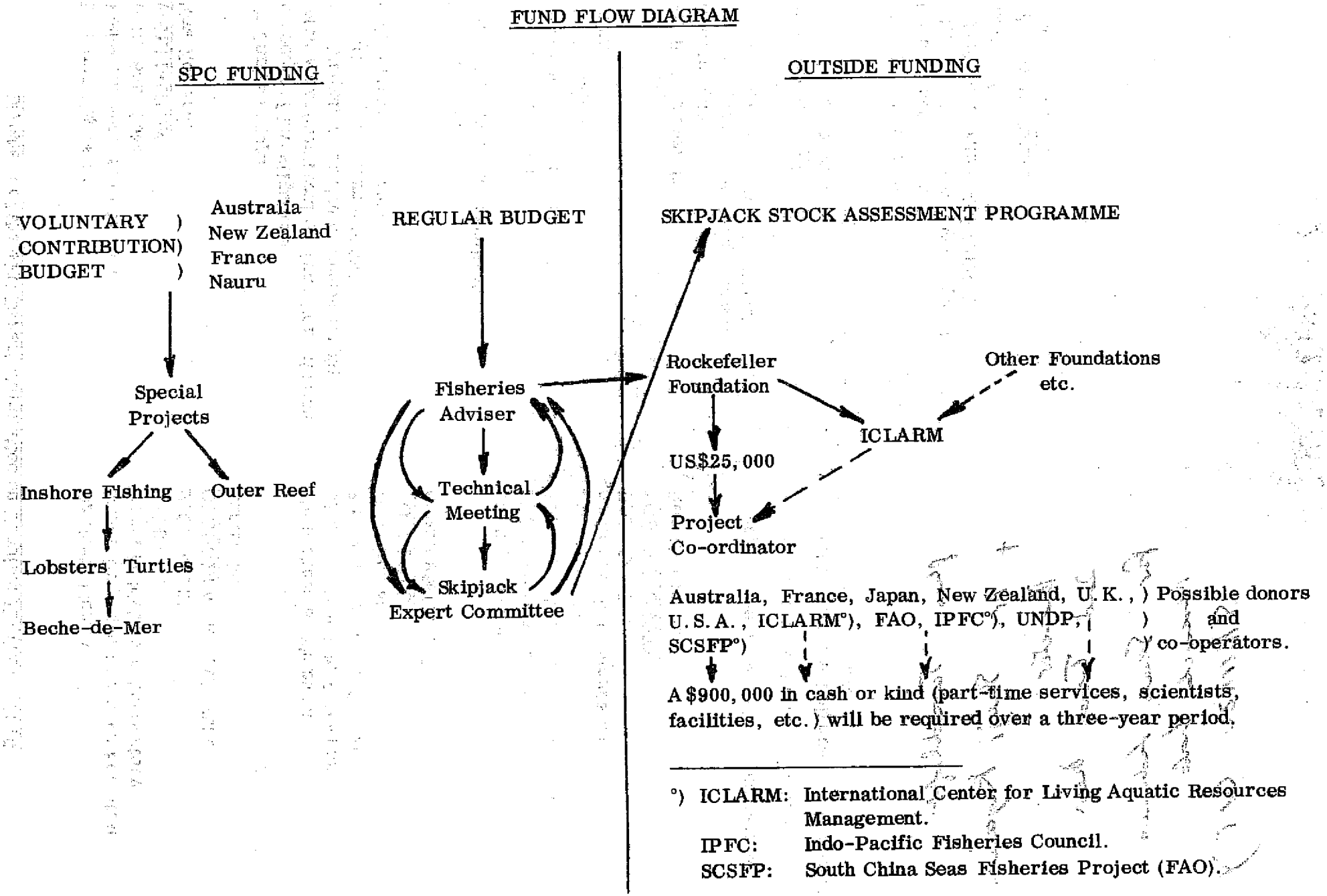
Mr R.H. Baird
SPC Fisheries Adviser,
Technical Secretary to and Convener
of the Expert Committee
South Pacific Commission
P.O. Box D 5
NOUMEA-CEDEX
New Caledonia.

- Japan, one person still to be named.
- FAO, one person still to be named.
- CNEXO, French Polynesia, one person still to be named.

plus - Swerdloff
+ Dr. Shoji Kyawa
Director
2nd Tuna Div
for Seas Fisheries
Research Lab
SHIMIZU CITY

Appendix 2

FUND FLOW DIAGRAM



°) ICLARM: International Center for Living Aquatic Resources Management.
IPFC: Indo-Pacific Fisheries Council.
SCSFP: South China Seas Fisheries Project (FAO).

ICLARM

by

Philip Helfrich
Director
ICLARM

The International Center for Living Aquatic Resources Management (ICLARM) is developing with two major areas of emphasis:

1. Integrated Aquaculture Research and Development Systems and
2. upgrading Artisanal Fisheries.

Within these areas of emphasis, the following coordinated and integrated subsidiary programs are being considered for long-range support:

(a) Socio-cultural and economic implications of fishery development.

(b) Infrastructure development - fish preservation, distribution and marketing.

(c) Resource assessment and management.

(d) Technical information exchange.

(e) Specialized training.

The basis for the ICLARM program as outlined above is its stated goals and objectives as interpreted by the Director aided by counsel from a broadly based advisory group. Suggestions for projects to be supported are welcome, but persons submitting such proposals for consideration should be cognizant of the ICLARM policy to support only those activities that relate to one of our integrated long-range programs. ICLARM is unable to support separate ad hoc requests for funding of services, material or salaries that are unrelated to existing or proposed total, integrated programs.

ICLARM will have a category under specialized training to support fellowship and scholarship programs for qualified and worthy candidates who intend to pursue careers in some aspect of aquatic resource management. In addition to evidence of academic qualifications, candidates will have to present a statement of their career goals and how these goals relate to the future development and management of their own countries' aquatic resources. An additional assurance is needed from the candidate and his employer or sponsoring agency that he will return to work in his country with a reasonable chance that he will be placed in a position to benefit from his acquired education.

SPC INSHORE SPECIAL PROJECT: TURTLES

Introduction

This project is divided into two components - research and development at the University of the South Pacific (USP) in Suva, Fiji. This programme is directed by Dr Uday Raj of the School of Natural Resources.

In the Cook Islands, a village-level farming project is being run by Mr D. Brandon, a New Zealand Volunteer. Close co-operation is maintained between these two developments.

All the turtle hatchlings so far obtained in Fiji are Hawksbill (Eretmochelys imbricata) and all those obtained in the Cook Islands are Green Turtles (Chelonia mydas). Now that each section of the project has several hundred hatchlings, exchanges will be made - Hawksbills from Fiji to the Cook Islands and Greens from the Cook Islands to Fiji so that each may have specimens of each of the two most important species in the Pacific for experimentation (Ed.)

A) Fiji (by Dr U. Raj)

USP-BASED TURTLE RESEARCH: PROGRESS REPORT 1974 - 75 BREEDING SEASON

The research programme at USP commenced on a full scale this season, with the availability of adequate numbers of eggs.

1. Collection and transportation of eggs

Eggs were collected from a total of 8 nests on Makaluva, Nananu-i-Ra and Namara islands (in Astrolobe lagoon), respectively. These islands lie several miles apart. Six nests were immediately transported (via boat and road transport) in sand to the laboratory for incubation. One nest from Nananu-i-Ra was reburied on a nearby Dolphin island beach for incubation in natural conditions. A nest from Makaluva island was reburied higher up on the same beach and shifted to the laboratory 43 days afterwards.

Essentially the aim was to correlate the hatching success with

(a) age of eggs at transportation

(b) distance of transportation via sea and road and

(c) to compare the successful emergence rate in the laboratory with that of a nest set in natural conditions.

2. Incubation and hatching

In the laboratory the eggs were incubated in moist sand contained in plastic containers. There was no temperature control and incubation proceeded in complete absence of sunshine. The temperature of one nest at top, middle and bottom of egg mass was continuously monitored with thermocouples to compare with ambient temperature. The mechanical activity of another nest was continuously monitored with a microphone-amplifier-penrecorder arrangement, the microphone being buried in the middle of the nest.

The hatching success from all nests was higher than recorded in literature (averaging over 90% from laboratory experiments and 80. 6% from single nest incubated in nature). The conclusion can be drawn that provided adequate care is exercised, turtle eggs can be transported over several miles either by land and/or by sea for successful incubation. Also, the eggs can be shifted at any time and artificially incubated to give even a greater emergence rate of hatchlings than in nature. The high emergence rate achieved in this study is a real contribution to turtle biology. Together with data on temperature and mechanical activity of emerging hatchlings it will be presented as a scientific publication in the near future.

3. Observations on hatchlings

All hatchlings belong to a single species, Eretmochelys imbricata (Hawksbill).

(a) Measurements taken at hatching:

(i) Weight

(ii) Carapace length

(iii) Carapace width (maximum)

(iv) Head width and length

Subsequently, weekly measurements of (i) to (iv) are made.

(b) Feeding and maintenance

The hatchlings are maintained in shallow trays in USP aquarium seawater. The hatchlings are fed twice a day on fish flesh cut into small pieces. Usually, there is a continuous flow of fresh seawater through the trays. The trays are cleaned of waste food, at least once a day. Survival is generally very good.

4. Laboratory experiments with hatchlings

At present 500 Hawksbill hatchlings are present in our aquarium.

(a) Dietary trials

Several different foods have been tried as alternatives but clearly the hatchlings prefer animal protein, particularly marine fish and shellfish. The quantitative ingestion rates are being studied.

(b) Ability to retain salts in fresh water

Experiments show that hatchlings will stay in fresh water for at least a week without ill effects. In this time they do not lose significant amounts of sodium ion (major cation in body fluids). The long-term effects of living in fresh water are being studied.

5. Outside laboratory experiments with hatchlings

(a) Experimentation at Dolphin island

30 hatchlings are being reared under village conditions by the caretaker of the island.

(b) Experiments at Ravi Ravi Aquaculture Station

100 hatchlings are being reared in artificial aquaculture ponds at Ravi Ravi. Mrs Popper, a Biologist, is assisting in the project. Besides growth rate experiments it is hoped to attempt conditioning the turtles to gather them for feeding.

(c) Fulaga island

Dr Steve Nielson, a marine biologist, is based at Fulaga island to carry out some rearing experiments at village level. His results will be available within the next few weeks when he returns to Suva.

6. Adults and sub-adults

Feeding and growth rate observations are being made on a few Hawksbill and Green Turtles. Tethering experiments to assess the weed consumption rate in Green Turtles are being carried out.

FUTURE PROGRAMME

1. Continue with rearing hatchlings from eggs in the laboratory for release and small-scale farms.

2. Effective tagging of the hatchlings.

3. Experiment with "weaning" diets.

4. Exchange Hawksbill for Green Turtle hatchlings from the Cook Islands. This season a more intensive search will be made for Green Turtle nests.

5. Commence formulating ideas for mating and getting females to lay eggs in captivity - a true farming. In this regard a natural salt-water lake in Lau Group will be investigated as a possible site for the experimentation.

6. Government help will be increasingly needed to interest village people to conserve and carefully utilize the turtle resource. A turtle resource manual is being prepared to communicate with village people through fisheries extension field officers.

7. If rearing experiments at Ravi Ravi are successful, there could be possible extension of the programme to increase the productivity of the ponds.

The future and the success of the turtle programme will entirely depend on continued financial support and on full backing of the government, particularly the Fisheries Department, to educate and interest the village people to participate in it. It is most encouraging to observe an enormous interest in turtles amongst the Fijian people.

B) Cook Islands (by D. Brandon)

The Project Officer has been in post since August 1974. He visited Fiji en route to Rarotonga where Dr Uday Raj was setting up experiments on food requirements of turtles at the University of the South Pacific (see section A on Fiji). Upon arrival at the Cook Islands the Project Officer conducted surveys of nesting beaches on the outer islands and made provision for collection of turtle hatchlings during the nesting season - November to March. All turtles found nesting in the Cook Islands so far have been Green Turtles (Chelonia mydas). In the meantime shallow metal trays were constructed to receive the hatchling turtles and were set up at the Fisheries Station.

More extensive facilities have just been completed at Muri lagoon (about four miles from the Fisheries Station) where the turtles are held in two large concrete tanks and 12 aluminium trays. Sea water is pumped from the lagoon into large reservoir tanks which already existed on the site. There is a continuous flow of water through the tanks and trays. 250 sixteen-week old hatchlings are now being held at Muri and fed on fish (which is difficult to obtain on Rarotonga), coconut and on other diets as available. The holding tanks at the Fisheries Station had become overcrowded as the turtles grew and a fairly high mortality resulted. The move to Muri with more space has reduced the mortality to negligible proportions.

The Cook Islands Government has recently given approval for establishing the major part of the project on Aitutaki, 120 miles from Rarotonga. The delay was a result of some contention over the effects of the project on the proposed tourist industry planned for this island as well as some concern over the ecological consequences that the farm may cause. The farm could eventually be a major tourist attraction and a very careful monitoring of ecological changes will be maintained. It is now necessary to wait until negotiations with the land owners have been completed before construction can begin. However, a certain amount of the building can be prefabricated in Rarotonga to be ready to begin assembly as soon as the land negotiations are completed.

There are about 500 hatchlings on Palmerston Island ready to be brought down to Rarotonga (or to be shipped direct to Aitutaki) so that there will be sufficient numbers of turtles for the initial experiments to be carried out. When these hatchlings are picked up attempts will be made to transfer one nest of eggs to the Muri site in polystyrene containers where they will remain until the turtles hatch out. If this experiment is successful, then future collection of hatchlings from distant islands will not prove to be so difficult and cumbersome.

The future of turtle farming, here in the Cook Islands, seems to be very good from information regarding the number of turtles that came to nest this season. However, it is essential that the project continues along the lines of a small-scale, village-level cottage industry until further information on the extent of the resource can be compiled. In this respect it is planned to make a brief survey of the numbers of adults arriving during the next nesting season, in conjunction with a limited tagging programme. Data recording sheets will be given to the fisheries representatives on the major nesting islands.

The main objective of this project is to find a method of holding and growing the turtles which is both cheap in capital outlay and in operation costs and also successful in withstanding extreme weather conditions (cyclones, tidal waves etc.). These two aims may seem incompatible as the cost of building intertidal structures able to withstand tropical storm conditions could be very high. It is proposed to consider the possibility of conditioning the very young hatchlings to be "called" for at feeding time by some simple sonic method. If this type of experiment proves possible with turtles, and there is already some evidence of conditioning in captive turtles, then one can see a major break-through in the whole concept of turtle rearing. The turtles would be free to range. There is some evidence that they would remain in the vicinity of their point of liberation and would be concentrated at feeding time. The area chosen in Aitutaki for the turtle complex is at O'otu where a channel approximately 500 metres long, 50 metres wide and about 1-2 metres deep at low water is formed between the main island and the island of Akitua. This channel has several sandy beaches. A proportion of the turtles would be allowed to grow on to maturity in the hope that mating and nesting might occur.

In the meantime a method for enclosing the turtles using cheap local materials will be sought. These enclosures will eventually not be necessary if the conditioning experiment's results are positive.

SPC SPECIAL PROJECT ON FISH POISONING

PROGRESS

by

Dr A. Bourre
Medical Officer
South Pacific Commission

During the period 1 September 1974 to 31 January 1975, the Louis Malardé Medical Research Institute (Dr Laigret) concentrated its biochemical work on investigation of the fat-soluble toxins from Scarus gibbus (a parrot fish).

The results confirmed that, as had been previously demonstrated, the fish contains two fat-soluble fractions which are quite dissimilar as far as their effect on mice and their behaviour on silicagel H plate are concerned.

It is interesting to note that those results also confirm a number of clinical observations made on patients poisoned as a result of eating Scarus gibbus in the Gambier Islands. Two phases were noted in the development of the syndrome: an early phase similar to that observed in normal Ciguatera poisoning and a second phase, which is observed much later, with nerve and cerebellum involvement.

At the University of Hawaii (Principal Investigator: Professor Banner), Dr Yoshisugi Hokama working with the group studying Ciguatera has been successful in producing an antibody to ciguatoxin. Ciguatoxin extracted from moray eels (Gymnothorax javanicus), from Johnston Atoll, was conjugated to blood serum protein and injected into laboratory rabbits. These rabbits then produced a series of antibodies one of which has now been shown to be a specific antibody to ciguatoxin itself. They are now in the process of developing a test with this antibody for the testing of fish on a commercial scale. The test will use either immunofluorescent assay or radioimmunoassay.

At the University of Tokyo (Principal Investigator: Professor Hashimoto), the following research work was carried out from January 31 to April 30, 1975:

- Study of the purification of fat-soluble toxins of a parrot fish Scarus gibbus from the Gambier Islands.
- Study of the toxicity of Ctenochaetus striatus from the Marshall Islands.
- Study of the occurrence of toxic shellfish associated with the bloom of a toxic dinoflagellate Conyaula catenella.
- Study of the Ichthyotoxicity of the green alga Chaetomorpha minima.

PRELIMINARY EXPERIMENTS IN MIXED CULTURE OF MILKFISH, TILAPIA AND CARNIVOROUS FISH

by

D. Popper °)
T. Lichatowich
R. T. Pine °°)
N. Gundermann

Summary

One pond of five acres was stocked with 2,000 Tilapia mossambica (Peters) and 3,500 Chanos chanos (Forskal). Only organic fertilizers were applied. During the first month 150 Elops hawaiensis and 50 Megalops cyprinoides were introduced. After 165 days 880 kg of marketable fish were harvested.

Introduction

Tilapia mossambica is a species native to Africa that was imported to Malaya in 1960 and was later spread over the Pacific islands. Being an extremely hardy fish it became established in many places and produced populations which are practically impossible to eradicate. The species is considered a pest in milkfish (Chanos chanos) ponds in Southeast Asia because of two main reasons: 1. its prolific breeding habits cause overcrowding and stunting and 2. as part of the breeding behaviour, males dig holes that destroy algal pastures of high nutritional value to the milkfish.

Preliminary experiments in Ravi Ravi had shown that T. mossambica has a moderate potential of growth in sea-water under controlled densities and that densities can be regulated by allowing predators (Elops hawaiensis Regan) into the pond.

Milkfish (Chanos chanos) is a hardy fast-growing herbivorous fish that is traditionally cultured in fish-ponds in Southeast Asia. Fry are obtained in large numbers from coastal waters. Substantial stocks of fry were found in Fiji. Preliminary experiments suggested that it may grow together with T. mossambica.

The experiment described here was conducted in view of these preliminary indications.

Methods

The experiment was conducted in Ravi Ravi on the north western coast of Viti-Levu. The five-acre pond used for the experiment is one of eight ponds constructed of soil in a reclaimed mangrove marsh. The construction of the pond in the initially acid soil was completed in January 1974. During the first six months of 1974 the pond was continually flushed, coral sand (5 tons) and lime (500 kg) were applied to reduce acidity. The pond was then stocked for an initial period of five months in which it was flushed every two weeks because of low pH readings. After harvesting the pond was prepared for the experiment by exposing it to sun over one month, eradicating the fish present in the ditch and filling it with sea-water.

°) FAO/UNDP Consultant to the project

°°) U. S. Peace Corps Volunteer attached to the project

The pond was filled by tidal action through a concrete inlet sluice and drained through a similar outlet structure at the opposite end. Both inlet and outlet were screened with 1 cm wire mesh to eliminate large intruders and loss of fish. During the experiment the pond was flushed monthly to get rid of acid water and waste materials. The pond was initially fertilized with 900 kg of brewery waste°) and 80 kg of chicken manure and periodically (about twice monthly) with 350 kg brewery waste and 80 kg chicken manure. The total amount of fertilizer added was 3,500 kg brewery waste, 480 kg chicken manure and 5,000 kg mill mud°) that was applied in four portions during the last three months of the experiment.

The pond was stocked with 3,500 milkfish fingerlings of 10 g over a period of five days (10-15 November 1974) and with 2,000 tilapia on 10 November. The tilapia females ranged from 36 to 56 g (average 45 g) and males from 60 to 120 g (average 85 g). During the first month 200 predators were introduced into the pond. These consisted of 150 Elops hawaiensis and 50 Megalops cyprinoides (Broussonet) of 10-22 cm (20-50 g). The fish were cropped over a 5-day period starting on 28 April after 160 days of growth.

During the growth period the following physical parameters were recorded: maximum and minimum temperatures (daily), salinity and pH (twice weekly). Salinity was determined through the use of a refractometer and pH using pH paper occasionally calibrated against an electrical pH meter. Plankton tows across the pond were made twice a week. The net used was of 41 cm in diameter and 80 µ mesh size. The pH of the pond bottom soil was taken twice, once before filling and once after draining the pond, using a BDH soil testing outfit.

Fish samples were taken occasionally in an effort to try to follow growth. Stomach contents of fish were checked on one occasion and some food items identified. Observations were made daily for the appearance of tilapia fry and on the behaviour of fish when possible.

Results

Water temperature of the pond fluctuated between 27° to 35° C with extremes reaching 25° and 37° C. Values of pH varied between 6.5 and 8.2 with lower readings prevailing during the first two months. This is explained by the improvement of soil pH during the experiment which was expressed also in the pH readings of the soil, 5.5 before filling the pond and 6.5 after draining. Salinities ranged from 24 to 35 parts per thousand depending mainly on the amounts of rain. No extremely high salinities were experienced as the experiment took place during the wet season.

Plankton organisms included mainly spionid polychaetes and copepods with occasional blooms of the rotifer Brachionus plicatilis. Total volume of plankton per tow ranged between 2 and 10 cc; the number of organisms per litre was between 1 and 30 and the number of copepods was about 2 per litre.

°) Brewery waste and mill mud are waste products of beer and sugar industries.

Observations on the behaviour of the fish in the pond suggested that milkfish fed largely on planktonic organisms. The fish were seen in dense schools feeding at the water surface. This is also supported by the fact that the fish continued to grow in periods when practically no benthic algae was present in the pond (after the first week of the experiment). Stomachs of milkfish and tilapia mostly contained very minute particles that were impossible to identify. However, some remains of copepods and splonids were positively identified along with parts of mangrove roots in both species. A lorica of Brachionus plicatilis was found in a gut of a milkfish.

Growth rates of tilapia and milkfish (Fig. 1) differed substantially: tilapia (males and females) grew through the entire period of the experiment while milkfish stopped growing after three months.

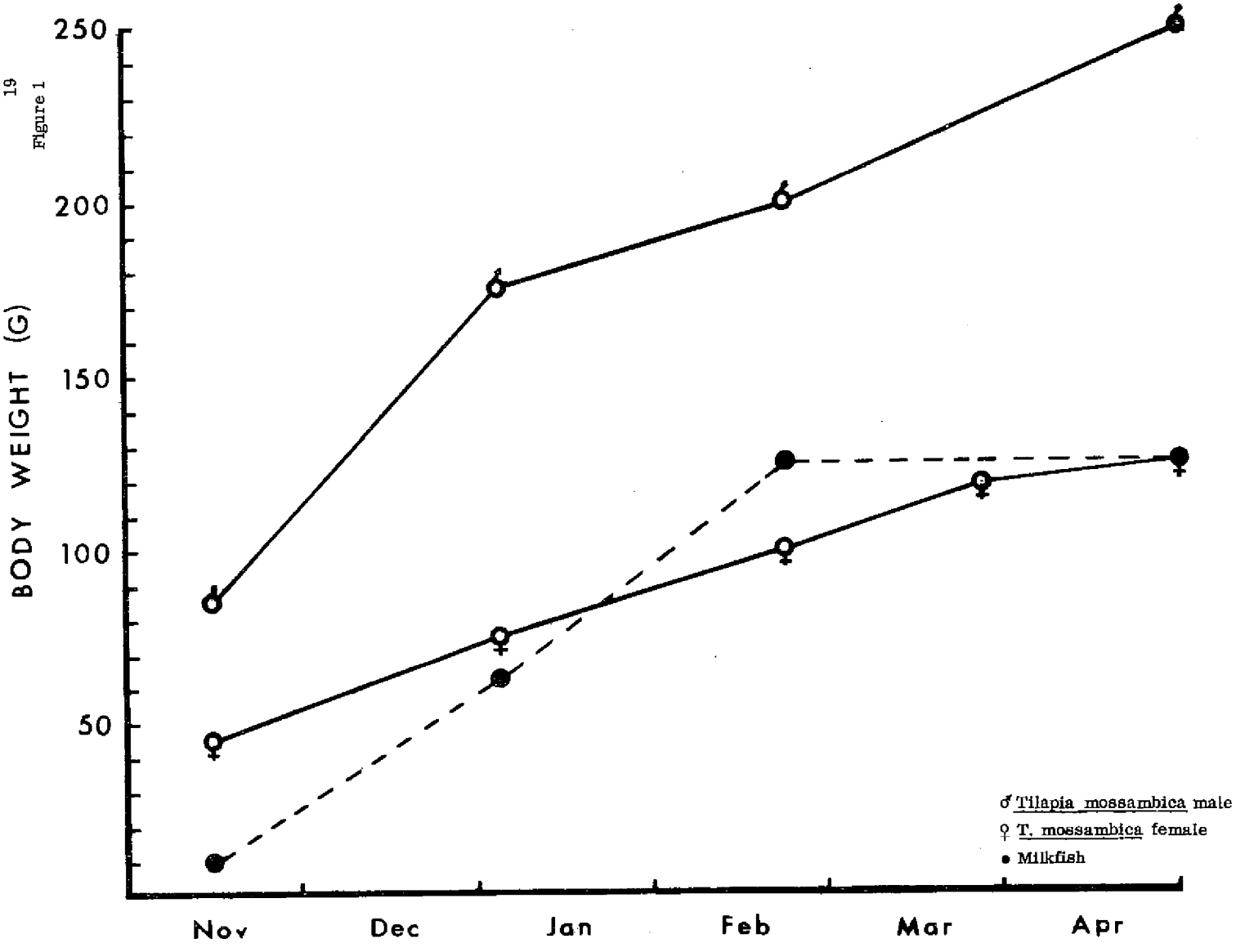
Many thousands of newly hatched tilapia fry were seen around the edges of the pond during December 1974. Very few were seen later. Some Elops guts included fry of tilapia of 2-3 cm. No overcrowding with tilapia occurred.

The final crop totalled 880 kg and consisted of the following:

1. 440 kg of tilapia which consisted of 1260 males of 200-330 g (average 244 g) and 760 females of 100-160 g (average 125 g).
2. 395 kg milkfish of 100-160 g (average 125 g).
3. 15 kg predators of 10-30 cm.
4. 15 kg Kaikai (Leiognathus sp.) of some 50 g.
5. 15 kg "trash fish", i.e. small tilapia and other small fish, mainly gobies.

All the fish, including predators and trash fish, were sold almost immediately.

Figure 1


250
200
150
100
50
BODY WEIGHT (G)
Nov
Dec
Jan
Feb
Mar
Apr
♂ Tilapia mossambica male
♀ T. mossambica female
• Milkfish

FINAL REPORT OF THE "M E R" COMMISSION

SEVENTH PLAN (1976-1980)

by

J. Sauvée
Administrateur Principal
des Affaires Maritimes
Noumea, New Caledonia

1. Introduction

No real inshore or open-water fisheries policy has been laid down for the Sixth Plan. Nevertheless, the rational management of marine resources is a matter of world-wide concern.

Her geographical situation being what it is, and surrounded as she is by a lagoon, New Caledonia cannot be unaware of her potential in this respect. Further, a "fisheries industry" should be one of the determining factors in diversifying New Caledonia's economic activities.

Before the end of the Sixth Plan, open-water tuna fishing and aquaculture will have their place in the Territory's economic activities. For the first, 25 to 30 long-line boats (production 5,000 metric tons in 1975) will be operating from Noumea; as for the second, experiments, particularly with shrimp, should gradually lead to production on a semi-industrial scale.

2. The alternatives selected

The factors conducive to the rational exploitation of marine resources in New Caledonia, or through operations based in this Territory, may be summed up as follows:-

(1) New Caledonia is situated in the centre of a zone covering the part of the Pacific between New Guinea in the North, New Zealand in the South, Australia to the West and the international date-line to the East. Tuna stocks within this perimeter are as yet under-exploited;

(2) the selling price of tuna is rising, and there is an ever increasing demand for this fish throughout the world;

(3) the broad expanse of the New Caledonian lagoon contains an unexploited stock of small fish species that can be used for live-bait tuna fishery; and

(4) the hydrological, thermal and biological quality of the lagoon waters is such that all the basic requirements are present for diversified aquaculture activities.

However, certain unfavourable aspects are to be taken into account: high-cost labour with no fishing tradition, remoteness of major processing and marketing centres, lack of basic information on lagoon fauna, and the fact that sites suitable for aquaculture are often private property.

With these factors in mind, one may decide on two main objectives for the Seventh Plan:-

(1) developing a tuna fishing industry; and

(2) carrying out aquaculture on a semi-industrial scale.

Objective 1 - Tuna fishing industry

In setting up a tuna fishing industry, one should take into account:-

markets;

catch levels of the various species; and

fishing techniques used.

Although at present there are no EEC quotas nor taxes on raw frozen tuna produced by non-member countries, New Caledonian fishing bases should still seek markets in countries bordering the Pacific, particularly Japan and the U. S. A. The catch levels of the various species will necessarily determine the extent of the base's cold-storage facilities, as well as the possibilities of setting up a processing industry (canning factory, by-products processing, etc.).

At present, only traditional Pacific techniques (long-line) can be relied on to operate a commercial fishing base. However, one may justifiably expect better results from the development of purse seining and live-bait techniques.

On the basis of experiments carried out using these two techniques, one may establish minimum and maximum objectives.

1 - Minimum prospects for 1980

Long-line fishery

Number of ships = 140 to 160 : annual production = 30, 000 tons. (1)

Live-bait fishery

Live-bait stocks not exploitable - skipjack stock not exploitable : production = nil.

Purse seining

Technique cannot be developed owing to lack of thermocline : production = nil.
Number of bases = 2 - cold-storage capacity = 20, 000 m^3 in all.

---

(1) All tons mentioned in this paper are metric tons.

2 - Maximum prospects for 1980

Long-line fishery

Number of ships = 140 to 160 : annual production = 30,000 tons.

Live-bait fishery - (French ships exclusively)

Number of ships = 7 to 10 : annual production = 5 to 7,000 tons.

Purse seining - (preferably with French ships)

Number of ships = 10 : annual production = 30 to 40,000 tons.
Number of bases = 2 - cold-storage capacity = 30,000 m^3.

Cannery with a processing capacity of 15,000 tons/year.

In 1980, the minimum port facilities should consist of 240 m of wharf for ships with a draught of 6 metres, a hauling-slip of 80 metres, or a floating dock of equivalent capacity.

Objective 2 - Aquaculture

Aquaculture consists of applying knowledge of techniques involved in the art of rearing aquatic animals and plants.

In 1971, following recommendations made by FAO experts, the Territory initiated, in co-operation with the South Pacific Islands Fisheries Development Agency, aquaculture experiments involving mainly sea shrimps and herbivorous fish.

Initial results would indicate that there is vast potential for developing shrimp-farming in New Caledonia.

Before production on a semi-industrial scale can be contemplated three important problems, concerning aquaculture in general, must be solved:-

(1) the production of juveniles and the successful development of post-larval rearing techniques;

(2) developing foods for maintenance; and

(3) finding suitable sites.

1 - The production of juveniles and development of post-larval farming techniques

The Pacific Centre for Ocean Development (CNEXO), using specimens caught in New Caledonia, has now solved all the technical problems involved in the reproduction and rearing of "merguiensis" shrimps (banana prawn), and is in a position to gradually supply juveniles to a Caledonian farm. Post-larval stages, however, are to be reared in New Caledonia itself, so as to obviate the hazards of air transport.

In respect of other shellfish (lobsters), molluscs (oysters) and fish, reproduction problems have not been studied. Tests on painted lobsters and local species of oysters should be carried out throughout the period of the Seventh Plan.

2 - Developing foods for maintenance

Although the problem of feeding the farmed shrimp should be considered technically speaking as settled, the very high cost of manufacturing the food is a serious obstacle to the development of shrimp-farming.

The only way to reduce the cost and render such a "culture" economically viable is to use animal and vegetable by-products in a rational manner, unless shrimping no longer meets the growing world demand, which would bring about an increase in the selling price.

In any case, such a problem does not seem likely to arise where painted lobster and oyster-farming are concerned, as lobsters thrive on natural food, while oysters find enough food for maintenance in sea-water.

3 - Finding suitable sites

There are many sites along the coast of the mainland which are suitable for aquaculture development. These should be surveyed and officially set apart for specified activities.

OBJECTIVE

Shrimp-farming

During an initial phase, shrimp-farming should be geared to the needs of local consumption, feelers being put out to assess possibilities in outside markets.

The 1980 programme cannot involve more than 100 tons.

Oyster-farming

The scope of New Caledonian oyster-farming has to be limited to the local market. Three or four well managed farms should be able to ensure a production of 200 to 250 tons in 1980.

Lobster-farming

Studies and experimental breeding operations should be carried out so that, before the end of the Seventh Plan, the possibilities of economic lobster production are well known.

ARTISANAL FISHERY

I - General

Artisanal fishing is carried out in lagoon waters by a fleet of about 130 boats. Of these, only about forty operate on a truly professional scale.

Most of these ships are fairly old (average 10 years); only a few of them were built less than two years ago.

This activity is not always carried out along well-organized lines, and the market for fish is hard hit by competition from pleasure boats.

II - Marketing

Marketing is largely carried out by co-operatives such as the:-

(1) Groupement d'intérêt économique; and the

(2) Coopérative des pêcheurs.

But some fishermen have stalls in the Noumea market and carry out their own selling operations.

Finally, certain dealers sell fish supplied by pedlars who buy it outside Noumea.

III - Prospects

There does not seem to be any likelihood that artisanal fishery will develop in the years to come. It will probably remain very artisanal and independent in character.

However, it is desirable that the professional fleet be renovated during the period of the Seventh Plan.

In order to encourage this, there should be a fisheries incentive scheme, providing for subsidies of the order of 50%, with the proviso that a type of boat suited to local fishing conditions be determined.

At the same time, it is desirable to limit the number of professional fishermen, as well as the fishing effort of owners of pleasure boats.

FISH PRODUCT DEVELOPMENT

The following article is from a pamphlet produced by the Tropical Products Institute (Fish and Meat Section), 56-62 Gray's Inn Road, LONDON WC1. We hope that TPI scientists may be able to try some of these simple processes of fish preservation and utilization in the Pacific (Ed.)

In many developing fisheries there is a need to develop new products from waste material such as fish which is not readily acceptable to the consumer. Seasonal gluts can also cause problems and require novel preservation techniques. In certain situations it may also be feasible to process fish to upgrade their value, thereby increasing their value to the fisherman. Several projects of this kind are currently being carried out at TPI.

Fish/carbohydrate animal feed

Quantities of trash fish are, in many situations, available on a daily seasonal basis. Because of the high cost of equipment the quantities available are not sufficient to warrant conversion to fish meal. To meet this need, a means of producing an animal feed at the village level is being investigated at TPI.

The process involves very simple equipment and skilled manpower is not necessary. Fish or fish offal is minced and acidified with a mineral acid to pH 3.0. Approximately 0.5 to 1.0% of formic acid is then added, largely as a preservative. Under these conditions the enzymes within the fish break down the tissues, and after 4 or 5 days the product becomes liquid. This product is known as fish silage. Fifty per cent powdered cassava or maize is then mixed with the silage to absorb most of the water. The resulting paste is then dried in the sun and subsequently powdered.

The dry powdered product can be handled more easily than the liquid silage, and has additional value as an animal feed. Feeding trials are at present being carried out. The product shows considerable promise as a means of utilising waste fish in certain situations.

Shark cakes

Many species of shark are caught in the tropics. They tend to be unpopular as a source of food because of the development of ammoniacal odours during storage or processing. Consequently, quantities of shark are often wasted.

A product has been developed at TPI which can convert this material into an acceptable food product. Shark flesh is minced with salt to give a paste containing 10 to 15% salt. Using a hamburger press, this paste is formed into fish cakes which are then dried. The cakes can be stored for many months before use, and they are eaten after soaking, to remove some of the salt, and boiling for 10 to 15 minutes. In many situations overseas, where salted fish traditionally forms part of the diet, the product is readily acceptable. It is hoped that large-scale trials will be carried out in the near future.

Novel smoked products

In Malawi, smoked haddock is imported from Europe and South Africa for the higher income market. Local products can be upgraded as substitutes for such imports, thus saving foreign exchange, and developing the local fishing industry. TPI has developed a substitute product using a local fish called Kampango (Bagrus sp.). Fillets of this fish are washed and lightly brined prior to smoking. Various salt concentrations and smoking regimes have been tried and the product has found a ready market. Pilot scale production is already being carried out.

PEACESAT OPERATIONS

by

P. Mahony
South Pacific Commission

PEACESAT, the Pan Pacific Education and Communication Experiment by Satellite, is an experiment in telecommunications made possible by the National Aeronautics and Space Administration (NASA) by the use of its first Applications Technology Satellite (ATS-1), which was designed and used for weather control experiments in 1966. The University of Hawaii initiated the PEACESAT Project under the direction of Professor John Bystrom in 1969. A demonstration of the satellite communication system began in Hawaii in 1971 and has since then expanded to include first Wellington, then Suva, Tonga, Lae, Port Moresby, Saipan, Noumea, Rarotonga, Niue, Honiara and Tarawa. These are the satellite ground stations now in operation within the PEACESAT network.

The PEACESAT system consists of co-operating institutions linked by inexpensive self-contained ground terminals and a communication satellite relay. Each station is capable of sending and receiving voice and facsimile signals to all the other terminals in the network. Facilities for telephone linkage are available in the more sophisticated terminals in Hawaii and Wellington. Conference type discussions between two or more terminals, each having one or more participants, seem especially suitable to this system.

PEACESAT DISCUSSIONS ON "OCEAN MANAGEMENT" - AN INTERNATIONAL ORGANISATION BY/FOR THE COUNTRIES OF THE REGION

by

Dr H. J. Squires

At present the S. W. Pacific region is technically not a convention area for fisheries or ocean resources - that is, the countries do not have representation in a plenary organisation for the region with direct concern for fisheries or ocean resource management. Since an increase in ocean fisheries is occurring and countries of the region are becoming interested in developing their own fishing capability, the need for such an organisation is immanent. With representation on a regional organisation for fisheries, countries could have a voice in management of fish or invertebrate stocks such as are at present or soon to be fished by distant water fleets. °)

°) See Pacific Skipjack Stock Assessment Programme, pp. 4-8.

Countries could initiate the formation of such a regional body by asking the assistance of an existing body such as the South Pacific Commission or some other regional organisation such as the South Pacific Forum. Perhaps since it is up to the politicians to decide ultimately, they should be asked to take the initiative, or they could ask the South Pacific Commission, for example, to present a brief on how it could be done and the probable costs involved. Larger countries like New Zealand and Australia must be beginning to realise that with large economic zones of ocean to manage they must look forward to co-operative international programmes to collect resource data and to exploit resources of these zones themselves.

A regional body through which data on resources from the whole area would be collected, analysed and exchanged could also make recommendations or/and take decisions on how such resources should be exploited to the greatest benefit of a protein-scarce world.

International Commission for Southwest Pacific Fisheries (ICSWEPF)

1. Parent body could be the South Pacific Commission at Noumea.
   Precursors: The South Pacific Commission Technical Meeting on Fisheries and the Skipjack Tuna Committee.

2. Composition:
   (a) Countries or territories of the region (Papua New Guinea, Solomon Islands, New Caledonia, Cook Islands, Fiji, Tonga, etc.).
   (b) Metropolitan countries (New Zealand, Australia, United Kingdom, France, United States of America, etc.).
   (c) Countries with distant water fleets (Japan, Korea, Taiwan, USSR, etc.).

3. Participants at meetings:
   (a) Country Representatives with plenary powers.
   (b) Technical Advisers - Fisheries Officers.
   (c) Representatives of international bodies: FAO, UNESCO, etc.
   (d) Observers.

4. Functions of Secretariat:
   (a) Co-ordinating the collection of data on Fisheries and the presentation of these data at meetings.
   (b) Compilation, editing, publication and distribution of data to member countries and in general.
   (c) Organising Technical and Plenary Meetings.
   (d) Assistance to Committees on Special Subjects.

5. Functions of the meetings:

   (a) Presentation of technical data on Fisheries.

   (b) Making recommendations for international regulations on Fisheries management zones, quotes for fishable stocks, fishing gear regulations, fisheries management in general, etc.

   (c) Organization of Committees on Special Subjects such as:

      i) Skipjack Tuna
      ii) Reef fishes
      iii) etc.

6. Alternatives to an international body for the region:

   (a) Membership in an existing organisation such as the IPFC (Indo-Pacific Fisheries Council), but this body is only advisory and has no regulatory powers.

   (b) As at present with representation on the South Pacific Commission Technical Meeting on Fisheries. Again it is advisory and non-regulatory in scope.

7. Advantages in having an international organisation and a "convention area" for fisheries:

   (a) All countries would have a voice in management of ocean or other fisheries in the area.

   (b) Data on fisheries would be compiled, analysed and exchanged.

   (c) Collection of data on fisheries would be planned and co-ordinated.

   (d) Countries could enter into collective or individual bargaining for fishing concessions.

   (e) Regulations for management of fisheries could be formulated and agreed upon by the majority.

8. Disadvantages which may be felt by organising countries:

   (a) Costs of the organisation are required to be met by all countries some of whom are poor. They may feel that they cannot afford it.

   (b) Larger countries may feel that they will be out-numbered by the smaller ones and that they may have freer action in fishing if there is no such organisation. They may feel that they may be obliged to assume most of the costs.

   (c) Smaller countries may feel that they will be dominated by the larger since they have less expertise.

   (d) Countries with vested interests may fear attack in open forum such as provided by an organisation with representation from many countries of the area.

   (e) All countries may not join the organisation.

JAPAN'S TUNA PRODUCTION

(Waga kuni no maguro gyogyo seisan)

Extract

Translated from the Japanese by Tamio Otsu, Southwest Fisheries Center, National Marine Fisheries Service, NOAA, Honolulu, HI 96812, July 1974.

Once again we are deeply indebted to Tamio Otsu of the National Marine Fisheries Service and to the Southwest Fisheries Center at Honolulu for making available and allowing us to print this translation. It is particularly valuable in helping us to see the extent of the skipjack fishing in the Western Tropical Pacific. (Ed.)

Skipjack tuna (Katsuwonus pelamis), larger tunas[1], and billfishes are distributed very broadly in tropical and subtropical waters of the world. Although many nations are already exploiting these fish, there is great interest in the further development of these important fishery resources. The 1971 world production of skipjack tuna, larger tunas and billfishes amounted to 1.6 million metric tons (MT). Looking at the annual world landings of these fish over the last 20 years, it it seen that Japan greatly increased her fishing effort in response to the increasing demand for these fish in the United States and in Europe. Similarly, there was increasing effort on the part of various other nations, and the world catch of tunas (including skipjack tuna and billfishes), which amounted to only 570,000 MT in 1950, has continued to increase year after year and by 1966 reached 1.24 million MT. The increase continued to 1.51 million MT in 1967, 1.59 million MT in 1968 and to 1.64 million MT in 1969. Thus, between 1950 and 1969, there has been a threefold increase in landings. However, there followed a decrease to 1.61 million MT in 1970 and to 1.60 million MT in 1971, indicating either that a downward trend had started or that a maximum level of harvest had been reached.

The statistics show that with the exception of skipjack tuna and albacore, all the other species have been caught in smaller amounts than in previous years. Thus, it would appear that the production of larger tunas and billfishes has attained its limit.

Japan's tuna fishing methods differ from those of most other tuna producing nations. In the course of their fishery development, Japan as well as Taiwan and the Republic of Korea have developed mainly the longline and pole-and-line fishing methods. The United States, Spain, France, Peru and other western nations use primarily the purse seine and pole-and-line fishing methods. In utilization of tunas, Japan from ancient times has consumed these fish fresh as sashimi or processed into fushi (dried sticks). More recently, some fish have been frozen or canned for export. Therefore, the longline fishery is largely aimed at taking the larger tunas that are most highly prized as sashimi. In contrast, the western nations are utilizing the tunas as export items, or canned for domestic consumption. For this reason, these nations fish for skipjack, albacore and yellowfin tunas, which are suitable raw material for canning.

---

1) Translator's note: The Japanese traditionally separate skipjack (katsuo) from the larger tunas (maguro), and on the other hand, often include the billfishes in the latter group. Perhaps the former can be considered surface-caught fish and the latter deep-swimming fish taken largely by longline.

A greatly increasing fishing effort has had its effect on the catch rates. The trip lengths of the longline vessels became longer and longer, and the landings began to show a decline after having reached a peak of 540,000 MT in 1962. In 1963, the landings amounted to 530,000 MT, followed by 500,000 MT in 1965, 380,000 MT in 1969, 340,000 MT in 1970, 300,000 MT in 1971 and 300,000 MT in 1972.

In recent years the domestic fish prices have increased greatly, resulting in a situation where landing fish in Japan has become far more profitable than exporting them. For this reason, the foreign-based tuna longline vessels and those in the Atlantic Ocean, that had previously concentrated on catching fish such as albacore and yellowfin tuna for export, decreased in numbers. The emphasis turned towards species that were in very high demand in Japan, such as the southern bluefin and the bigeye tunas. Thus, there was a significant changeover from foreign-based operations and Atlantic operations to Japan-based operations, resulting also in a dramatic change in catch composition.

This expanded home-based operation resulted in a great increase in vessels fishing the southern bluefin tuna waters off Australia. The landings in the Atlantic Ocean decreased as did the landings of foreign-based operations and catcher boat-carrying mother ships. Combined with generally declining longline catch rates, these various factors have resulted in a general decrease in landings by the Japanese tuna longline fishery.

Variations in fishing grounds and type of operations

The principal fishing grounds for the tuna longline fishery in the Pacific include the coastal waters of Japan, waters off Central America in the eastern Pacific, the vicinity of the Hawaiian Islands, and off New Zealand and Tasmania. In the Indian Ocean they are the northwestern Indian Ocean, waters off South Africa, the vicinity of Las Palmas and off Angola. All of these grounds have shown generally declining catch rates. The overall average catch rate of 3.22% (3.22 fish per 100 hooks) in 1963 decreased to 1.80% in 1971. If the 1971 catch rates are examined by major oceans, it is seen that the average was highest in the Atlantic Ocean at 2.49%, followed by the Pacific with 1.69% and the Indian Ocean with 1.68%.

Examining the Pacific Ocean catch rates more closely, it is seen that the best catches were made in the eastern Pacific, with an average of 2.69%, followed by the South Pacific with 1.96% and the North Pacific with 1.40%. Catch rates are generally used to measure the productivity of a fishing ground. However, it must be remembered that catch rates vary according to the species sought in a given area, and therefore cannot be considered an accurate measure of overall productivity. Nevertheless, since the average catch rates exceed 2.0% in the eastern Pacific and in the Atlantic Ocean, these fishing grounds can probably be considered to be more productive of tunas than the other areas now fished.

Next, let us examine the landings by type of operation. In 1971, the landings of the home-based distant-water fleet amounted to 239,000 MT. This constituted about 75% of the total tuna longline fishery landings. Although this home-based distant-water fleet decreased in size for a period before 1965 because many vessels were leaving to operate in the Atlantic or out of foreign bases, the situation changed greatly after 1966. There

was a reversal in the trend when, due to the influence of fish prices, vessels started fishing for the higher priced sashimi fish such as southern bluefin tuna and bigeye tuna rather than for the export-type yellowfin tuna and albacore. There was thus a marked improvement in home-based operations in 1966. After 1967, however, the landings of the home-based distant-water fleet did not increase in proportion to the very large increase in fleet size (fishing effort), and instead, declined steadily.

Importance of resource management

Because the tuna resources are of great value worldwide, there are new entrants into the tuna fishery. These include both advanced and developing nations. As for the tuna resources, it already appears that they are being fished at or near the maximum level. There is thus an urgent need to manage the resources in order that they can be properly utilized. In an effort to conserve these vitally important resources, management bodies have been formed in various areas. In the eastern Pacific there is the Inter-American Tropical Tuna Commission (IATTC), in the Atlantic the International Commission for the Conservation of Atlantic Tunas (ICCAT), in the Indian Ocean the Indian Ocean Fishery Council (IOFC) of FAO and in the western Pacific the Asian Tuna Fishery Conference. Japan is deeply involved in all of these.

It is vitally important that the tuna resources be conserved and maintained and this can only be done through close international co-operation.

PENAEID SHRIMP FARMING IN POLYNESIA

C.O.P. AQUACULTURE TEAM

The paper below was written for the SPC Seventh Technical Meeting on Fisheries in Tonga in 1974. Regrettably it has not been possible to print it in an earlier edition of the Newsletter (see Editorial). Knowing the speed with which Alain Michel and his team work, this paper will now be rather out of date. However, the results outlined in this paper will be of such interest to other workers in this field we felt that to print late was better than not to print at all. We hope that the 'Centre National pour l'Exploitation des Oceans' (CNEXO) team at the 'Centre Océanologique du Pacifique' (C.O.P.) will be able to bring all participants to the Eighth Technical Meeting on Fisheries in Noumea in October up to date with progress at Vairao. Together with the developments of the 'Association for the Development of Aquaculture in New Caledonia' (AQUACAL) at 'Baie de St. Vincent', operating under the technical guidance of CNEXO, the C.O.P. team is well in the van on world progress in shrimp culture (Ed.)

INTRODUCTION

Throughout the world there is an increasing interest in farming this type of shrimp, either from captured gravid females or by collecting the juveniles from natural stocks. This species of shrimp does not exist in French Polynesia and transport of mature females over long distances usually inhibits spawning.

OBJECTIVES

- To test imported species for adaptation and growth.
- To obtain seed-production in confinement so as to avoid the risks and high costs involved in obtaining post-larvae from distant places.

1. SPECIES EXPERIMENTED

Penaeus merguiensis Metapenaeus ensis Penaeus semisulcatus	)	Juveniles from 'Baie de St. Vincent,' New Caledonia
Penaeus aztecus	:	Post-larvae from the Galveston Laboratory / U.S.A.
Penaeus japonicus	:	Institute Fujinaga, Japan

2. RESULTS

P. merguiensis: Complete cycle in captivity, one generation in 4 months. Spawning starts when females weigh 6 to 10 g. Successive maturations have followed. About a thousand mature individuals have been observed and several hundred spawnings obtained since September 1973.

M. ensis: Breeding in captivity of females of 15 to 18 g which were received by C.O.P. as juveniles (3 to 6 g). The first complete cycle should be achieved soon.

P. semisulcatus: Several mature specimens have been observed but there was no spawning. Very few individuals (10 to 15) were collected and the species appears to suffer considerably from handling.

P. aztecus: By July 1974, post larvae received in September 1973 had developed into adults weighing between 11 and 25 g. Maturation and spawning were observed in several females after cutting one of the eye-stalks, but egg production and hatching rate have been very low; a 100 or so post-larvae only have been produced.

P. japonicus: Post-larvae arrived in October developed into adults weighing between 10 and 32 g. The fertilized females do not display any notable signs of maturation.

3. MAINTENANCE OF BREEDING-STOCK (applies to the 5 species)

Circular tanks, 4 metres in diameter (see diagram on next page) with a substratum of volcanic and coralline sand, forming a filter - circulation of the water is through the bottom inlets sand filter-tank - overflow: 200 to 300 individuals per tank.

Temperature: 22°to 26° C - Salinity: 25‰ - pH: 8.2 - shaded by a screen (arresting 60% of the light) - Food: pellets and trochus flesh.

4. LARVAL CULTURE (P. merguiensis and M. ensis)

4.1. Spawning

Females ready to lay their eggs are selected by eye (green spot on the head and dark stripe on the abdomen) in the tanks. Spawning occurs at night.

The spawning tank of 500 litres has a conical bottom. The eggs which have been laid are carried by airlift into semi-immersed boxes, the bottoms of which are made of a plankton screen of 100 y mesh.

4.2. Hatching

The hatching-tank is a 50 litres cylinder, the bottom of which tapers into a cone. The nauplii stay there 24 hours.

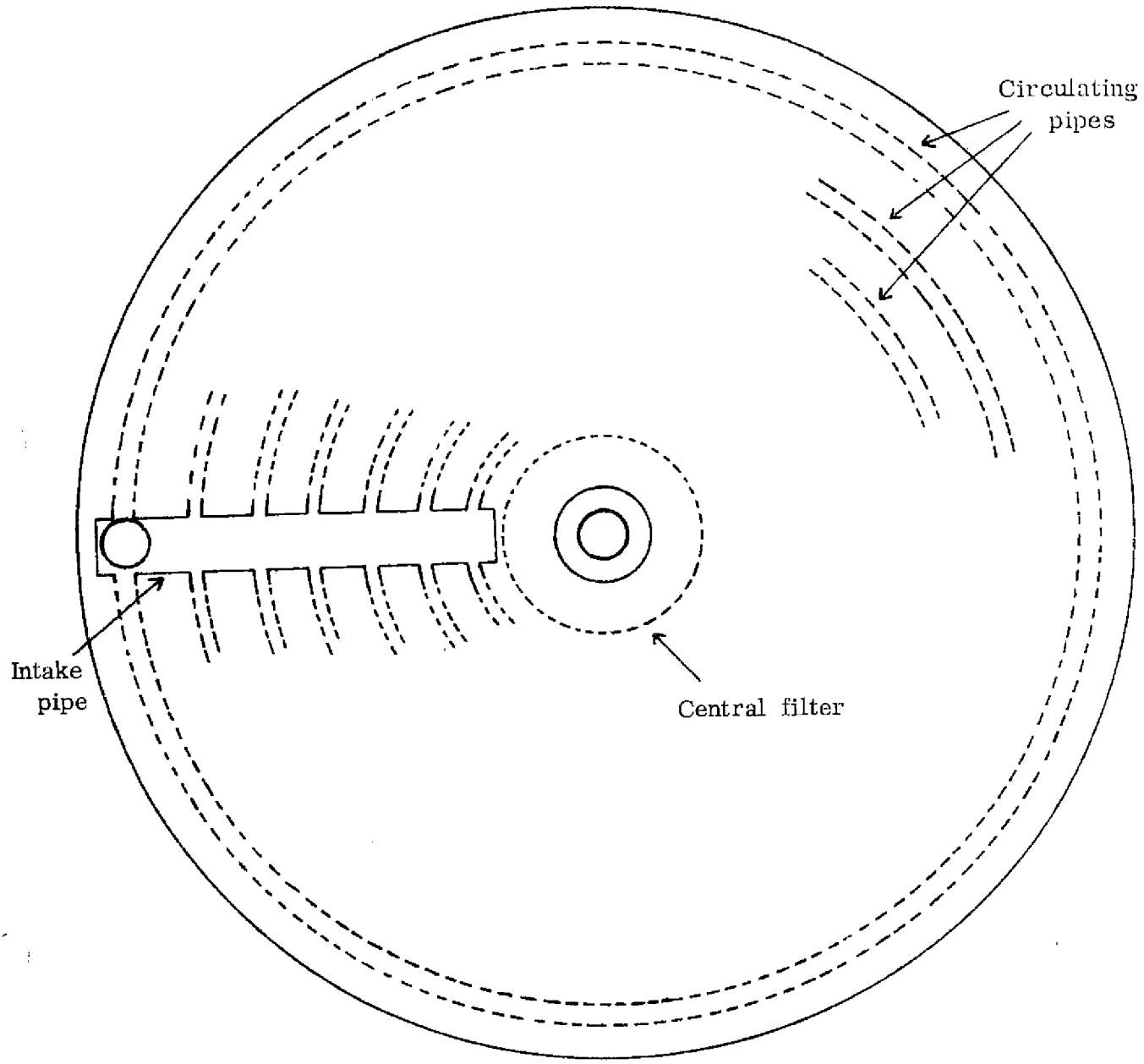
4.3. Stages (techniques are those used in the Galveston Laboratory, U.S.A.)

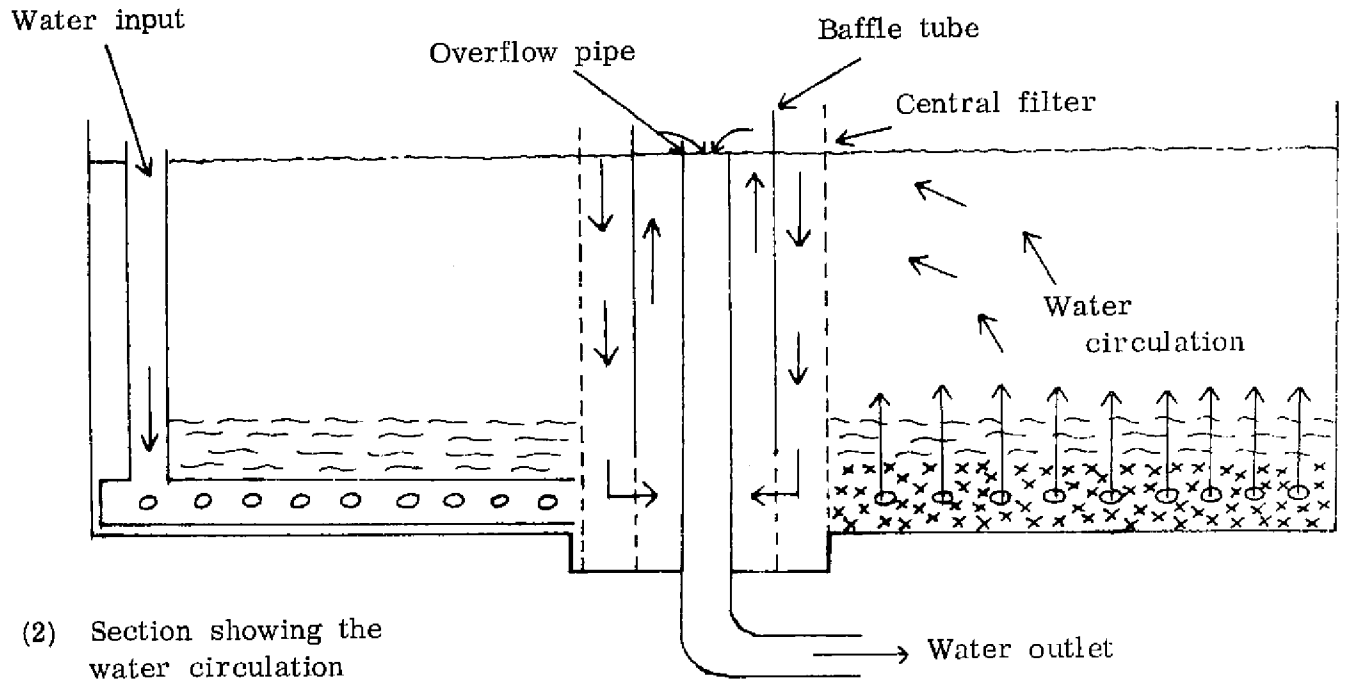
500-litre tank; temperature controlled by the water of the lagoon; water filtered by a 50 y mesh; salinity: 35‰; temperature between 26° and 30° C. Rearing is started with 250 litres, water being added daily to reach 500 litres at the Mysis stage. Then partial daily renewal of the water, depending on the state of the tank and density of the larvae.

(1) Plan of:

- water intake pipe
- circulating pipes
- central filter

Tank for holding breeding stock





(2) Section showing the water circulation

Food: nothing for the nauplii (6 stages): Skeletonema (100,000 cells per cc.) and Tetraselmis (10,000 cells per cc.) fresh or frozen (after concentration) for the zoe stages. Artemia nauplii (5 per cc.) for the Mysis and post-larval stages.

A tank of 500 litres can hold between 30,000 and 50,000 post-larvae. About 400,000 post-larvae (PL_1) have been so produced.

At the moment, production is limited by:

- the relatively low number of eggs laid by the females which do not grow over 13 g (7,000 to 15,000 eggs/female);
- the difficulty of obtaining, in temporary algae culture ponds, a good and reliable production of Skeletonema.

5. POST-LARVAL CULTURE (P. merguiensis)

In a 500-litre tank until day10 to day15. One fifth of fresh water is added daily in order to prevent the massive mortality caused by fungus experienced during the first trials (more than 150,000 post-larvae killed).

6. NURSERY (P. merguiensis and M. ensis)

6.1. Circular tank of 4 metres in diameter (12 m3) - stocking rate of 750 individuals per m2 of day20 and day50 post-larvae. The food consists solely of prepared mixtures. The post-larvae reached an average weight of 1.15 g at day50.

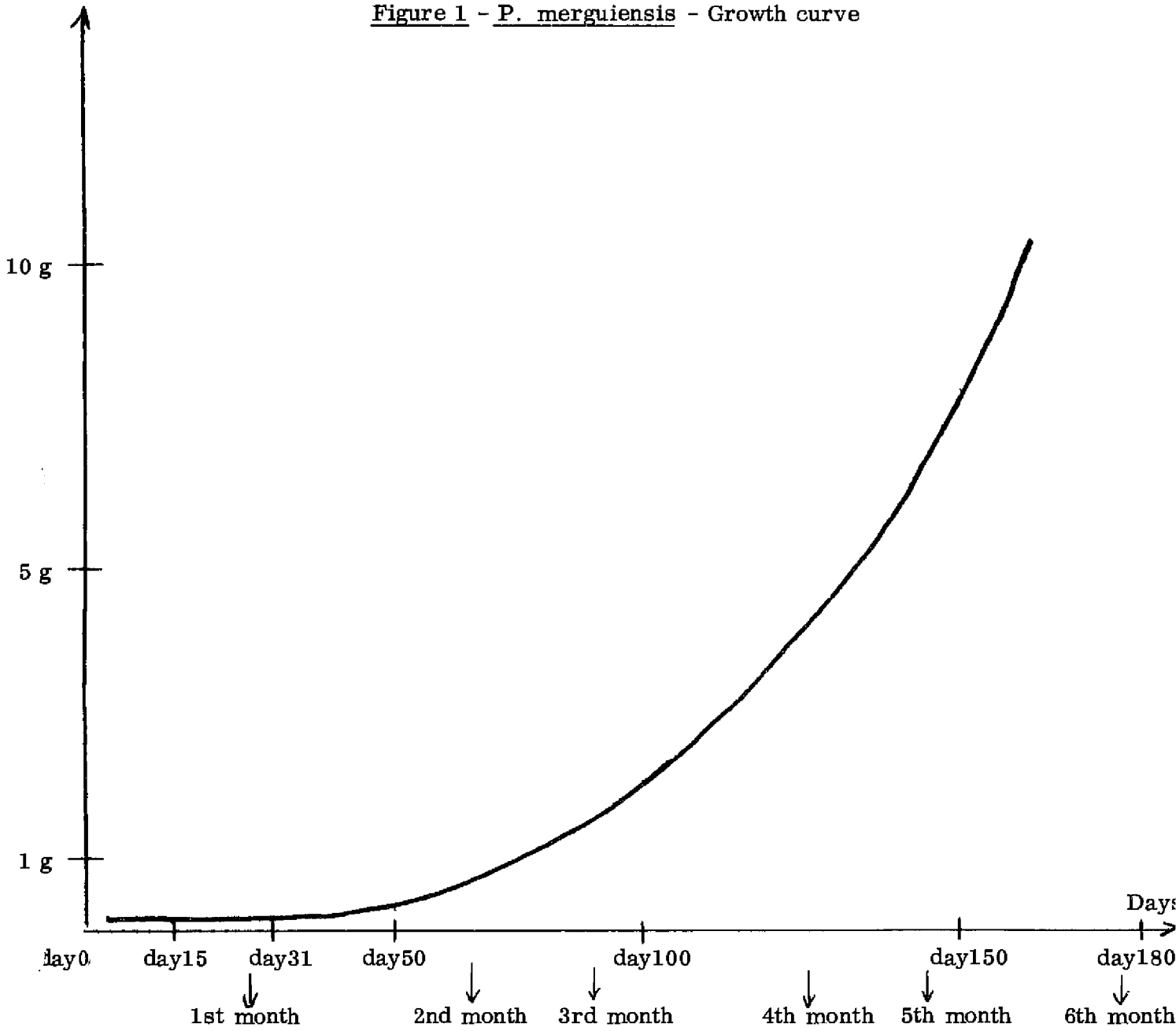
6.2. Growth tests with food mixtures

Growth tests with food mixtures are carried out for periods of two to three months on post-larvae of stages day15 and day20, in small 100- or 500 litre tanks. A commercial Japanese food (Shigueno) gives good growth for P. merguiensis and M. ensis and the results have shown to be repeatedly consistent. Several locally-made foods have not yet given such good results. However, a mixture made from rice and shrimp flour appears to cover the requirements of post-larvae, and growth after six months is practically equivalent to that obtained with the Japanese food. Other trials involve the use of locally-produced fish flour as a shrimp feed.

7. GROWTH

7.1. The growth curve in fig. 1 is that recorded for the small tank with a small number of individuals; it needs to be confirmed.

Figure 1 - P. merguiensis - Growth curve



7.2. Intensive growth in tanks

Tank of 403 m2, fibreglass water-proof lining. The bottom of the tank has 1/4 of the area without substratum and 3/4 covered with volcanic sand in which are buried the pipes through which the water comes. The total volume of the water is changed three times a day. This type of "reversed" circulation (as compared with the one normally used for intensive shrimp-farming), offers the following advantages:

- sediment is always in contact with clean water, showing no loss after six months of continuous operation;

- substratum is always loose, does not harden and always permits the shrimps to bury themselves easily.

Food consists solely of mixed compounds (types: Fujinaga, Shigueno and COP'). No fresh food is added.

Stocking has been as follows (several species in combination):

From December to January:

677 (2-3 g) P. japonicus which had survived a pump failure causing massive mortality in the nursery tank.

1,237 (2-3g) P. aztecus obtained from a high-density rearing trial in a small tank.

2,700 (1-3 g) P. merguiensis obtained from the initial larval and early growth culture trials.

This first stocking allowed us to study the progress of the stock and to observe the behaviour of the shrimps.

From February to June:

8,200	P. merguiensis	(av. wt. = 120 mg)	- 8th February
7,000	P. merguiensis	(av. wt. = 120 mg)	- 11th March
7,000	P. merguiensis	(av. wt. = 220 mg)	- 26th April
5,000	P. merguiensis	(av. wt. = 100 mg)	- 26th May
2,500	M. ensis	(av. wt. = 200 mg)	- 1st April

Total harvesting of the tank was done at the beginning of July. 150 kg of shrimps were produced which represented a biomass of 375 g/m2; survival rate was 80%.

In spite of the fact that stocking with P. merguiensis was done at widely spaced time intervals, the separate batches did not maintain their discrete size distribution and very few individuals grew beyond 7 g. This did not apply to P. aztecus and P. japonicus which burrowed in the substratum and grew to over 20 g. It is possible that the growth of P. merguiensis may be slowed down after 5 g due to the light factor; rearing is carried out in clean water and the animals do not stop swimming, therefore using up considerable energy; on the other hand, where areas of shade exist or if water has a dense mass of phytoplankton, they rest on the bottom without moving. Experiments are in progress to verify this hypothesis.

7.3. Growth under semi-intensive conditions

Experiment conducted in New Caledonia under a contract with the Association Aquacal.

The pond of 1.2 hectares was filled on 10 January 1974. In January and February, it was stocked with post-larvae of P. merguiensis and M. ensis producted at C.O.P. and sent by air. Out of 50,000 sent 37,000 arrived alive.

In March and in April, 4,000 juveniles of 2 to 6 g were added.

Food

The natural productivity of the pond was supplemented by a prepared mixture in the form of paste (mixture of wheat flour and fish flour).

A first sampling at the end of March showed good growth of these two species. The first cropping was done at the beginning of May and 77 kg were landed in four sets of the net. The biggest individual weighed over 30 g. The average weight was around 18 g for the females and 10 g for the males of P. merguiensis and about 12 grams for females and 7 g for males of M. ensis.

Other harvests are planned.

7.4. Experimental extensive culture in the lagoon

Experiments are being carried out in a lagoon in Tahiti, in an enclosure of 100 m2 with a stocking rate of 5 shrimps per m2; supplementary feeding with prepared foods.

7.5. Experiments in floating cages

Experiments are in process in a cage 3 m x 3 m x 3 m.

8. CONCLUSIONS

- Breeding in captivity of P. merguiensis, M. ensis and P. aztecus will eliminate problems associated with seed supply.
- Maturation and spawning have been obtained all year round, at least in the case of P. merguiensis.
- The short life-cycle (4 to 6 months) makes it possible to envisage a programme of genetic selection.
- Larval culture is being developed.
- Satisfactory early growth has been obtained with prepared foods.
- Growth tests are still being carried out.

DIARY OF FORTHCOMING MEETINGS

August 18-30	Pacific Science Congress, Vancouver, B.C., Canada.
September 29-October 10	Fifteenth South Pacific Conference, Nauru. South Pacific Commission.
October 16-17	Expert Committee on Tropical Skipjack, Noumea, New Caledonia, South Pacific Commission.
October 20-24	Eighth Technical Meeting on Fisheries, Noumea, New Caledonia South Pacific Commission.
October 27-28	Workshop on Small Boat Design and Engines, Noumea, New Caledonia, ICLARM.