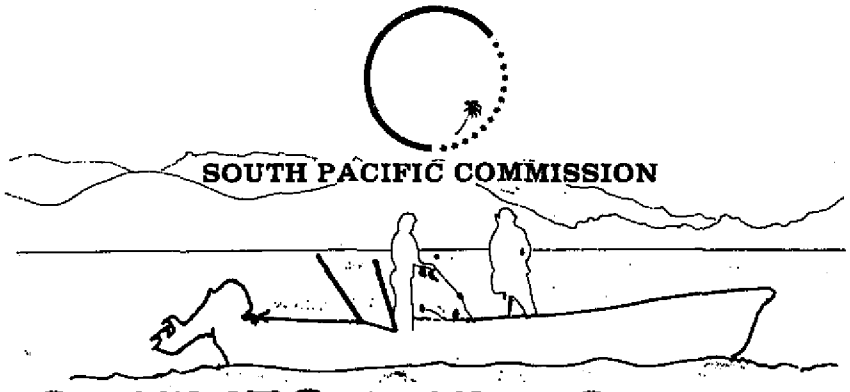

FISHERIES NEWSLETTER

NUMBER 31 - DECEMBER 1984

This issue is put together in something of a hurry, as heavy commitments to other work programme activities on the part of our editorial staff have prevented as much time being spent on its preparation as usual. In particular, the "News from In and Around the Region", and other regular sections have been omitted. These will re-appear in the next issue.

Contents

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SPC ACTIVITIES

New Fisheries Programmes approved by South Pacific Conference

The decisions of the Twenty-fourth South Pacific Conference, held in Noumea in October 1984, will have significant implications for future SPC coastal fisheries development activities. Two new projects in this area were approved: a Regional Fisheries Training Project, and the appointment of a Fish Processing and Marketing Specialist. Both are concomitant upon the Commission obtaining extra-budgetary funding support.

The Regional Fisheries Training Project, which was discussed in detail at the Sixteenth SPC Regional Technical Meeting on Fisheries in August 1984, will provide the Commission with the framework within which to respond to the ever-increasing number of requests from member countries for technical training in fisheries-related fields. Two new staff positions are envisaged under the Project, and these will enable the Commission both to assist member countries match their fisheries training needs with training opportunities at institutions inside and outside the region, and to organise courses and workshops in technical subject areas not presently covered by these institutions.

The appointment of a Fish Processing and Marketing Specialist was strongly urged by the Fifteenth SPC Regional Technical Meeting on Fisheries in 1983, and presents a means complementing the activities of the Master Fishermen working in the Deep Sea Fisheries Development Project. Previous work by this Project has concentrated on developing the catching sector of member country's fisheries, but there is now an increasing requirement for assistance in upgrading the post-harvest sector as well, and the new position has been created to address this need.

Deep Sea Fisheries Development Project Notes

- Federated States of Micronesia

SPC Master Fisherman Lindsay Chapman has been working with the Yap Fishing Authority (YFA) since July in a wide-ranging programme aimed at assisting development of local commercial fishing activities. The early parts of the visit involved upgrading the quality of deep-bottom fish landed by YFA vessels prior to exports of prime fish to the high-priced market in Guam. Fish were landed live into an ice slurry for rapid chilling before dry-packing in insulated boxes. Several shipments have now been made and good prices obtained for some species.

In the second part of the visit, Lindsay has been involved in the construction and deployment of several fish aggregation devices (FADs), all to the SPC recommended design, both around Yap proper and in outer island waters. Following deployment, Lindsay has been conducting fishing trials around the reefs, but so far with only disappointing results. Vertical longlining for large tunas has been unproductive, and surface trolling has yielded mainly small juvenile fish. The trials are planned to continue for several more weeks.

- Kiribati

Master Fisherman Pale Taumaia's visit to Kiribati terminated in December when he left Kiritimati (Christmas) Island after a two-months period spent deep-bottom for prime species for shipment to the Hawaiian market. Catch rates were excellent, averaging at least 7 kg/reel/hour, although the landings contained numerous large fish. However, shipment of the catch to Hawaii was not as successful as envisaged, due to unpredictable alterations to the timing of

the weekly air connection, and to large price variations on the Hawaiian market, caused by large landings from several commercial vessels which have recently started fishing out of Honolulu.

Prior to the work in Kiritimati, Pale spent several months conducting training courses on several of the outer islands of the Gilberts group. The training concentrated mainly on deep-bottom fishing, which is a technique unfamiliar to many of the local fishermen.

- Fiji

Master Fisherman Paul Mead recommenced gear development work in Suva in November, following a 6-month period spent training village fishermen in deep bottom fishing and FAD-fishing techniques along the north coast of Vanua Levu, in Fiji's Northern Division. Paul spent this period working with selected local fishermen from their own vessels, giving training in fishing methods such as vertical longlining and deep trolling, which he refined earlier in the visit.

Paul is now continuing his experimental fishing on FADs located near Suva, until the Project visit concludes in 1985.

Regional Fisheries Refrigeration Survey completed

SPC Assistant Fisheries Officer Garry Preston and UN Refrigeration Specialist Mike Vincent returned to Noumea on October 6 after a long tour of 11 Pacific Island countries to examine and discuss aspects of fisheries sector refrigeration systems with technical personnel. Briefly, the objectives of the study (described more fully in SPC Fisheries Newsletter # 30) were to compile comparative information on existing refrigeration equipment and its effectiveness in a variety of situations, identify major problem areas common in the region and suggest remedial action where possible, and provide planning guidelines and recommended design criteria for future fisheries sector refrigeration installations. The team were also briefed to assess the immediate and long-term refrigeration training requirements in the region, and to interview potential trainees for an 19-week refrigeration training course planned to be held next year, as well as tuning the course syllabus to the needs and problems of the region.

During the survey, the study team were able to visit a number of remotely located fish collection centres as well as more centrally placed holding stores, markets, ice machines, etc. Operating conditions varied greatly among the installations visited, but, almost without exception, each faced its own particular set of economic, management and technical problems, which in some cases were severe enough to have caused the near or total failure of integrated fisheries development activities of which the installation formed a part. Specific problems described were very wide ranging, and included poor parts supply, lack of trained service personnel, unexpectedly high running costs, irregular power supply, poorly designed and fabricated machinery, and an inability to cope with the extremes of supply and demand presented by local suppliers and consumers.

The study team draft report will be circulated for comment by specialist reviewers in the new year, and released as soon as possible thereafter.

Two SPC Fisheries training courses announced

SPC Savingrams issued in November and December respectively invited nominations from member governments for two forthcoming training activities, both of which commence in February 1985.

The first is the SPC/Nelson Polytechnic Pacific Fisheries officer Training Course, which will be held from 6 February to 7 June. The first 18 weeks of the course are to be based at Nelson Polytechnic in New Zealand, where the 12 selected trainees will study a wide range of fishery-related subjects, including net repair and construction, navigation and chartwork, marine diesel and outboard maintenance and repair, welding, fibreglassing, refrigeration, fish processing and quality control, and basic fishery research and management methods. Subsequently, the trainees will spend 5 weeks in Fiji learning small-boat handling techniques, seamanship and fishing methods under the supervision of an SPC Master Fisherman. The course thus covers the broad field of skills required of a Pacific Island fisheries officer or extension agent who is expected to provide support services to local fishermen in a remote area.

The second course is the SPC/UNDP Regional Refrigeration Training Course, which will be held in Rarotonga from February 25 to June 28. The course is oriented towards fisheries sector engineers or technicians responsible for operating and maintaining refrigeration equipment of various types, including freezers, ice machines, etc., and forms phase II of the SPC/UNDP Regional Refrigeration Assessment and Training Project described in the preceding article. The course covers electrical and diesel repair and maintenance, welding, and soldering, as well as refrigeration service and troubleshooting. Trainees are required to have a fairly strong engineering background and proven mechanical aptitude.

Nominations for both courses closed in December.

Prawn-Fishing survey carried out in PNG

An SPC-funded consultancy aimed at investigating the potential for the development of a small scale prawn industry in Papua New Guinea was completed in late November by Australian Department of Primary Industry Fisheries Reseach Specialist Mr Michael Dredge, in collaboration with the Papua New Guinea Fisheries Division. The aim of the survey, which was carried out at Daru on the Gulf of Papua New Guinea was to identify fishing gears which could be adapted for use by local small-scale fishermen and allow them access to the areas lucrative prawn fishery. Among the fishing gears looked at were small beach seines, push nets; anchored stow nets, bottom-set tangle nets, and small beam and pair trawls.

Another aim of the survey, while carrying out these gear trials, was to locate areas of prawn abundance and suitable fishing grounds. It was also envisaged that the Province's research vessels, once fitted out, could continue experimental fishing after the surveys completion and thus collect information on seasonality and other long-term changes affecting the resource.

The results of the consultancy will be reported in the next issue of the Newsletter.

SPC Fisheries Newsletter No. 31 - December 1984

A LOCAL LONGLINE FISHERY IN NEW CALEDONIA

by

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1. History

In 1981, a new fishing company was formed in New Caledonia based on the idea that long range Japanese pole-and-line vessels which fished in New Caledonia waters needed live bait.

During the 1970s, the Japanese pole-and-line fishery extended its operations towards the South Pacific Ocean and in 1974, the first vessel started to fish in New Caledonian waters. In the following years fishing effort increased from two boat-days in 1974 to 263 boat-days in 1980. Vessels came from Japan with their own bait, purchased at high cost, for the tuna fishing season in New Caledonia which generally lasts from October to March, the warmer season. In 1981, Japanese pole-and-line vessels paid approximately US$3.80 to $4.00/kg for live bait (Kearney, 1981). Often, while crossing warm equatorial waters, bait mortality was high until new water cooling systems were installed in most of the vessels' bait tanks.

A live-bait fishery based in New Caledonia which could supply good quality live bait at a reasonable cost was thus of considerable interest to these vessels, as it would permit them to extend the length of their fishing trips, and come back to Japan with a full load of tuna. "Polypêche", a New Caledonian-Japanese bait-fishing company, was therefore created in December 1981. As the skipjack pole-and-line fishery in New Caledonia is very seasonal, it was planned that outside the tuna pole-and-line fishing season, Polypêche bait fishermen would fish for tunas and billfishes (trolling and longlining) and for deep bottom snappers. Vessels chosen for this multi-gear fishery were small size Japanese coastal vessels 12 to 16 metres in overall length (Hallier, 1982).

For several reasons, Polypêche chose Thio, on the east coast of New Caledonia, as its fishing base. This choice was unfortunate because the coast here is very poor in baitfish resources (Conand, 1984). However, before Polypêche could even catch any marketable stock of live bait, the Japanese withdrew most of their pole-and-line activities from the area. The number of Japanese pole-and-line boat-days dropped from 263 in 1980 to 13 in 1983. Polypêche therefore had to change its objectives or close down. It was decided to turn to longline fishing because this is a very well known technique which has been practised in New Caledonia waters for many years by the Japanese who extended their longline fishery into the South Pacific from 1952, and the Taiwanese who have been longlining in the region since 1964.

A large number of longline surveys by ORSTOM scientists (Angot et al, 1959; Legand et al, 1969; Bourret et al, 1972; Grandperrin et al, 1973; Grandperrin et al, 1974; Grandperrin, 1975) and South Pacific Commission catch statistics (Anon, 1981b) show that longline fishing in the New Caledonian

waters has in the past achieved reasonably good catches. However, when longline fish are sold for canning, the benefit is relatively small, too small to make a profit for a locally based fishery. More profitable is the Japanese sashimi market. Although the Japanese maintain something of a monopoly on the sashimi trade, Polypêche is able to have access to this market via its Japanese shareholding.

By selling sashimi-grade fish, a New Caledonia-based longline company could be profitable (Hallier, 1983). Thio based vessels were far too small for this type of fishing operation, so Polypêche company purchased a second-hand Japanese longline vessel. On 1st November 1983, the Caledonien commenced her maiden fishing trip, and a second, sister vessel, Oceanien, was put into service in June 1984.

2. The vessels and their fishing gear

Caledonien and Oceanien are Japanese built longline vessels of 134 gross registered tonnes with overall lengths of 36 metres and beams of 7 metres. The Fish hold capacity of each is 110 tonnes at -55 degrees C and fish are deep frozen in a -60 degrees C freezing tunnel. Each vessel has a crew of 19, including nine Japanese officers and fishermen, nine local fishermen and a French captain.

Fishing gear comprises a typical Japanese longline of about 100 km with an average 2,200 hooks which fish at various depths according to the target species. While fishing for marlins and billfish, the longline is set shallower than for yellowfin or bigeye fishing.

(Photo: J.-P. Hallier)

Figure 1: The *Calédonien*.

3. Fishing results

The results of the first three fishing trips of the Caledonien are analysed here. More details of each trip can be found in Hallier, 1984a,b and c.

3.1. Fishing effort

From 1 November 1983 to 30 September 1984, the vessels were at sea for a total of 296 days (68% of the available time) during eleven fishing trips averaging 27 days each. Seventy-eight per cent of the time at sea (53% of the available time) was spent fishing. During these 230 fishing days 524,125 hooks were fished in daily sets, giving an effort of 2,279 hooks/set or per day.

This effort is similar to the average achieved by Japanese longline vessels from 1969 to 1974 in the area 15 degrees S to 30 degrees S and 150 degrees E to 180 degrees. More recently (1982-1983) they tend to have a greater effort: 2,724 hooks/set for the Fukuichi Maru No. 35 in October 1982 (Muyard, 1982) and 2,801 hooks/set for the Hakkai Maru No. 21 in September 1983 (Desurmont, 1983). In Tonga, where a similar fishing project exists, the longline vessel Lofa, in 1982-83 spent only 52% of the available time fishing, during a thirteen month period (Anon, 1983b), and this was considered as largely insufficient. In a recent study on longline fishing in New Caledonia, Hallier (1983) estimated that a reasonable fishing effort for a local longline vessel would be 20 fishing days per month, for 11 months a year with 2,000 hooks per fishing day. Effort by the Polypêche vessels is just under the hypothesised number of days but over the predicted number of hooks per fishing day.

3.2. Fishing grounds

Figure 2 shows the vessels' fishing grounds and the geographical distribution of fishing effort by 1 degree squars. Apart from the area around the Isle of Pines, and nearthe coast of the main island, all other fishing areas are traditional Japanese longline grounds. They are all in areas where the sea floor is covered with many seamounts that seem to be favourable to tuna and billfish abundance and are also easily reached from Noumea. Areas off the east coast of New Caledonia are largely unknown and exploratory fishing surveys here would be most interesting. A difficulty could be the occurrence of an almost permanent current flowing from north-west to south-east in the Loyalty channel.

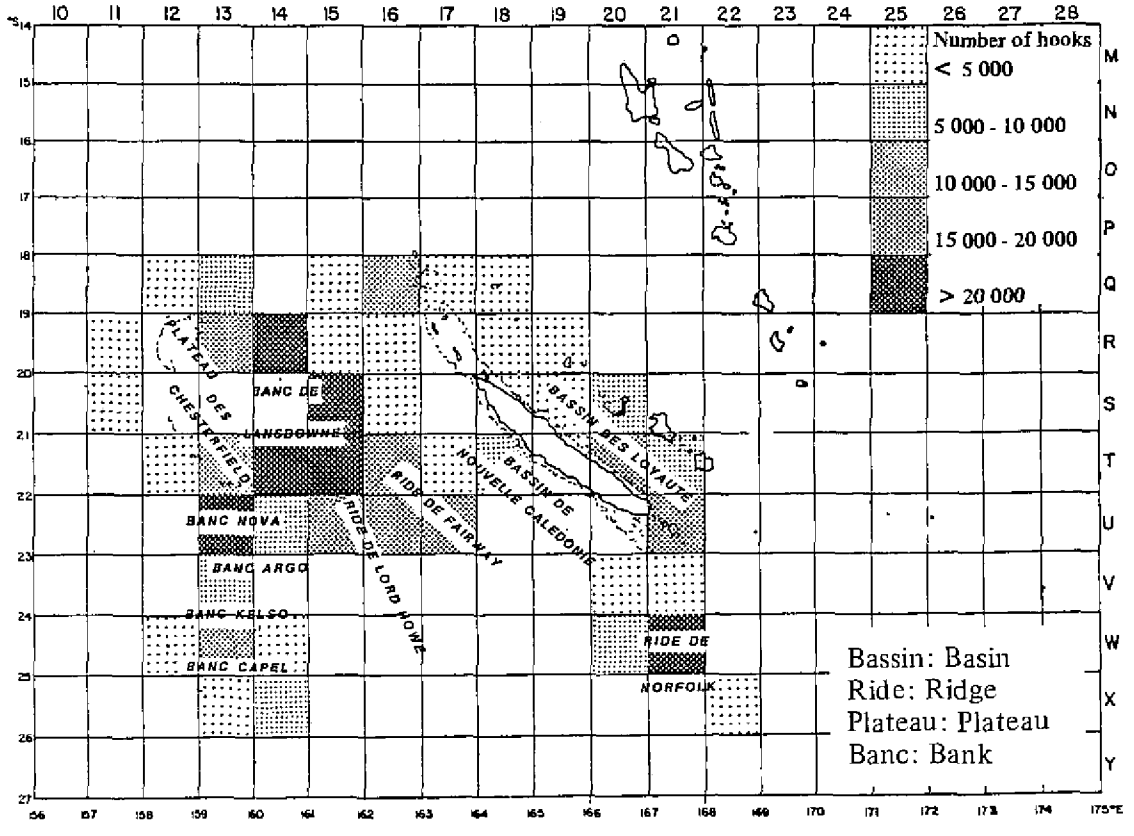


Figure 2: Geographical distribution of the fishing effort of Polypêche longline vessels, November 1983 - September 1984.

3.3. Catches and fish abundance

3.3.1. Total catch and species composition

Catch per species for the 11-month period November 1983-September 1984 are given in Table 1. Monthly catch data is shown in Table 2.

Table 1 - Polypêche catches (November 1983 - September 1984)

SPECIES	CATCHES			C.P.U.E.	
	Number	Weight (kg)	Average Weight (kg)	No. of fish per 1000 hooks	Weight of fish (kg) per 1000 hooks
Albacore (Thunnus alalunga)	7 566	147 775	19.5	14.4	282
Bigeye (Thunnus obesus)	362	13 158	36.3	0.7	25
Yellowfin (Thunnus albacares	2 573	82 487	32.1	4.9	157
Total Tunas	10 501	243 420	23.2	20.0	464
Striped Marlin (Tetrapturus audax)	665	45 934	69.1	1.3	88
Blue Marlin (Makaira nigricans)	287	26 445	92.1	0.5	51
Black Marlin (Makaira indica)	80	5 813	72.7	0.1	11
Swordfish (Xiphias gladius)	187	9 287	49.7	0.4	18
Sailfish (Istiophorus platypterus)	139	5 654	40.7	0.3	11
Short-billed Spearfish (Tetrapturus angustirostris	199	3 267	16.4	0.4	6
Total Billfishes	1 557	96 400	61.9	3.0	184
Wahoo (Acanthocybium solandri)	534	8 179	15.3	1.0	16
All fishes *	12 592	347 999	27.6	24.0	664

* Excludes sharks and mahimahi (Coryphaena hippurus) are not included.

Table 2 - Polypêche monthly catch information

Month	Number of fish	Weight (kg)	Average weight (kg)
November 1983	756	30 330	40.1
December 1983	307	30 141	37.3
January 1984	568	17 401	30.6
February 1984	641	17 368	27.1
March 1984	1 048	30 021	28.6
April 1984	1 138	34 062	29.9
May 1984	1 108	31 315	28.3
June 1984	441	10 126	23.0
July 1984	2 001	50 682	25.3
August 1984	2 845	62 443	21.9
September 1984	1 239	34 110	27.5
TOTAL	12 592	347 999	27.6

In terms of weight, tuna and billfish represent respectively 70% and 28% of the total catch. On average, 31.6 tonnes were caught on each trip. For the 11-month period of operation and a month in repairs and refitting, the annual catch totalled 348 tonnes. This amount is within the catch range which Polypêche expect would make this activity profitable. In 1982, Japanese longliners fishing in New Caledonian waters caught on average 33.8 tonnes per month. They fished from February to May and from August to December and their monthly catches fluctuated from 21.6 tonnes in August to 49.5 tonnes in March. These results are fairly comparable to those obtained by Polypêche.

3.3.2. Fish abundance

Several different units of effort have been used in calculating the productivity of longline operations, including "days at sea", "fishing days", "number of sets" or "number of hooks". The number of fishing days and number of sets are generally the same (as one set takes a full fishing day to perform) and are the units used here.

The abundance indices or catch per unit of effort (CPUE) for the main species and for the whole 11-month fishing period are shown in Table 1. The geographical distribution of abundance, as reflected by cpue, is illustrated in figure 3. Table 3 gives a comparison of Polypêche catch rates for selected species with those obtained by other fishing interests operating in New Caledonian water at various times.

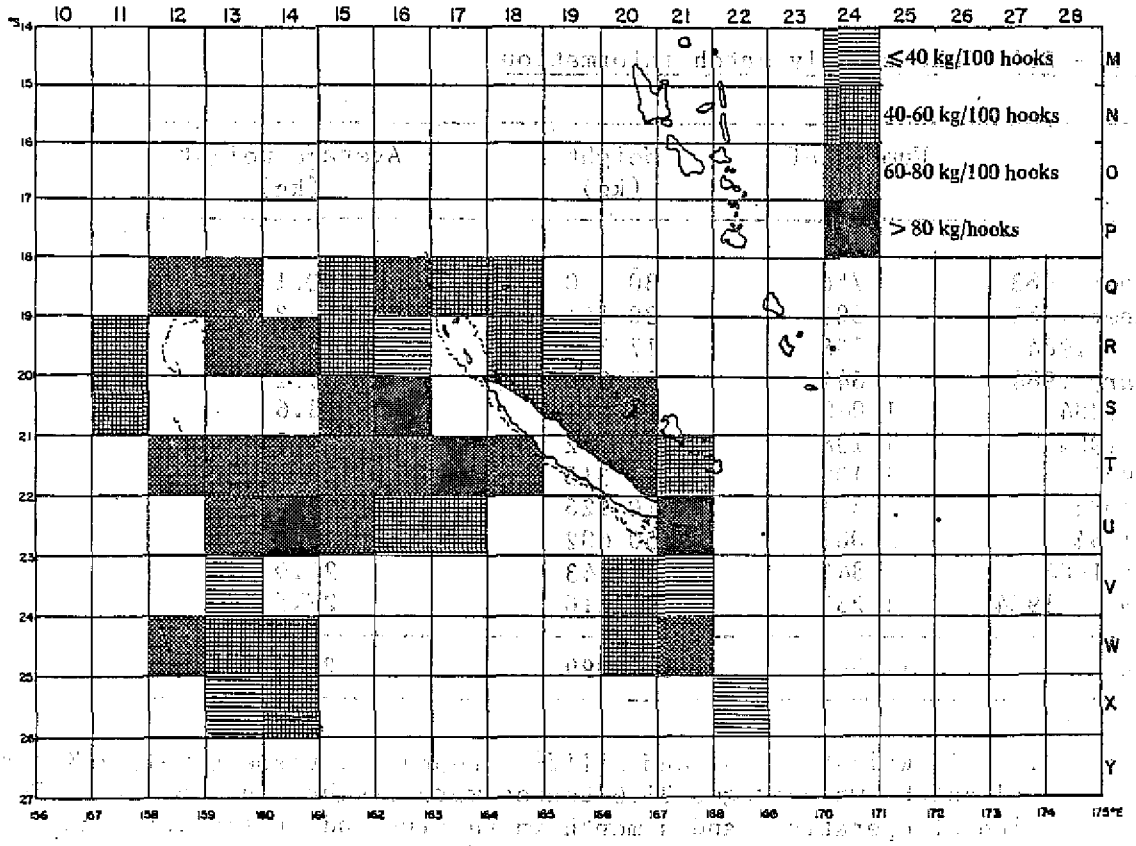


Figure 3: Geographical distribution of catch per unit effort of Polypêche longline vessels, November 1983 - September 1984.

Table 3 - Species composition and c.p.u.e. for Polypêche and Japanese longline vessels in New Caledonian waters

(A) % of total number of fish (B) No. of fish/100 hooks

SPECIES	POLYPECHE Nov.83-Feb.84		JAPAN LONGLINE 1969 - 1977(1)		FUKUICHI MARU 35 Oct.-Nov.1982(2)		HAKKAI MARU 21 Aug.-Sept.83(3)	
	% (A)	c.p.u.e. (B)	% (A)	c.p.u.e. (B)	% (A)	c.p.u.e. (B)	% (A)	c.p.u.e. (B)
Albacore	46	.76	44	.74	37	.43	39	.78
Yellowfin	22	.37	19	.32	18	.20	39	.77
Striped marlin	16	.26	20	.33	16	.19	12	.25
Other marlins billf., sailf.	13	.22	12	.20	26	.30	7	.14
All fishes	100	1.63	100	1.68	100	1.16	100	1.98

(1) Area: 15 degrees S - 30 degrees S / 150 degrees E - 180 degrees, Japanese Longlining Catch statistics from Research Division, Fisheries Agency of Japan.
(2) Muyard, J., 1982.
(3) Desurmont, M., 1983.

After the first two trips made by the Calédonien, the species and size composition of the catch showed a marked change with bigger proportions of albacore and yellowfin and lower marlin and other billfish catches. This is the result of a deeper longline; buoy ropes of 9 metres were replaced by 19-metre ropes, and the hooks therefore fished deeper. The first four months' fishing performance is quite similar to the Japanese long-term fishing results in New Caledonian waters. They are slightly worse than two of the three examples of Table 3 but these two vessels had a greater fishing effort by setting on average 2,749 hooks per fishing day instead of 2,175 hooks for the Caledonien during this period. Wahoo and dolphin fish (20% of the Caledonien total catch by number) are not taken into account in this comparison, but these fish are realising good prices on the local market.

3.3.3. Fish weights

Average fish weights for most species are given in Table 4 in comparison with weights of fish caught by two Japanese longline vessels. Average weights are quite different for the same species from one boat to the other. Season, year, fishing depths and type of bait used are probably some of the main parameters responsible for this variation.

Table 4 - Average weights of longline-caught fish (kg).

SPECIES	CALEDONIEN	FUKUICHI MARU 35 Oct. - Nov. 1982	HAKKAI MARU 21 Aug.-Sept.1983
Albacore	19.5	14.6	16.8
Bigeye	36.3	51.6	34.8
Yellowfin	32.1	23.3	25.4
Striped Marlin	69.1	71.5	72.7
Blue Marlin	92.1	132.7	195.0
Black Marlin	72.7	132.3	250.0
Swordfish	49.7	54.6	54.1
Sailfish	40.7	51.7	14.8

3.3.4. Fish sales

In February Polypêche exported its first load of fish to Japan. This shipment fetched reasonably good prices, particularly if we consider that this is the first fish from this company to be sold on the difficult Japanese sashimi market. Average prices realised by this shipment are shown in Table 5. A second load of fish was exported at the end of May, and a third in September.

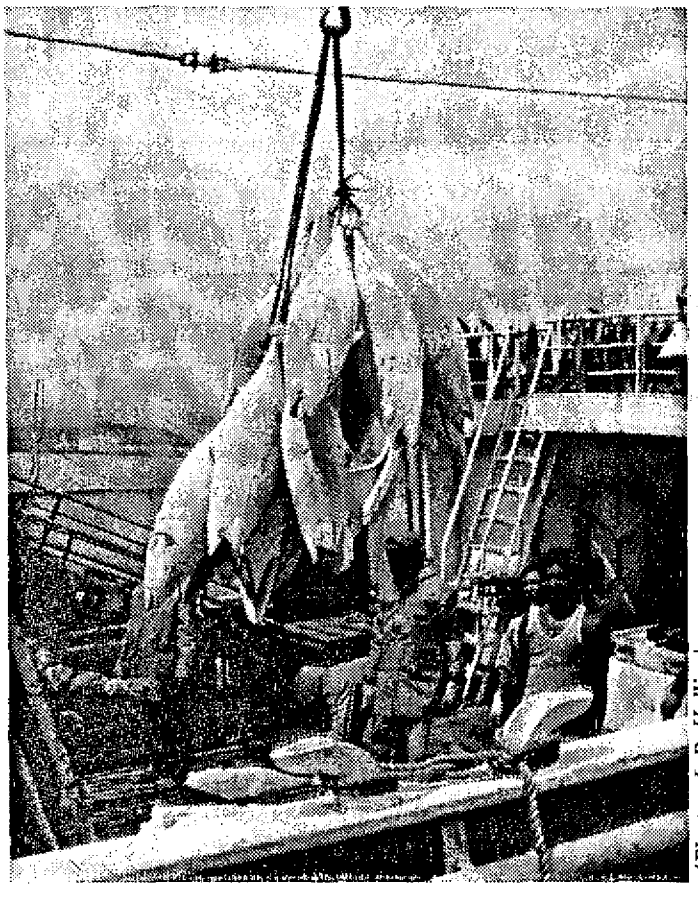
Table 5 - Average prices of Polypêche fish at Tsukiji (Tokyo) sashimi market in March 1984

Species	Average price (in Yen/kg)
Albacore	380
Bigeye	870
Yellowfin	500
Striped marlin	1000
Blue marlin	390
Black marlin	380
Swordfish	730
Sailfish	390

4. Conclusions

On average, during the first eleven fishing months, the crew of the local longline vessels achieved good catches and catch per unit of effort. Their results, in terms of total catch and cpue were as good as those of the Japanese longline vessels which fished in the New Caledonia area for many years. However, they are catching too many low-priced albacore and not enough high-priced striped marlin, swordfish and yellowfin when compared to the Japanese vessels. This difference seems to be due to the fact that Polypêche longlines are generally too deep.

Probably, time spent fishing and fishing effort as number of hooks per set can be slightly increased. If Polypêche can maintain or even increase its present effort, and also target for the higher-priced species, it should prove to be a profitable venture.



(Photo: J.-P. Hallier)

Figure 4: Unloading the catch.

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SPC Fisheries Newsletter No. 31 - December 1984

COASTAL FISHERIES AND THE MANAGEMENT OF MANGROVE RESOURCES IN FIJI

by

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1. Introduction

The term "mangrove" raises different images in the minds of different people. To some mangrove areas are nothing but stinky, sloshy muddy areas encouraging mosquitoes and sandflies. To others mangroves are "wastelands" of no value until they have been "developed" through conversion or other means. However, to the indigenous island peoples who depend partly on mangroves for their subsistence or livelihood, mangrove forests provide a source of fuel, timber for construction of houses and canoes, and a variety of fish and crustaceans for food and income.

Mangroves in Fiji have been estimated to comprise between 19,684 ha and 49,777 ha, largely present on the two major islands of Viti Levu and Vanua Levu. Mangrove plants belonging to three families (Rhizophoracea, Meliacea and Combretacea) and four genera have been catalogued. There are about 60 species of plants that are found exclusively in mangrove habitats, which is a characteristic forest ecosystem. Different species of mangroves around the world have been used for a multitude of purposes, as shown in Table 1. In Fiji, as in other Pacific Islands such as Papua New Guinea, Solomon Islands, and Tonga, mangroves are known to be used mainly by rural dwellers on a sustainable basis for firewood, charcoal production, construction purposes, tannin, medicinal purposes, and the collection of fish, shellfish and other animals. As discussed below, mangroves are important contributors to coastal and estuarine fisheries. Apart from these "onsite" benefits, which are generally recognised, mangroves also act as a buffer to storm damage, prevent shore erosion and provide nutrient input into the coastal system because of their presence on the land-water interface.

2. A study of mangrove-associated fishes in Wairiki Creek, near Suva

2.a) Purpose of the study

Although some efforts have been made to study the flora and fauna associated with mangroves, detailed studies of icthyofauna have not been undertaken. The present study was undertaken by the Fisheries Division of Fiji's Ministry of Agriculture and Fisheries (MAF) with the main objective of obtaining more information on fishes associated with mangroves to assist with the arbitration procedures discussed in section 4. Though initially the study was conceived as a multidisciplinary one aimed at investigating the relationship between mangrove productivity and coastal fisheries, due to a number of unforeseen problems the project was narrowed down to a study of mangrove associated fishes.

Table 1: Products of Mangrove Ecosystems

A. Mangrove Forest Products

FUEL

Firewood (cooking, heating)
Charcoal
Alcohol

CONSTRUCTION

Timber, scaffolds
Heavy construction (e.g. bridges)
Railroad ties
Mining pit props
Boat building
Dock piling
Beams and poles for building
Floor, panelling
Thatch or matting
Fence posts, water pipes, chipboards, glues

FISHING

Poles for fish traps
Fishing floats
Wood for smoking fish
Fish poisons
Tannins for net and line preservation
Fish attracting shelters

TEXTILES, LEATHER

Synthetic fibres (e.g. rayon)
Dye for cloth
Tannins for leather preservation

FOODS, DRUGS, BEVERAGES

Sugar
Alcohol
Cooking oil
Vinegar
Tea substitute
Fermented drinks
Dessert topping
Condiments from bark
Sweetmeats from propagules
Vegetable from propagules, fruit or leaves
Cigar substitute

HOUSEHOLD ITEMS

Furniture
Glue
Hairdressing oil
Tool handles
Rice mortar
Toys
Matchsticks
Incense

AGRICULTURE

Fodder, green manure

PAPER PRODUCTS

Papers of various kinds

OTHER PRODUCTS

Packing boxes
Wood for smoking sheet rubber
Wood for burning bricks
Medicines from bark, leaves, fruit

B. Other Natural Products

Fish
Crustaceans
Shellfish
Honey
Wax
Birds
Mammals
Reptile and reptile skins
Other fauna (amphibia, insects)

Source: Saenger, P.; E.J. Hegerl and J.D.S. Davie (1983). Global Status of Mangrove Ecosystems, IUCN Commission on Ecology Paper No. 3

2.b) Study area

Wairiki Creek, which is about 15 km west of the Fisheries Division headquarters at Lami, was chosen as the study site because of its relatively undisturbed catchment area with only a few houses and limited agricultural development. The mean tidal range is about 0.9 m during neap tides and 1.3 m during spring tides. Mangroves in the Wairiki Creek area cover about 60 ha and Rhizophora stylosa, R.x sellala, R. samoensis, Brugiuera gymnorhiza, Xylocarpus granatum and Lumnitzera littorea, representing all three families which occur in Fiji, have been recorded here. The Wairiki Creek bottom is mainly mud of 0.3m or deeper along the main creek but coralline and rocky surfaces are also present along the coast.

2.c) Sampling method

Monthly sampling of 6 stations in Wairiki Creek was undertaken using 2.5 inch mesh gill nets, which were set in the late afternoon or evening incoming or outgoing half-tides and cleared at the following low or high tides. Efforts to use other qualitative sampling methods such as bush traps or box traps for smaller fish were not successful because of tidal currents.

The fishes were identified using various published keys. With some families, where the taxonomy is uncertain or under review (e.g. Mugilidae, Leiognathidae, Lutjanidae and Sphyraenidae) unpublished keys were kindly made available by specialists working on these groups who also verified identifications in some cases. Standard lengths, weight, gonad weight and stage of gonad development were noted.

2.d) Results

In the 12-month study period, 1,308 individuals belonging to 42 families of fish and two families of crustaceans were caught while utilising the mangrove area as habitat for feeding and/or nursery grounds during various times of the year. The total number of species caught was 92, of which at least 70 species are of direct food value in Fiji. Of the estuarine and coastal fish species, which comprise over 70% of the fish sold in Fiji's markets, 60% were caught during the study period. Table 2 lists the families represented in the catch while Table 3 shows the more common fish species taken.

The species composition of the catch was typical of highly saline estuarine waters. Some species such as Kuhlia bilunulata and Mesopristis kneri were caught mainly after heavy rainfall. These species were also caught in other mangrove rivers with high freshwater runoff. Wairiki Creek, with its low freshwater runoff and low-tide salinity in the range of 20-32 ppt even after heavy rains, and with the presence of coral reefs and deep waters nearby, attracts a number of coralline, coastal species such as those belonging to the Plectorynchidae (harlequin fish), Triakidae (dog-sharks), Chaetodontidae (butterfly fish), and Lutjanidae (snapper) families. Species such as Siganus vermiculatus, and Lethrinus harak were caught in large numbers during dry periods when the water was less turbid.

Table 2: Families of fish and crustaceans caught using 2.5" Gill Net in Wairiki Creek during May 1982-April 1983

Family	No.	%	Wt.(g)	%
Fish				
Mugilidae	211	16.6	55 704	23.0
Leiognathidae	152	11.6	7 852	3.2
Lutjanidae	140	10.8	31 641	13.0
Mullidae	127	9.7	21 402	8.8
Siganidae	118	8.9	23 989	9.9
Lethrinidae	75	5.5	12 287	5.1
Gerridae	66	5.0	6 832	2.8
Carangidae	67	5.1	8 155	3.4
Apogonidae	14	1.1	-	-
Kuhlidae	28	2.1	3 558	1.5
Polynemidae	25	1.9	3 716	1.5
Acanthuridae	28	1.8	2 430	1.0
Theraponidae	23	1.7	3 233	1.3
Tetradontidae	15	1.1	4 976	2.0
Bothidae	9	.7	352	.01
Monodactylidae	5	.5	-	-
Belonidae	6	.5	3 830	1.6
Sphyraenidae	7	.5	4 056	1.7
Muraenidae	3	.2	4 164	1.7
Serranidae	5	.4	610	.02
Scombridae	2	.2	750	.03
Plotosidae	2	.2	220	.01
Chaetodontidae	3	.2	260	.01
Eleotridae	2	.2	329	.01
Hemirhamphidae	2	.2	582	.02
Dasyatidae	2	.2	1 770	.07
Dactylopteridae	2	.2	170	.10
Trichiuridae	1	.1	600	.2
Megalopidae	1	.1	600	.2
Triakidae	1	.1	1 576	.7
Periophthalmidae	1	.1	70	.01
Platacidae	1	.1	110	.1
Chirocentridae	1	.1	-	-
Muraenesocidae	2	.2	2 300	.9
Solidae	1	.1	350	.1
Priacanthidae	1	.1	-	-
Scaridae	1	.1		-
Scorpaenidae	1	.1	-	-
Plectorynchidae	1	.1	140	.1
Fistularidae	1	.1	-	-
Crustacean				
Portunidae	154	11.8	32 829	13.5
Xanthidae	1	.1	-	-
TOTAL	1 308	100	242 422	

Table 3: List of species of which 10 or more individuals were caught using 2.5" gill net in Wairiki Creek during May 1982-April 1983

	No.	Average Weight (gm)	Average Length (mm)	Length Range (mm)
Mullidae				
Upeneus sulphureus	23	186	186	125-270
Upeneus vittatus	71	185	225	105-316
Parupeneus indicus	33	120	214	112-305
Gerridae				
Gerres macrosonna	94	104	124	125-185
Carangidae				
Caranx sexfasciatus	28	96	151	135-215
Caranx papuensis	35	111	163	130-230
Leiognathidae				
Gazza minuta	31	46	123	95-160
Leiognathus equula	107	53	121	80-180
Leiognathus fasciata	14	50	117	96-141
Siganidae				
Siganus vermiculatus	117	198	173	100-290
Lutjanidae				
Lutjanus argentimaculatus	45	429	258	116-470
Lutjanus fulvus	71	126	165	125-255
Lethrinidae				
Lethrinus harak	69	167	195	124-310
Mugilidae				
Valamugil seheli	72	337	259	190-420
Valamugil buchanani	37	268	236	140-271
Liza subviridis	77	203	229	185-340
Liza tade	19	200	220	185-276
Kuhlidae				
Kuhlia bilunulata	27	132	178	155-230
Polynemidae				
Polydactylus plebius	22	147	205	160-303
Acanthuridae				
Acanthurus xanthopterus	28	87	126	100-185
Theraponidae				
Therapon jarbua	22	147	182	135-195
Crustaceans				
Scylla serrata	79	383	135	60-205
Portunus pelagicus	45	-	69	30-105
Portunus sanguinoleucus	39	-	91	40-140

2.e) Discussion

Because of high diversity, the small standing crop of any one species, limitations of the sampling techniques and few individuals being caught during any one sampling trip, it was not possible to ascertain definitely which species utilised mangrove for spawning purposes and/or as nursery grounds and feeding areas. However, some general observations on the more common species can be made.

Mullidae (goatfishes), and Mugilidae (mullets) which were caught all the year round appear to use mangroves as a habitat for feeding as well as nursery grounds, as do Leiognathidae (pony fish), and Gerridae (slipmouths), of which families individuals with mature gonads were also caught. Juvenile Lutjanus argentimaculatus (mangrove jack), various species of Carangidae (trevallies), and Acanthuridae (butterfly fish) were caught all year round and appear to use the mangrove creek as a nursery ground. No adults of these species were caught.

Siganidae (rabbit fish) were caught all the year round, though only two individuals caught in January had ripe gonads. Juveniles of commercially important species such as Sphyraenidae (barracudas), and Carangidae (trevallies) were also caught. Other species such as the eels, though caught in small numbers, appear to utilise mangroves as a habitat for breeding and feeding as well as nursery grounds. Crustaceans, of which Scylla serrata (mangrove crab) is the most important species, were caught all the year round, at various stages of maturity.

3. Mangroves and the Coastal Fishery

Commercial fisheries in the tropics are largely dependent upon coastal and estuarine fishes. In Fiji, over 70% of the fishes landed in municipal markets are coastal or estuarine species mainly dominated by Mugilidae, Siganidae, Carangidae, Lutjanidae and Lethrinidae. Of these over 60% of the species were found to spend some time in the mangroves. It has been roughly estimated that at least 30% of the commercial fishery is intimately tied in with mangroves.

Mangrove estuaries are one of the most productive natural systems, the mangroves being the primary source of nutrients for the aquatic organisms which provide the basis for the secondary productivity of the estuarine and coastal zone. In Fiji, about 1,100 gm/m2/year of litterfall have been recorded, which compares with litterfall of 1,000 gm/m2/year in Queensland recorded by J. Bunt and co-workers at the Australian Institute of Marine Sciences. Detritus forms the basis of the food chain within the estuary and coastal zone; detritivorous fauna then in turn provide food for organisms of higher trophic levels. Though the actual correlation between the fishery production and mangrove estuarine area is not fully understood, as few specific examples are available, it is gradually becoming apparent that coastal fisheries are often dependent upon mangrove survival. For example in Indonesia, recent investigations have indicated close correlation between mangrove estuarine acreage and annual yield of penaeid shrimps.

For developing countries and particularly for the small island nations of the Pacific with limited natural resources and considerable dependence on coastal fisheries, rational management of mangrove resources is essential for the conservation of their coastal fisheries. This can be achieved by managing mangroves for multipurpose utilisation and by avoiding or preventing activities which reduce natural primary productivity.

4. Historical 'development' of Fijian mangrove areas

Though the value of mangrove areas may be recognised, policy in many countries places emphasis on short-term economic development rather than longer-term objectives. This frequently results in a piecemeal approach to provide solutions to immediate problems under which mangroves have been allowed to be irreversibly converted or exploited for various purposes. For example, in Fiji where there are increasing demands for flat lands for agriculture and aquaculture, and for waterfront lands for industrial and residential purposes, and where an apparent shortage of land has resulted from the present land tenure system, "new lands" have been "created" by reclaiming mangrove areas. In the process highly productive mangroves have been reclaimed for recreational and industrial purposes (Table 4). Also, with increasing urban populations and mounting waste disposal problems, mangrove swamps have been used as refuse dumping sites by local councils and public. These irrational conversions to provide short-term solutions to immediate problems are not only found in Fiji but have also been prevalent on the South American, Asian and Australian continents.

In Fiji several attempts have been made to "manage" the mangroves. Management measures have included a moratorium on mangrove exploitation, the issue of forestry licenses for timber and charcoal production, and the creation of an arbitration procedure to compensate the indigenous Fijians who own customary fishing rights, for estimated losses incurred as a result of mangrove reclamation. The moratorium was lifted after numerous complaints from the indigenous population who were also prevented from subsistence use of resources. The forestry licences are still issued but only for domestic use of mangroves for fuel, firewood, etc., where large scale reclamations are not licenced. The arbitration procedure is the only form of "management", if it can be called that, which is presently enforced.

Under the arbitration procedure, the value of loss of resources and the right to fish due to "development" changes is determined by the government appointed arbitrator and is to be paid to the traditional fishing right owners by the developer. The value of this compensation has varied from F$900 for 20 ha to F$9,500 for 7.6 ha. Though the arbitrator's decision is based upon submissions made by the Fisheries Division and Forestry Department of MAF and traditional fishing right owners, it has been recognised that meaningful information on the real value of mangrove resources is limited, that decisions must therefore be made on an ad hoc, individual basis and that more information and a structured approach to management is required. Also, it is accepted that the arbitration system is not adequate for conservation as usually the arbitration hearing is the last step before the actual destruction of mangroves.

5. Future management of mangrove resources

The Fisheries division, realising the need for a structured management approach to conserve mangroves, organised an interdepartmental workshop in February 1983. The general conclusion of the workshop, which was subsequently endorsed by the Fiji Government Cabinet in August 1983, was that a National Mangrove Management Plan was urgently required and that a zone map should be prepared and adopted indicating areas where different types of mangrove use were to be allowed. The workshop report is available from the MAF as Fisheries Division Technical Report Number 5.

Table 4: Mangrove Reclamations approved since 1980

Where comments are not made reclamations have been for urban or industrial development

Location	Area (ha)	Comments
Suva Peninsula		
Narain Construction, Lami	4.5	
Tamavua River by Ministry of Lands	13	
Bhindi Brothers, Vatuwaqa	2.6	
Fiji Industries, Lami	11	
Lami Town Council Park	13	Recreation
Ika Corporation, Lami	1	
Suva City Council	39	Mangrove plus mudflat
Lami Town Council	2.9	
Nabua Road, PWD	7.6	
Laucala Beach Estate, Burgess Interstate Ltd.	20	
Walu Bay, Edinborough Drive	.5	
Rewa Delta		
Waidamu River	200+	Agricultural purposes
Ba Delta		
Sarava	70	Agricultural
Votua	25	"
Labasa Delta		
Seaqaqa sawmill	4.5	Approved in principle
Malau-Simpson Brothers	1.5	Approved in principle
Malau, Fiji Industries	8.5	
Vakamasuasua	22+	
Malau, Ministry of Commerce	2.2	
Bua reclamation	71	Agriculture
Lautoka-Nadi		
Maqalevu	32	Agriculture
Drasa North, Central and Southern	95	"
Saweni Beach Tourist Development Fiscal Industries	493	Approved in principle
Vitogo	18	Agriculture
Lovu	40	"
Teidamu	5	"
Lomolomo	60	"
Navakai	50	"
Lomawai	20	"
	1,300	

Other large-scale reclamation undertaken prior to 1980

Penang	160 ha
Rarawai	320 ha
Tabicola	120 ha
Wailevu	900 ha
Dreketi	150 ha
Nasea	1,230 ha
Wainikoro	470 ha

However, problems still remain with the preparation of a National Mangrove Management Plan. Figure 1, which was prepared at the recently held Mangrove Workshop at the Environment and Policy Institute at the East-West Center, Honolulu, Hawaii provides a preliminary guideline. Even where resources for compiling mangrove data bases are limited, management plans can and should still be developed, although later modifications may be needed.

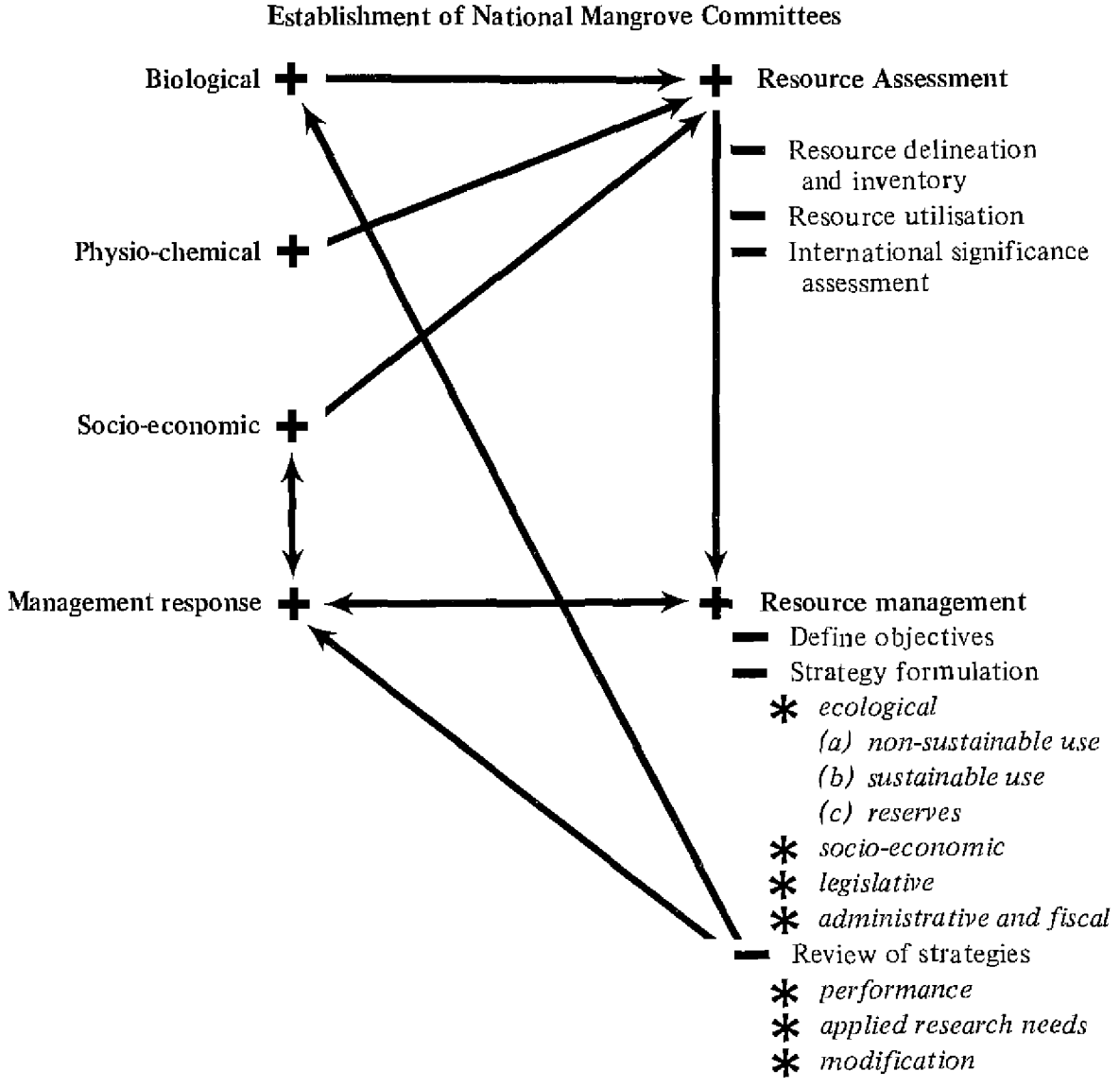
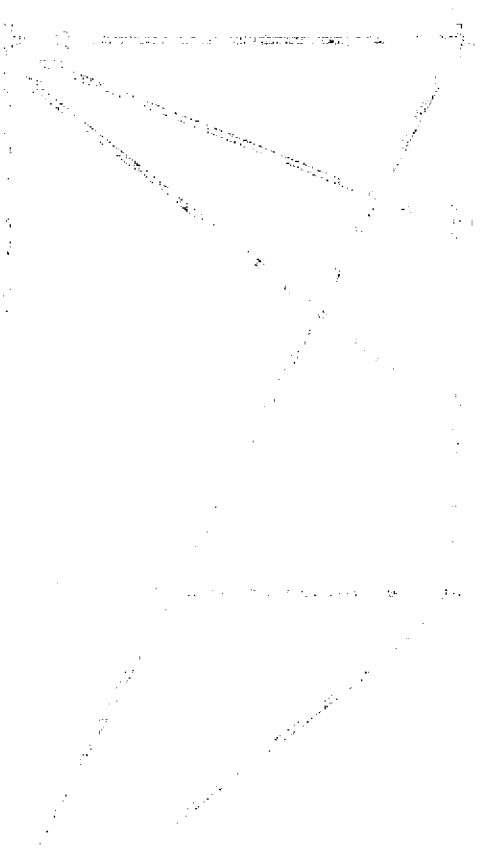


Figure 1: Features of National Plans and Mangrove Data Base, showing most important linkages.

Source: Mangrove Managers Handbook (in preparation), Environment and Policy Institute, Honolulu, Hawaii.

Island nations in the Pacific need to prepare their own national mangrove management plans for the rational utilisation of mangroves which would take into account the need for conservation of coastal fisheries.



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THE FATE OF A NORTH AMERICAN GAME FISH IN THE SOUTH PACIFIC

by
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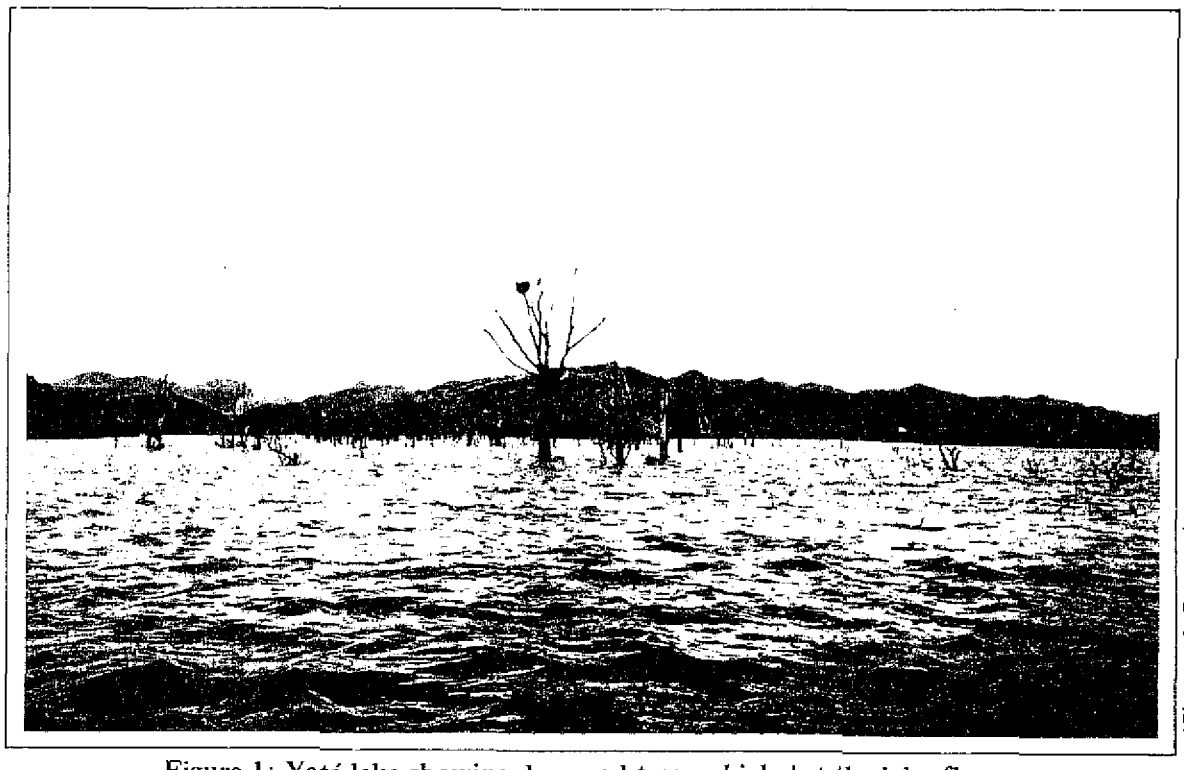
Noumea, New Caledonia

Largemouth bass (Micropterus salmoides), the notorious North American game fish, made its debut in the Pacific when it was introduced to Hawaii in 1897. It adapted quickly to tropical waters and became self-sustaining in the reservoirs of most Hawaiian islands. Its subsequent introduction to New Caledonia in 1960 was an attempt to control the tilapia (Oreochromis mossambicus) population of the newly-created Yaté reservoir and to provide fresh water angling (Devambez 1960). The fate of the 19 fingerlings introduced from Hawaii was sealed when, three years later, the first recorded catch of adult bass (Devambez 1963) marked the beginning of a sport fishery that spanned the next 20 years. Recently, however, allegations of declining catches and a drop in utilisation (measured as the number of boat licenses issued), prompted the local authorities to investigate the present status of the fishery. As a result, an initial research proposal (Anon, 1982) was developed and forms the basis of the present study, which was conducted between August 1982 and December 1983 by the author in cooperation with New Caledonia's Water and Forests Service. This paper presents the results of the evaluation of the fishery and proposes management strategies necessary for the rehabilitation of the fishery, and within the scope of the existing infrastructure.

During the study, 141 bass fingerlings were captured and flown to Fiji where they were introduced to the Vatum reservoir by the Fiji Fisheries Division, further increasing the range of the species.



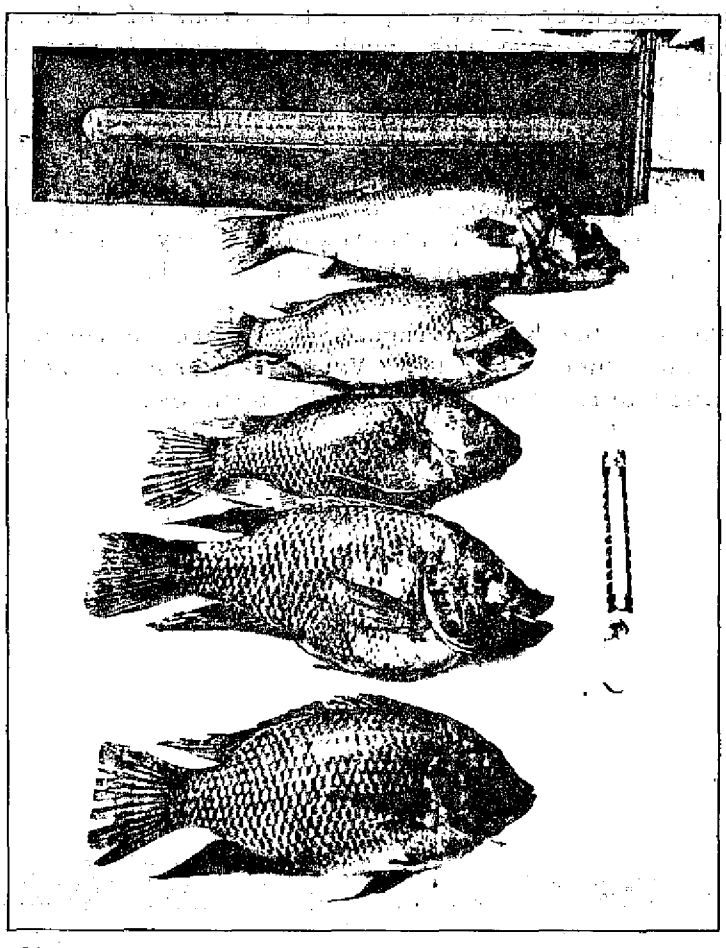
(Photo: G. Preston)

Figure 1: Yaté lake showing drowned trees which dot the lake floor.

1. The status of the fishery

The Yaté lake fishery was evaluated by comparing the 1982 and 1983 catch and effort statistics with those of North American lakes. In 1982, the statistics were derived from the fishermen's answers to a written questionnaire and the number of boat permits issued that year. The number of bass caught (1,435) and the number of hours fished (2,870) were calculated from the most frequent answer to each question and the total number of fishermen. This number was estimated from the ratio of boat to on-foot anglers and the number of boat permits. These figures represent a catch rate of 0.5 bass/hr and a fishing effort of about 1 man/hour/hectare (hr/ha) in 1982.

In 1983, similar statistics were derived from monthly on-site interviews of a total of 22 fishing parties of 1 to 3 anglers and from records kept by 40 volunteer anglers. The information collected was then applied to activities observed but not censused and extrapolated to the entire season. It was thus estimated that 1,722 bass had been caught and 3,421 hours fished between 15 February and 30 September 1983, giving approximately the same catch rate as in 1982.



(Photo: R. Farman)

Figure 2: Two introduced species: black bass (top fish) and tilapia.

In comparison, 24 reservoirs in the United States sustained an average effort of 12.4 hrs/ha and an average catch rate of 0.7 fish/hr all species combined (Campbell et al. 1976) and bass tournament fishermen caught between 0.05 and 1.0 bass/hr in 46 reservoirs (Holbrook, 1975). Fishing quality in Yaté lake, as measured by catch rate, is thus about average, although better results could be expected from such a lightly exploited population. The second part of the study on the structure of the fish community gives a better insight into the fishery.

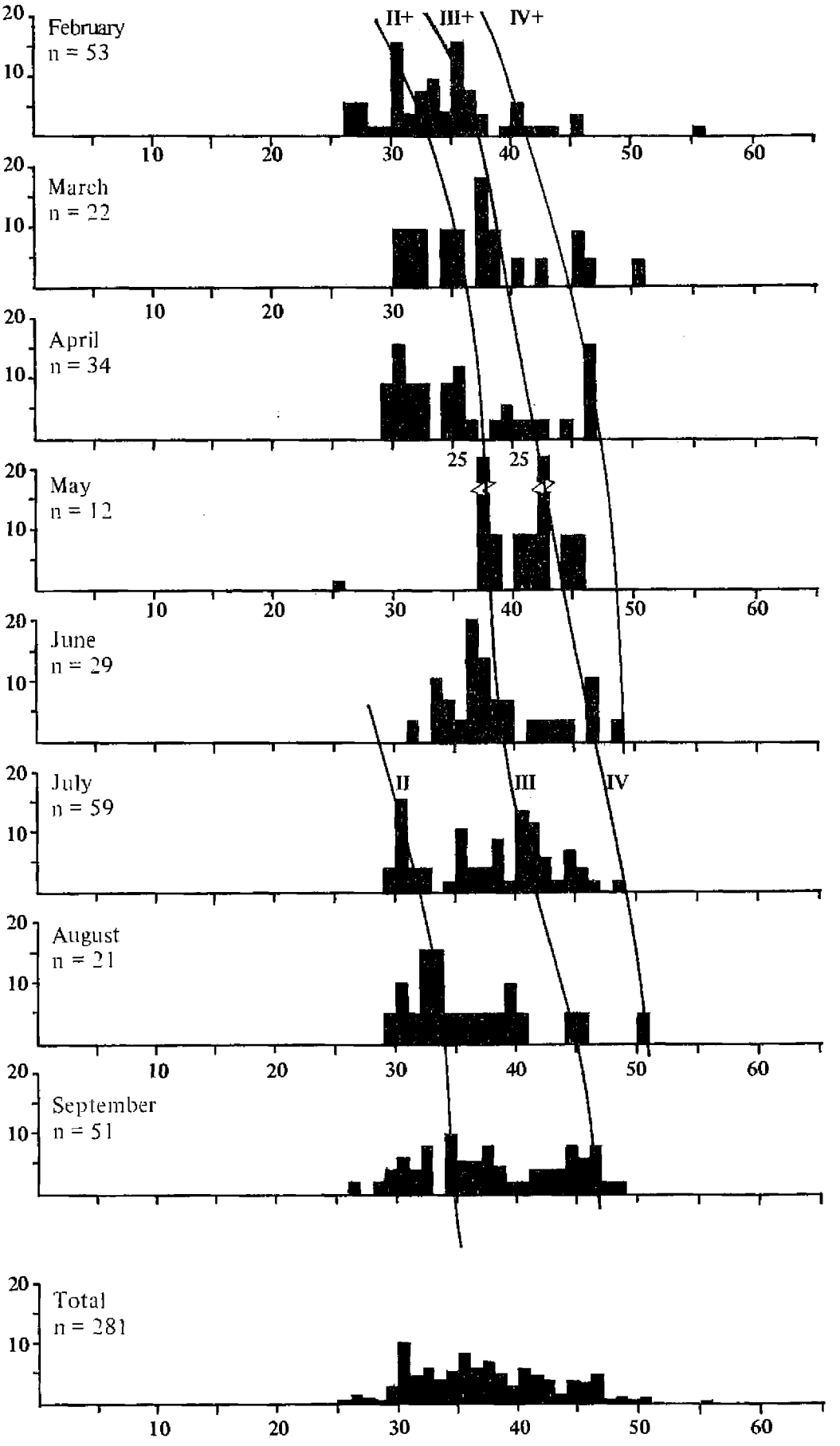


Figure 3: Monthly length-frequency histograms for black bass measured during the 1983 fishing search.

2. The structure of the fish community

This part of the study concentrated on the two factors most often associated with declining catches in ageing reservoirs: predator (i.e. bass) recruitment failures, and imbalanced predator-prey assemblages.

The predator-prey ratio was derived from gill net sets, of 24 hrs each, at six fixed locations each month. The ratio of 1:1.4 is well above the recommended level of 1:3 (Swingle and Swingle, 1968; Swingle, 1950) indicating a shortage of prey. In addition the absence of intermediate size tilapia, not only in gill net catches (which could have been biased by the selectivity of the gear), but also in the stomachs of the bass shows that the forage base is not adequate to support a large predator population.

Larger size classes also dominate the length composition of the bass caught (15, 34 and 52% for the 20-30 cm, 30-37 cm and 37+ cm classes respectively). Although fishermen tend to be selecting for bass greater than 30 cm, the sample still reveals a "top heavy" population relative to the ideal proportions of 40-50, 35-40 and 10-25% for the same size classes. This deficiency in the intermediate class is indicative of poor recruitment. Monthly length frequency plots (figure 3) indeed show that in most cases the size class just recruited (left-hand line) is not prevailing over size classes that have already been exposed to fishing (right-hand lines).

This recruitment problem can be traced to prey availability and water level. The analysis of bass stomach contents shows a fluctuation in the importance of fish in the diet (figure 4) that can be directly linked to the apparition of juvenile tilapia or bass in the field (February-June and September respectively). Since the importance of shrimp in the diet is inversly related to that of fish it implies that the supply of young tilapia is exhausted at the time of bass emergence, resulting in heavy cannibalism.

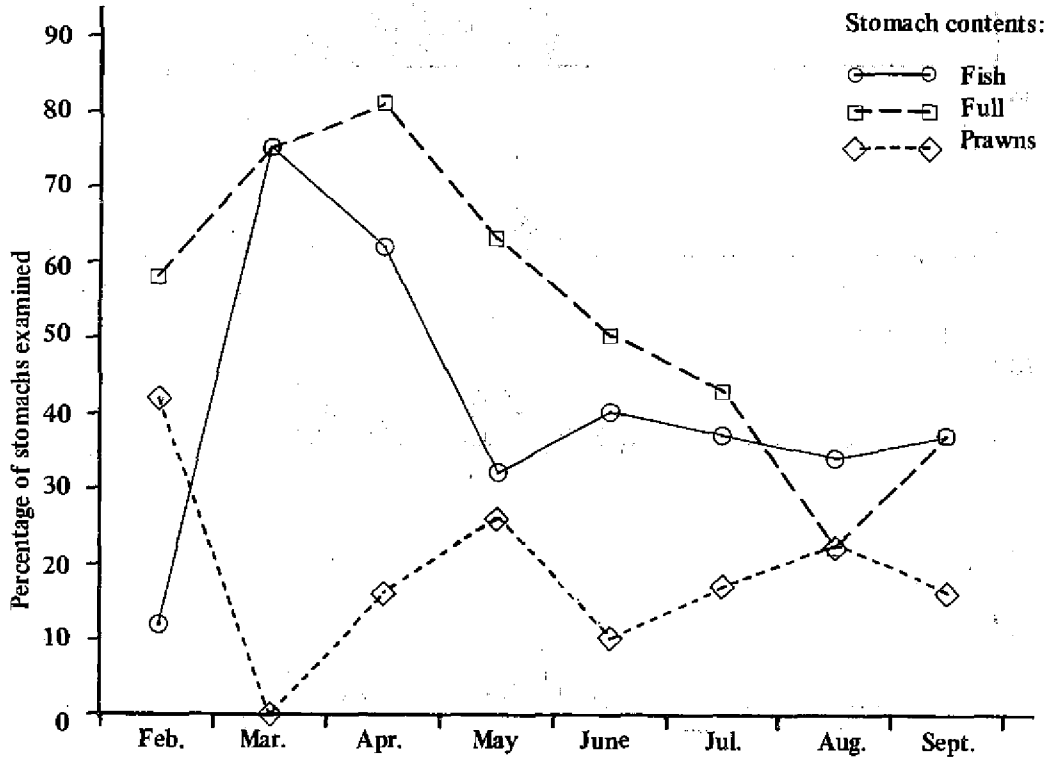


Figure 4: Monthly plot of percentage of black bass stomachs which were full, or contained fish or prawns.

Water levels have been related to year-class strength (Aggus and Elliott, 1975; Keith, 1975). Draw downs in spring and summer, as occur in Yaté lake, have been shown to adversly affect brood survival by exposing nests and reducing food availability. They have also been used to control prey populations by facilitating predation by crowding the prey. This measure, however, works equally well on young bass which are the available prey at the time, and the reproduction deficit is compounded.

These observations imply that the situation in Yaté lake is the result of a negative feedback in the bass population. The initial population explosion, unchecked by the subsequent low level of exploitation, drove the bass to "overgraze" their forage base (tilapia). The result is a slow-growing 'top heavy' population.

3. Management implications

The situation will not improve on its own and fishing success will fluctuate from year to year. A common solution, stocking, provides immediate relief to the prey population, yet it seldom results in long lasting improvements unless it is kept up. The community should thus be manipulated by removal and protection until a balance is obtained between predator and prey population. A figure of 15 bass/ha may be used initially (Childers and Bennet, 1967). Large individuals of both species should be removed to (1) alleviate the predation pressure and (2) stimulate a faster tilapia population turnover. Because of low angler activity and their disregard of tilapia it may be initially necessary to supplement catches with gill nets. It is also necessary to protect juveniles of both species to buffer the effects of predation, building up recruitment to both populations. Artificial shelters have been used in many reservoirs to increase the productivity of open waters (Prince et al. 1975). In Yaté Lake, juveniles have been observed congregating at creek mouths and are concentrated in large pools during drawdown. Strategically placed shelters could improve juvenile survival substantially.

4. Conclusions

Yaté lake has provided a welcome alternative to marine recreation in New Caledonia in the last 20 years. However, the structure of the predator-prey community has been altered by hydrobiological factors resulting in an unbalanced combination. Stimulation and protection measures on both tilapia and bass populations should check the negative feedback mechanism at work and allow the populations to rebuild, eventually restoring the quality of fishing to the lake. This prescription is widely applicable to closed predator-prey systems.

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