UNDP / FISHERIES DIVISION

Small Scale Tuna Fishing Project

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1) Introduction, Background, and Project Aims

Fiji's artisanal fishermen have a limited history of tuna fishing, despite the fact that extensive tuna resources exist within short distances of most parts of the Fijian coastline. Traditionally fishing activities have been mainly concentrated within barrier reefs, and as a result effective techniques for the capture of surface schooling tunas have not developed as they have in other parts of the Pacific. Tuna are only occasionally seen on the fresh fish market; of 772 tonnes of fish sold in Fiji's municipal markets in 1980, only 2.2 tonnes (0.29%) were tuna. Prices varied between markets, but were within the range F$1.15 (Nadi) - F$1.52(Suva) per kilo, for the small quantities sold, as compared to average fish prices (for all fish species combined) of F$1.54 (Nadi) to F$1.74 (Suva). Tuna is locally regarded as being of inferior quality and consumers tend to be unfamiliar with, and wary of, these fish, which are characterised by red or pink flesh.

Despite underutilisation by the artisanal sector, tunas support an expanding industrial fishery currently comprising 12 pole and line boats and two purse seiners. Pole-and-line boats have taken catches up to 20 tonnes in a day and purse seiners up to 60, and there is little doubt that the resource is extensive. Pole-and-line catches show a strong seasonal variation, but this is thought to be attributable more to fluctuations in the bait supply rather than in tuna abundance. Tuna schools can be observed in Fiji waters all year round; 'out-of-season trials by purse seiners have at least partly confirmed that the fish are available for capture during the months of June-September, when bait is scarce and the industrial pole-and-line boats frequently cease operations. At other times of the year, tuna is abundant, pole-and-line catches tending to peak in January or February. All fish caught industrially is delivered, iced or brine frozen, to the Pacific Fishing Company's cannery in Levuka, where prevailing prices are around US$1100/tonne.

In spite of the great length of coastline and the extent of lagoons and other productive areas in Fiji, fish supplies are unable to meet demand in many parts of the country, particularly urban centres.

A number of stretches of coastline are fully or over-exploited, but as yet no effective distribution channels exist between underutilized areas and centres of consumption. Although development of such channels is progressing, a further logical step towards improving this situation is to divert fishing effort from the over exploited lagoon areas around urban centres to the abundant resources outside the reef, namely surface schooling tunas, pelagic non-tuna species, and deep sea snappers, in the vicinities of the same urban centres.

A significant development in this regard has been the deployment in Fiji waters of fish aggregation devices (FAD's). These devices, consisting of rafts or buoys anchored offshore in depths of up to 1000 fathoms, serve to act, for reasons which are not yet clear, as a home base for surface schooling tuna, which remain in the vicinity of the FAD for days or weeks at a time. As schools move out, others move in, so the FAD acts as a virtually permanent tuna fishing ground, and does away with the necessity for fishermen to spend time and fuel each day searching for tuna schools. It is likely, though yet unproven, that FAD's will remain effective year round. As well as improving the economic performance of the industrial vessels, FAD's open the door to small boat fishermen, who can incorporate tuna fishing into their activities to a greater or lesser extent.

It Is known that large quantities of fish may congregate around a FAD, and schools of over 100 tonnes have been detected below some of Fiji,s rafts by echo sounder. In other parts of the Pacific, such as Western Samoa, dozens of small boat operators fish the same FAD on a full time basis. It was in an attempt to assess whether FAD's in Fiji promised the same potential that the United Nations Development Programme (UNDP) and the Fisheries Division of the Ministry of Agriculture and Fisheries embarked on the Small Scale Tuna Fishing Project. The broad aims of this project were as follows:

a) Identification of methods for the exploitation of tunas and other surface schooling pelagic fish practisable by small-boat fishermen. Evaluation of the effectiveness of FAD's in this context.

b) Identification of methods of processing and/or presentation necessary to encourage local sale of the catch.

c) Training of local people in both these fields by demonstration and active participation. Improving public awareness of the resource.

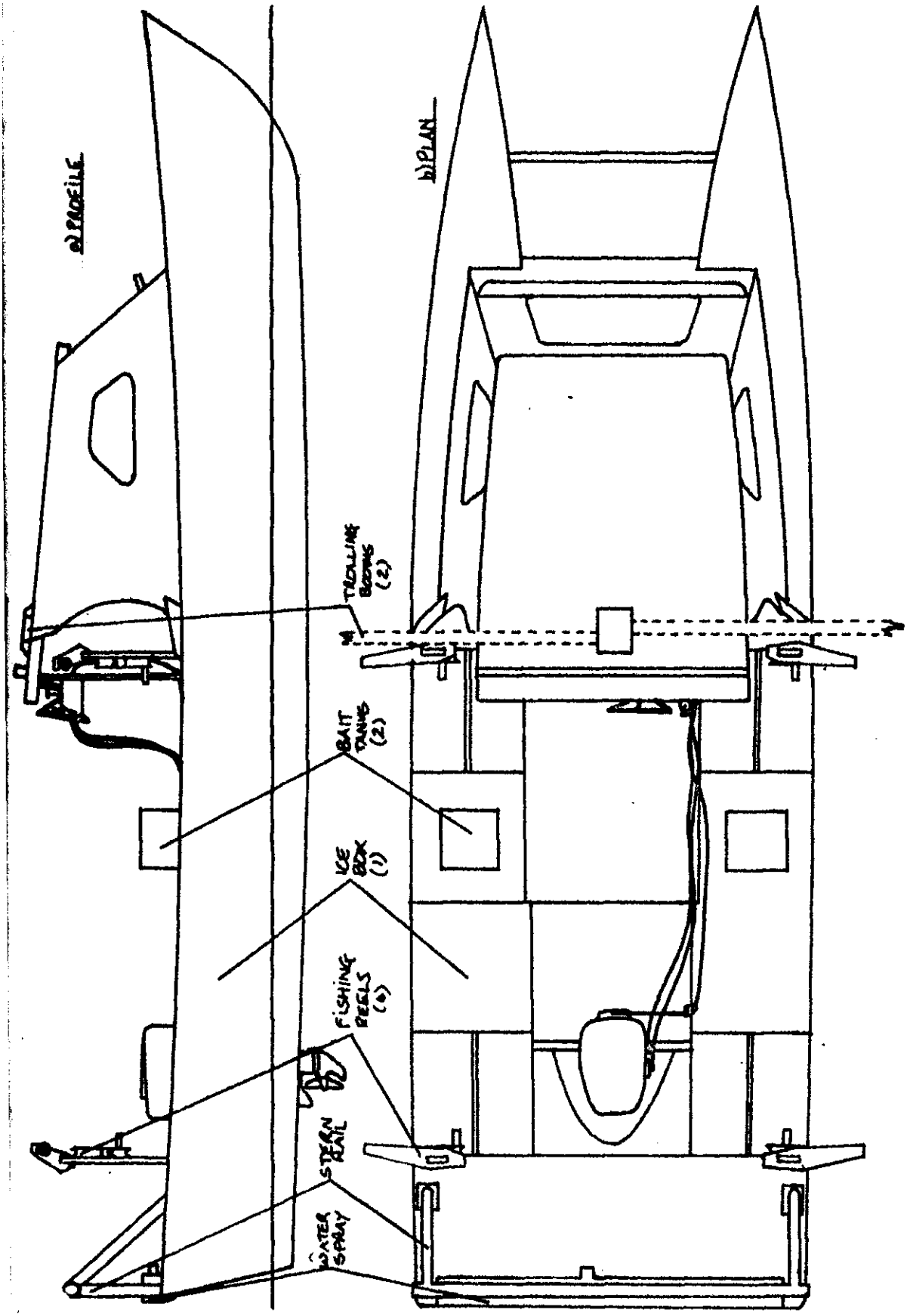
Each of these general areas covered a variety of specific activities which underwent extensive modifications as the project developed.

2) Implementation; Specific Objectives and Methods.

In order to effectively assess suitable fishing methods, a project vessel was provided by UNDP. This was an aluminium hulled catamaran of the Western Samoa 'alia' type, which is the standard FAD tuna fishing boat in that country. The hull sponsons were imported into Fiji from Western Samoa, and assembly of the hull and the deck and superstructure were completed by the Fisheries Division, using materials provided by UNDP. Final fitting out was completed on September 19th 1981 under the supervision of Mr. U. O'Brien, a Western Samoan fisherman who acted as UNDP project consultant on fishing and related aspects, for the 4-month period from 14th August to 16th December 19S3.J , The vessel had an overall length of 9m and was equipped with two live bait tank of approximately 0.7m3 each, one insulated ice hold of roughly the same size, four Samoan type hand operated fishing reels, and a Yamaha 75 h.p. outboard motor, which was subsequently replaced by a 40 h.p. outboard to reduce fuel consumption. A water spray was. fitted across the stern, and a 75 c.c. (240 gall/hour) portable petrol driven water pump and appropriate connector pipes provided adequate water for both the spray system and the live bait tanks. Figure 1 shows the vessels general arrangement.

It was envisaged that as many fishing methods as possible would be attempted during the consultancy period to enable comparison of their effectiveness. In particular, it was hoped that live-bait pole and line fishing could be attempted as in Western Samoa, where this type of fishing often yields upwards of 200 fish per day. Possible difficulties in bait supply were foreseen, since in Fiji there is no bait farm as there is in Western Samoa, and the project consultant had no experience of fishing with the comparatively fragile wild bait used by the industrial vessels. It was appreciated that a vessel of this size would have difficulty in capturing its own bait, and alternative means of supply were considered. The suggestion of beach seining, with the assistance of labour from; coastal villages, and using 3 joined seine nets from the Naduruloulou fish farm, was finally rejected in view of the difficulty of organising this activity, the uncertainty of success, and the time limits of the consultancy period. Two more likely means of bait supply were decided upon; the capture of bait by bouke-ami using Fisheries Division vessels, and the transportation of small trash fish from the Naduruloulou fish farm.

Fig.1:Alia,general arrangement.



first of these two activities the 20m "Tui-ni-Wasabula" with its 10 fathom bouke-ami (Japanese stick-held dip net) was made available on an occasional basis as time permitted., and the 12.5m "Tavuto", with a 6 fathom net, was used exclusively for project activities from November 3rd until the end of the project period. The second activity, transfer of fish from Naduruloulou, was attempted once on 8th October. Finally, a broad commitment by the industrial vessels of the Ika Corporation, to provide small quantities of bait when circumstances permitted, was obtained.

In addition to live bait pole and line fishing, trolling, night handlining and pole and line fishing with pearl shell lures were included in the list of fishing methods to be carried out, the latter at a late stage in the project. Pearl jig heads and rubber octopus lures for trolling were imported from Western Samoa and American Samoa at the beginning of the project and occasionally thereafter, those surplus to requirements being made available for sale to interested fishermen at cost. Pearl shell poling lures were imported from New Caledonia on 9th December and were used on one trip. Other fishing gear was provided by Fisheries Division, with the exception of 6 poles and 24 tuna jigs obtained from Ika Corporation, and about $100 worth of lures purchased locally using U.S. aid funds. All fishing was conducted under the supervision of Consultant Mr. U.O'Brien. Up to & Fisheries Division staff worked alongside the consultant during this period, as did over a twenty local Fijians. One member of UNDP's Suva staff acted as liaison with Fisheries Division and worked periodically on project activities.

The second broad aim, concerning marketing of the catch, was less rigidly planned, as it was intended to first dispose of the fish, gutted and gilled, at "introductory prices" to consumers at the point of landing, and to the National Marketing Authority terminal in Lami for storage and subsequent sale to individuals and institutional buyers. To improve saleability if necessary, possibilities considered were smoking of tuna fillets, and sale of frozen fillets and steaks in attractively designed cartons or packages. In the event, only the former of these activities was carried out on a trial basis.

The third aim concerned exposure of project activities to local people. To this end at least two crew places were filled by interested villagers at all times, and on some occasions all four crew were 'trainees' It was appreciated that novice fishermen would probably reduce the vessels fishing effectiveness, but this was considered acceptable.

Provision was also made for part of the catch to be given to local people who joined the vessel.

Prior to the commencement of active fishing, two FAD's were laid, sites were selected bearing in mind the following important factors, which limit freedom of choice:

a) Shelter from prevailing winds
b) Known occurence of fish in area
c) Proximity to identified shipping lanes
d) Proximity to coast
e) Proximity to Suva

Item a) clearly has a bearing both on the likelihood of raft loss and the conditions in which the vessel has to operate. As south-easterly winds prevail in the Fiji group, sites sheltered in this direction were preferred. Item b) refers to the fact that a FAD does not appear to attract fish to an area in which they do not normally occur, but rather serves to act as a focus for the otherwise unpredictable wanderings of any schools already present. Item c) is a voluntary restriction accepted for the time being by the Fisheries Division, in deference to the Marine Department of the Ministry of Tourism, Transport and Civil Aviation's contention that FAD's constitute a potential hazard to shipping. It may be possible to review this restriction once seamen accept the presence of rafts in areas of only moderate traffic. Item d) refers to the tendency of skipjack to move close into reefs for short periods to feed. It was felt that if a raft were to be located too close to a reef, the effect would be to disperse the fish and enable them to feed more heavily, possibly rendering them less available to pole-and-line fishing. The final consideration, proximity to Suva, refers to the fact that many of the facilities required for the projects operation were available only in that place. Adequate supplies of ice, fuel and fishing gear, plus administrative, and budgetary restrictions on operating service vessels and staff out of station, and the relative availability of processing and freezer storage facilities, were all factors which effectively limited the operational base of the project vessel to within one days travelling, or about 80 miles, of Suva.

Bearing all these constraints in mind, two rafts were located in the sites marked on Fig. 2: raft A in the tee of the Beqa/Yanuca archipelago, about 2% miles outside Frigate passage: and raft B in the lee of Vatulele island, about 5 miles west of Vatulele lighthouse. It was originally intended that both these rafts be fished using a point along the coral coast as a home base, but as the project progressed

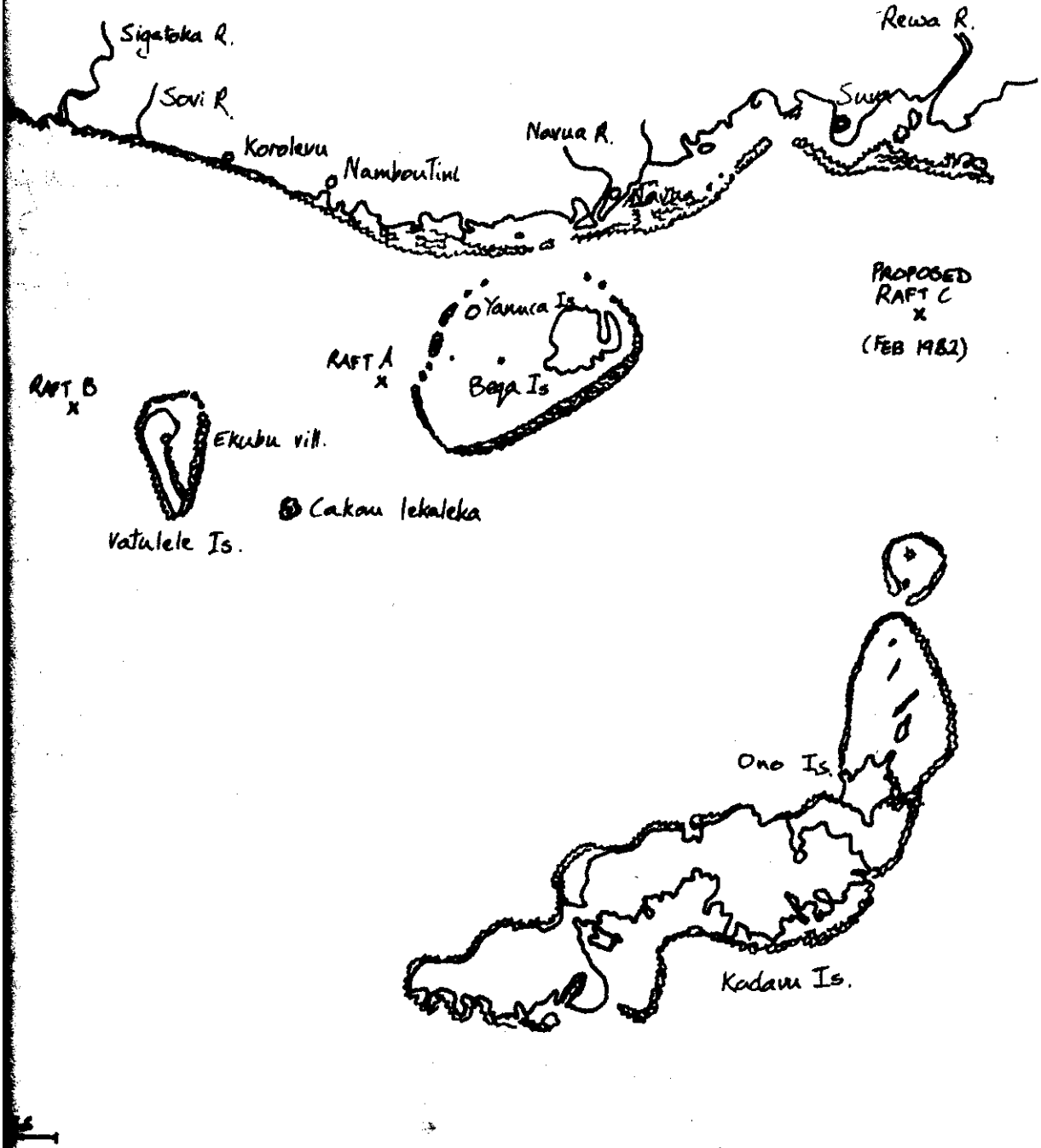


Fig.2:F.A.D. sites in southern Fiji.

it became clear that Vatulele Island would be a more suitable base. The problems this caused in servicing the project were overcome by allocating the FRV 'Tavuto' to the project full-time, and making weekly service runs to Vatulele in order to deliver ice, fuel and other requirements, catch bait, and collect fish for delivery to Suva.

Thus the project period was occupied as follows:

August 14th-Sept. 19th: vessel fitting out, gear preparation, Suva.

Sept. 200h-Sept. 26th : fishing raft A from Deuba

Sept. 27th-0ct. 26th : fishing raft B (rarely A) from Korolevu

Oct. 27th-Nov, 3rd : repairs to vessel, replacing engine, Suva.

Nov. 4th-Dec. 15th : fishing raft B (rarely A) Vatulele

The project officially terminated on December 16th, when the consultant and the Fisheries staff involved participated in the Fisheries Division's Annual Review and presented an interim report on the projects results.

3) Results; Catch rates, Landings, Project Economics and Indicated Potential.

a) Live bait pole and line fishing.

Perhaps the greatest disappointment of the project was the almost unbelievable scarcity of wild bait during the whole of the time when the catamaran was actively fishing. For parts of this period varying numbers of the industrial pole and line vessels were forced to tie up due to bait scarcity, and during all the FRV 'Tavuto's baiting trips to Vatulele (12 nights over 7 weeks) bait was seen around the lights on only one occasion, at which time a strong current prevented setting of the net. The FRV "Tui-ni-Wasabula" spent two nights baiting on behalf of the project, once off Pacific Harbour and once at Yanuca Island. Bait was present one both nights; however, on the first night a strong current rolled up the net, and on the second weather conditions were too rough to allow the catamaran to join the vessel, so the net was not set. The Ika Corporation vessel "Sunbird" also baited close to project locations on 4 separate occasions, but at no time caught any bait.

On October 8th, while the catamaran was still fishing from Korolevu, transhipment of about 10 buckets of trash fish from the Naduruloulou fish farm was attempted. The fish, mostly Gambusia (mosquito fish) and small (less than 5 cm) Tilapia were seined from 3 ponds at Naduruloulou and placed in a container containing about 0.5m water on the back of a 3 - ton truck. The water was oxygenated and after the 1 1/2 hour journey, partly on rough roads, the fish appeared to be in surprisingly good condition when loaded into a holding pond at Lami. However, about 8095 of the fish were found to be dead the next morning, and it was not considered worthwhile to attempt further transportation of the remaining fish.

Thus, bait problems completely prevented even a single trial of the live bait pole and line method. Whilst extremely disappointing, this situation very strongly underlined the danger of relying on a fishing method so susceptible to fluctuations in a basic requirement such as bait. The establishment of a reliable bait farm in Fiji, such as has occurred in Western Samoa, would certainly improve the potential of this fishing method, but if any reliance is to be placed on wild bait, periods of short supply must be anticipated and alternative fishing methods used.

b) Pearl shell pole and line fishing.

This was attempted only once, on December 10th, the day after a consignment of 6 pearl shell lures arrived from New Caledonia. The lures were used with the alia more or less stationary and in conjunction with the water sprays. Fish were seen to come around the stern of the boat but did not begin to bite. The alternative method of using the lures at a trolling speed of 5-6 knots has yet to be tested.

c) Trolling

Almost all fish caught during the project were trolled. The vessels four handreels and Two outrigger poles allowed a total of four lines to be worked, with an occasional short fifth line from the stern rail when additional crew were on board. A variety of lure heads and skirts were used (see fig. 3), one on each line. These were characterised by being generally smaller than those typically seen in use by Fiji's commercial fishermen, a typical lure being 10 cm long and 1 cm in diameter. Trolling speeds varied between 5-8 knots.

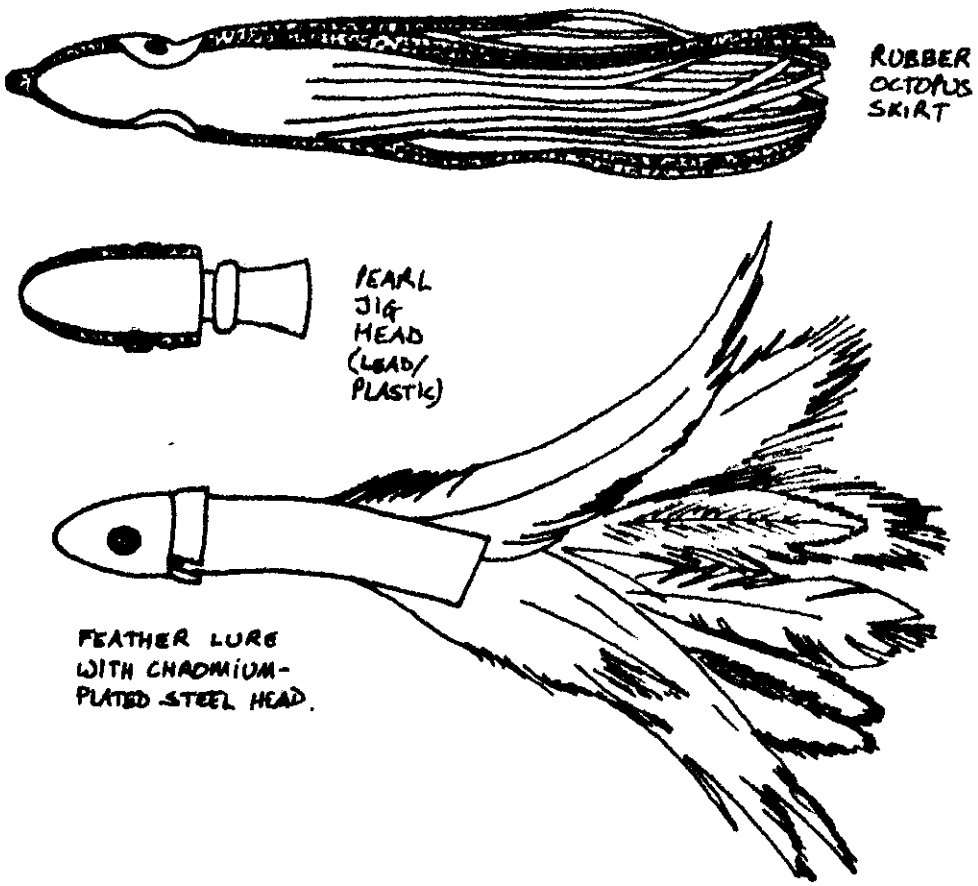
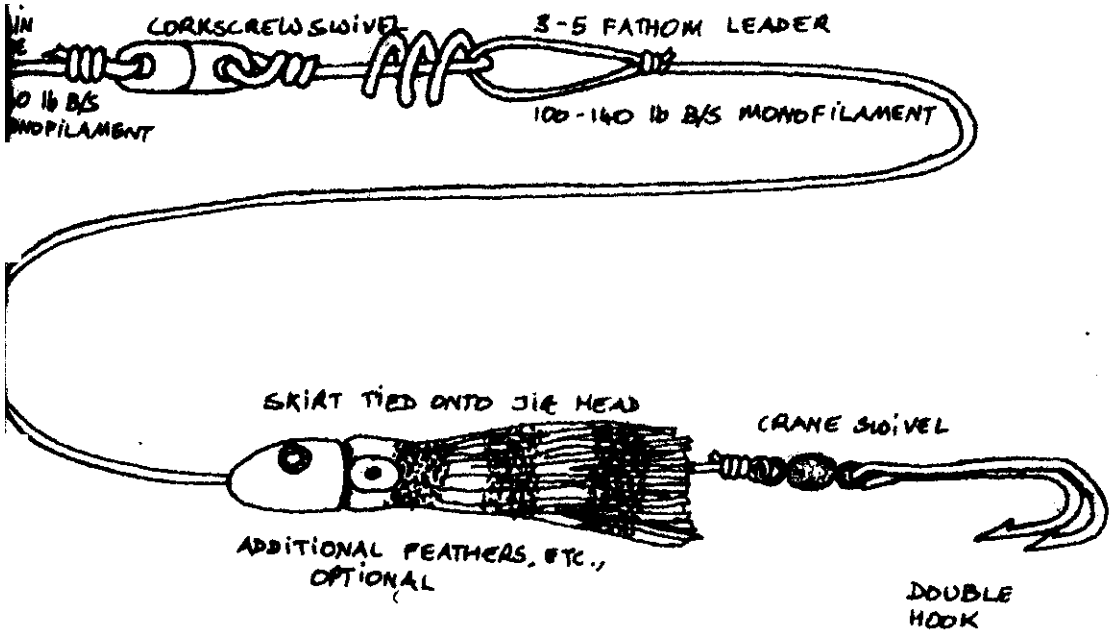


Fig.3: Lures used during the survey, showing rigging method.



Catches were variable, typically ranging from 3 to 20 fish per hour, with an average of about 10. Varying trip durations and the amount of time spent travelling (which was affected by weather conditions) make exact evaluation of catch rates difficult, but the table below gives indications of the figures which apply.

Table 1 Approximate catch rates during project period.

Dates	Location	Fishing Area	No.of trips	Av.time spent trolling	Catch No/wt (kg)	Catch/hr No/wt (kg)
20/9-24/9	Deuba	Raft A	1	12hrs	5/47	0.4/3.9
25/9-26/10	Korolevu	Raft B	8	6 hrs	481/1416	10.0/29.5
4/11-16/12	Vatulele	Raft B	42	2½hrs	1080/2562	9.5/24.4
			51	165hrs	1566/4025	9.5/24.4

As can be seen, over the project period catches averaged 24.4kg or 9-10 fish per hour. These figures exclude travelling times, which were about 3-4 hours per trip from Korolevu and 1-1½ hours from Vatulele. The greater distances involved account for the longer duration of trips made from Korolevu. The single trip made from Deuba immediately illustrated the impracticability of working from such a distant base.

It is probable that catches would improve as a fishermans knowledge and experience of the fishing method and conditions grew. Selection of the correct lures for use under particular conditions of weather, season etc. required local knowledge and an understanding of the behaviour of the fish on a raft, each of which appears to have different characteristics. It was observed while fishing raft B that some lures performed better than others, and a general preference for dark lures on overcast days, and lighter lures on sunny days was noted. On some occasions the tuna were seen to be feeding on small euphausiids (pelagic

shrimps) which were pink in colour, and on these occasions pink coloured lures performed well. Feathers and fluorescing plastic fibres (fire tails) were also incorporated into lures, but the number of variations used prevented definite conclusions on the effectiveness of each combination, (except in cases where lures seemed grossly more or less effective than usual) during the short period of the project.

A second factor affecting catch rates was the presence of numerous sharks, which were quick to attack hooked fish, around both rafts. Whether these are associated with the tuna schools, or the raft, or are free-ranging pelagic individuals, is uncertain, but their presence has accounted for the loss of a great number of fish (on bad days up to 50% of strikes were taken by sharks) and about $500 worth of fishing gear. Sharks were occasionally landed, but because of the length of time this took, it was more usual to bring the shark in close enough to retrieve the lure head and skirt, (which were free to slide up the leader), then cut off the sharks tail or fins and cut it loose. Sharks are not commonly regarded as an edible fish in Fiji, the only regularly saleable items being the fins, and the effort of landing the animals is not justified by the return involved. Nevertheless, sharks were a continual nuisance throughout the project, and it will be necessary in future to devise an effective method of thinning them out around the FAD.

d) Still fishing.

Two forms of still fishing were performed on an occassional basis during the project. The first was daytime float fishing, practised in response to the observation that large yellowfin could occasionally be seen scavenging around the vessel when the troll catch was being gutted. On these occasions, a plastic long line float with a 1-2 fathom monofilament line and a single hook baited with offal was thrown overboard. On 3 occasions yellowfin took the bait, and were allowed.

to exhaust themselves fighting the float, which was recovered 5-10 minutes later. Two 30 kg fish and one 57 kg fish were caught in this manner,all at mid-morning.

The other still fishing method, night hand lining, was attempted on a total of 7 nights. One storm lantern was hung on each outrigger pole, and varying numbers of baited lines, weighted and unweighted, were paid out to depths of up to 100 fathoms. Only 2 Mahimahi and 6 Barracuda were caught in this way. Again the main problem was the presence of sharks, which would frequently take the bait very rapidly and took hours to land or kill, thus preventing other fishing. Sharks were caught at all depths, and unless the majority of sharks around a raft can be eradicated it seems unlikely that this type of fisheries will be worth while.

e) Project Economics

Due to the different markets adjacent to each fishing site, different procedures were used in disposal of the catch at each stage of the project. Main outlets for fish were:

a) sale at point of landing (Korolevu, Vatulele)
b) sale to local retailers, hotels, etc. (Korolevu)
c) sale to National Marketing Authority (NMA) (All sites)
d) fish given to crew (All sites)
e) fish given to local dignitaries, in return for assistance, etc. (Korolevu, Vatulele).

All fish delivered to Lami were individually weighed prior to sale. At other points of sale, only numbers of each species and total weight were recorded daily. Total landings were as shown below:

Table 2: Total landings

Dates	Location	Species*	No	Wt(kg) (gutted and gilled)	Disposal	Amount received (F$)
20/9-24/9	Deuba	YF	3		NMA 47kg	46.41
		MM	2			
			5	47		46.41
25/9-26/10	Korolevu	YF	339		NMA 26kg	25.68
		SJ	118		Local sale 556kg	625.75
		MM	24		Given away 787kg	0.00
			481	1416		651.43
4/11-11/12	Vatulele	YF	326		NMA 877kg	879.18
		SJ	701		Local Sale-Lami 950kg	867.35
		MM	30		Local sale-Vatulele 154kg	154.00
		WH	6			
		BC	16		Fsrs functions 157 kg	0.00
		FT	1		Given away 418 kg	0.00
	Tot.		1080	2562		1900.53
Grand Tot.			1566	4025		2598.37

YF = Yellowfin tuna THUNNUS ALBACARES
SJ = Skipjack tuna, KATSUWONUS PELAMIS
MM = Mahimahi (Dolphin fish), CORYPHAENA NIPPURUS
WH = Wahoo, ACANTHOCYBIUM SOLANDRI
BC = Barracuda, species not recorded
FT = Frigate tuna AUXIS THAZARD

As can be seen, total landings by the project were 4025 kg, or just over 4 tonnes, which realised a total revenue of F$2598.37. The overall average price obtained for the 2610 kg of fish sold was almost exactly $1.00/kg and at this price the total catch would be worth about F$4025. The remaining 1415 kg of fish was given to crew members and other individuals in order to encourage villagers to join the vessel and participate in fishing, and to maintain an acceptable image in the eyes of the people to whom the project was being demonstrated.

Although a thorough costing of the project was planned from the outset, a number of elements make this difficult The fishing activities were never intended to be profit-making, and priority was given to demonstration and experimental fishing, in some instances in the knowledge that this would reduce catches or lead to unrealistically high operating costs. Various sources of funds contributed to the projects expenses including UNDP Fiji Government, and U.S. Aid, and revenue from fish sales was also used to cover operational costs, buy fishing gear, etc. Items such as the servicing of the project by government vessels cannot be realistically costed, but in any case are not expenses which a commercial fisherman would expect to have to meet.

Despite these constraints, the figures which follow can *bo,* taken as a rough indication of the economics involved in operating the vessel.

a) Vessel fitting out - F$6819.54
b) Total operational expenditure (all sources) - 3509.65
c) Total costs - F$10329.19
d) Project revenue + F$ 2598.37
e) Balance - F$ 7730.82

As can be seen, the project showed a net deficit of some F$7730. However, these figures must be modified to some degree to realistically represent a commercial operation in the following ways:

i) Firstly, of the 70 days available for active fishing during the project period, only 30 were spent in actual fishing, the remainder being lost due to an extended period of rough weather, industrial action affecting fuel supply, occasional operational holdups affecting the "Tavuto" and religious rest days. Over the long term, a more reasonable expectancy would be 40 days out of 70, i.e. an additional *33%* of time spent fishing. This would increase revenue and expenses, but not in proportion to each other.

ii) In a commercial concern it should be assumed that all fish would be sold, and that the introductory price maintained throughout the project would be raised to a more realistic minimum of $1.30/kg. At these rates, total revenue for the project would have been of the order of F$5232, or F$174 per day. Assuming 40 days fishing rather than 30, total income would be F$6976.

iii) A number of operational costs would have been reduced in a private concern, namely those involved in conducting demonstration/public relations trips, and those associated with fishing at unrealistic distances from the fishing ground. These savings are estimated to be;

Fuel	F$ 641.92
Ice	F$ 490.13
Rations	F$ 419.32
Total saving	F$1541.37
Total expenses	F$3509.65

Real expenses 1968.28, or some F$66 per fishing day. For 40 fishing days, this would total F$2624.

iv) Additional expenses which would accrue to the commercial operator would be crew wages and possibly insurance. Wages of F$7.50 per man day would add F$30 to the daily operating expense, or F$1200 for 40 fishing days. Insurance at 5% of hull value (F$7,000) would be F$350 per annum or F$70 for a 70 day (ten week) period. It is not anticipated that provisions would constitute a substantial expense in a day fishery.

v) It would not normally be expected to recover the cost of the vessel in the first 3 months of operation. An aluminium hull of this type would normally be depreciated over, say a five-year period, which is F$1400 per annum, or F$280 for a ten-week period.

Thus, assuming the project had operated on a commercial basis for ten weeks, and that instead of 30 days fishing a more realistic 40 had been performed, the following estimates of expenditure and revenue would apply;

Operational expenses:	F$2624	(= 66/day)
Crew wages	: F$1200	
Insurance	: F$ 70	
Depreciation	: F$ 280	
Total expenses	F$4174	(= 104/day)
Revenue	F$6976	(= 174/day)
Profit	F$2802	(= 70/day)

Naturally these estimates would apply to the long term, and would be subject to fluctuations caused by a number of physical factors. Nevertheless, this is see as a reasonable estimate of typical operating economics involved in such a fishery. A further Important factor is the human element of self-motivation. In a private concern, the direct relationship between input and rewards provides incentives not seen in a project staffed by civil servants whose salaries are independent of the catch. The degree to which this might be expected to improve catches is not quantifiable, but a serious fisherman operating for 200 days or more per year would find his business lucrative,

f) Species composition of the catch

Total numbers of each species caught during the project were as follows:

Yellow-fin	Skip-jack	Mahi-mahi	Wahoo	Barra-cuda	Frigate Tuna	Total
668	819	56	6	16	1	1566

with a total weight of 4025 kg.

Of this total 737 fish (2151 kg) were individually weighed at Lami, on seven seperate dates. All the fish originated from raft B. Moan weights and percent species composition are shown in table 3.

Of the whole sample, 33.7% by weight of the fish caught were yellowfin, 57.9 skipjack and the remainder mostly mahimahi. This varied from day to day but apparently not in an obviously regular pattern (see fig. 4). It is dangerous to try to infer too much from this information as it represents only a sample of the total catch, and is unlikely to be random. For instance, yellowfin being preferred by most consumers to skipjack, it is likely that those fish given away or sold on Vatulele would be mostly yellowfin. Unfortunately these records are not available.

The three major species, yellowfin, skipjack and mahimahi showed mean weights for the whole sample of 4.0 kg, 2.3 kg and 7.0 kg respectively. It should be noted, however, that if 10 large yellowfin of over 10 kg (including one of 57 kg) are excluded from the sample, the average yellowfin weight is 3.3 kg. This probably more accurately represents the size of the surface schooling fish which form the bulk of the catch, but does illustrate the presence of the larger fish on the raft. Fig 5 shows the change in mean size over time for each species, and again it does not appear that these changes are part of a regular pattern or associated with each other,

Table 3.

Landings to Lami from Vatulele, 4/11/81-16/12/81

Table 3.

Date	spp	n	w	%w	$\bar{w}$	Remarks
11/11/81	YF	70	297.0	61.1	4.2	
	SJ	45	126.8	26.1	2.8	9 yellowfin total wt 111
						$\bar{w}$ = 12.3 kg.
	MM	7	52.5	10.8	7.5	61 yellowfin total wt
						186 kg, $\bar{w}$= 3.1 kg
	WH	1	9.6	2.0	2.0	
	Tot	123	485.9	100.0	3.95	
13/11/81	YF	18	52.8	28.9	2.9	
	SJ	38	86.1	47.0	2.3	
	MM	7	44.3	24.2	6.3	
	Tot	63	183.2	100.1	2.91	
20/11/81	YF	11	48.2	18.8	4.4	
	SJ	62	149.8	58.5	2.4	
	MM	5	36.7	14.3	7.3	
	WH	3	21.4	8.4	7.1	
	Tot	81	256.1	100.0	3.16	
27/11/81	YF	9	32.2	38.7	3.6	
	SJ	17	51.0	61.3	3.0	
	Tot	26	83.2	100.0	3.20	
4/12/81	YF	26	85.7	20.2	3.3	
	SJ	143	339.1	79.8	2.4	
	Tot	169	424.8	100.0	2.51	
11/12/81	YF	8	37.0	11.9	4.6	
	SJ	126	259.7	83.8	2.1	
	MM	1	6.8	2.2	6.8	
	WH	1	6.4	2.1	6.4	
	Tot	136	309.9	100.0	2.28	
16/12/81	YF	38	172.9	42.4	4.5	1 yellowfin 57 kg
	SJ	100	233.9	57.3	2.3	37 yellowfin 115.9 kg
	FT	1	1.4	0.3	1.4	$\bar{w}$ = 3.1 kg.
	Tot	139	408.2	100.0	2.94	
TOTAL	YF	180	725.8	33.7	4.03	10 yellowfin 168kg,
						$\bar{w}$=16.80 kg.
	SJ	531	1246.4	57.9	2.35	170 yellowfin 557.8kg $\bar{w}$=3.28kg
	MM	20	140.3	6.5	7.01	
	WH	5	37.4	1.7	7.48	
	FT	1	1.4	0.1	1.40	
	Tot.	737	2151.3	99.9	2.92	

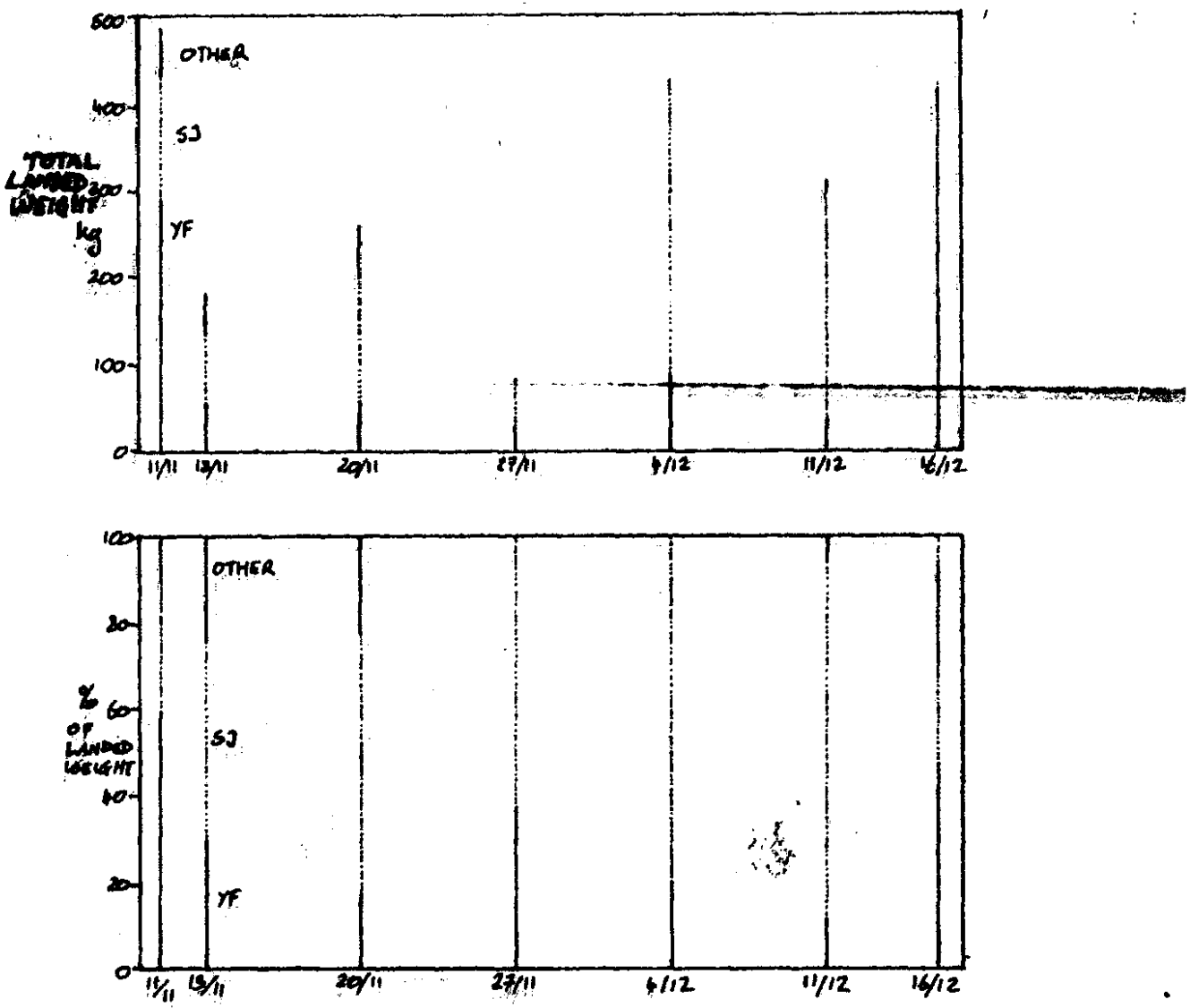


Fig.4: Actual and % composition by weight of landings to Lami.

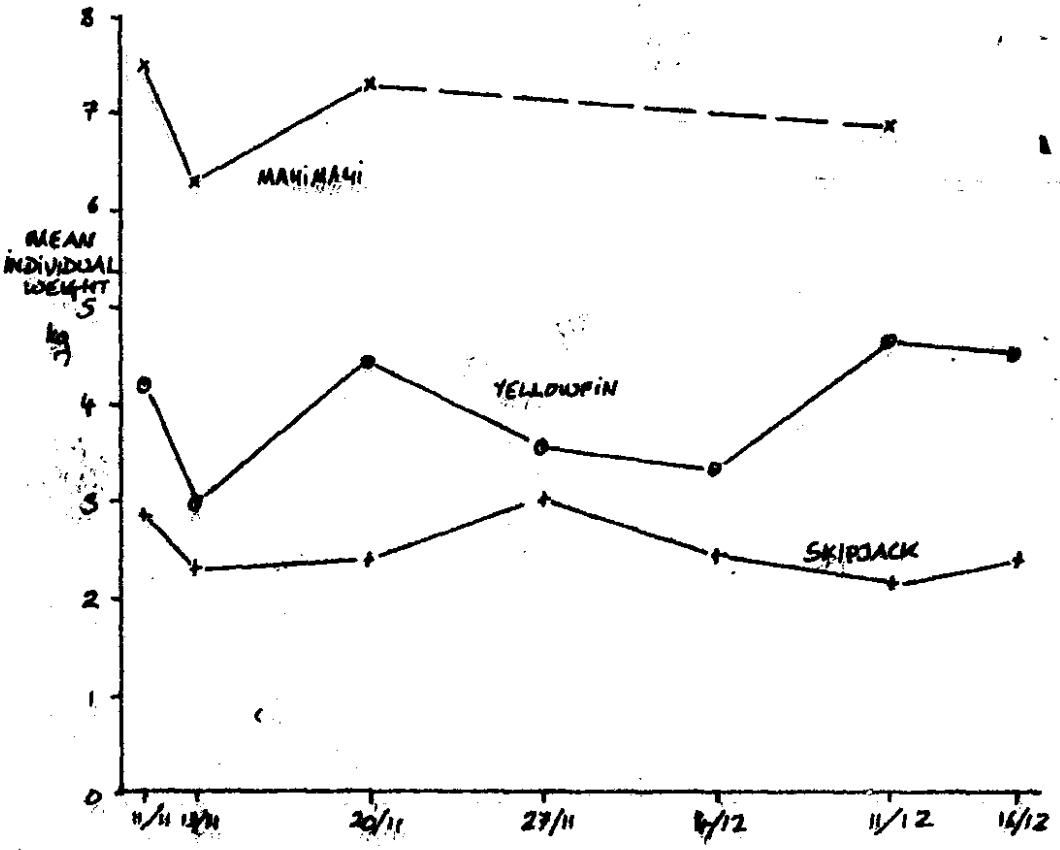


Fig.5: Individual mean weights of three major species

either directly or inversely. It will, however, be interesting to continue monitoring this data in order to detect longer term changes in mean size, catch rates and percent composition which may occur in connection with normal seasonal changes in the fish population.

g.) Processing

The catch was found surprisingly easy to sell as fresh fish and little work was done to investigate the acceptability of processed forms. Only one smoking trial was attempted, using a 6.6 kg yellowfin cut into longitudinal fillet blocks of 0.5-1 kg. The skinless blocks were smoked in a traditional type hardwood chip kiln for 4 hours by a commercial delicatessen in Suva. Samples of the resultant product were tasted by Fisheries staff whose comments summarised expressed the view that the fish had too soft and raw a texture, only a mild smoky flavour, and an unappealing dark red colour. It is possible that a more acceptable product would be produced if the smoking process was allowed to continue for 12-36 hours, as in traditional methods for smoking mackerels and tunas practised in other countries. This has not yet been attempted.

h) Training.

In addition to exposing 5 different members of the Fisheries Division staff to the fishing techniques used, about 21 local people joined the catamaran, some for only one trip, others for as long as 7 weeks.

5) Comments, Recommendations and Future Work

With the benefit of hindsight it is possible to be critical of a number of problems which arose during the project period, probably needlessly. The most important problem resulted from siting the two fish aggregation devices at such a distance from Suva or another urban centre. This led to the need to devise a regular system of fish collection and equipment delivery for much of the period of active fishing, and resulted in occasional delays in supplies of essential items and a reduction in equality of fish landed to Lami. In future a major consideration must be to base the project at an urban centre. Seventy five percent of operational and organisational problems will be avoided in this way.

Such a situation would also obviate the shortcomings of the project vessel. Th alia is purpose built for, and well suited to, live bait pole and line fishing on a day basis. It is not suited to trips of more than two days duration, as it lacks adequate ice box facilities for the catch, storage space for the crews provisions, and accomodation or sun shelter. Crew came back from 3-day trips badly sunburnt, short of sleep, with rapidly spoiling fish and all gear and provisions soaking wet, and it is not envisaged that the vessel will be utilised in this way again. IF it proves impossible to fish economically on a day basis, then a major re-think of suitable vessel features will be necessary. Nevertheless, in performing the job for which It was designed, the catamaran formed a fast, manoeuvrable, and extremely stable fishing platform with ample deck space.

A great deal of additional work remains to be done on various aspects of the fishing regime performed during this project. Further study on the longer-term effectiveness of FAD's repeated attempts to perform live bait fishing, and a more thorough costing of the fishing operation in a commercial operation are three examples which spring to mind. Hopefully all these items can be combined, when commencing in February 1982, the catamaran is chartered on a commercial basis to a private fisherman for a period of at least three months. A new raft will be placed within operating distance of Suva, and troll fishing will commence immediately after placement, with details of catches and operational costs being submitted to the Fisheries Division daily. In this way it should be possible to observe the speed at which resources become available around the raft, and obtain regular information for an extended period, hopefully an entire year. Once a fishing routine is established, systems for the collection of biological data can be introduced, and occasional controlled experiments aimed at determining optimum lure types conducted. Live bait will be available occasionally from Ika vessels baiting at Lami, and a bait farm also to be operated by Ika Corporation, should "enable" live bait fishing to be, attempted. Sales of the catch during this period will be the responsibility of the charterer. NMA have made a commitment to purchase the catch when required but every effort will be made to sell the fish on Suva's fresh

fish market for more realistic prices. Occasional samples of tuna will be purchased for further smoking trials. Fisheries Division will purchase finless shark carcases for $5 each to enable NMA to offer shark meat samples to institutional buyers; as dried shark fins can be sold in Suva for $4 - $6/kg, this should encourage the charterer to land most of his shark by-catch, and thus profit from shark eradication. Long lines will also be set overnight on an occasional basis, with the aim of removing sharks.

Despite the problems encountered during the project, there seems every reason to believe that fish aggregation devices will provide a useful alternative fishing ground to lagoon waters. None of the difficulties which presented themselves were insurmountable, and as experience of the fishery grows it should be possible to make effectiveness and potential of FAD's known to the established commercial fishermen who for obvious reasons are loth to give up proven fishing techniques for novel ones without a concrete demonstration of the prospects for success.

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