SPC/Fisheries 21/Information Paper 17
25 July 1989

ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

TWENTY FIRST REGIONAL TECHNICAL MEETING ON FISHERIES
(Noumea, New Caledonia, 7-11 August 1989)

A Review of Small Scale Tuna Purse Seine Operations in Fiji

(paper prepared by the Secretariat)

1. INTRODUCTION

The major purse seine tuna fishery of the western Pacific region is concentrated within a well defined area centered between the exclusive economic zones of the Federated States of Micronesia and Indonesia/Papua New Guinea. Purse seine activity in this area has expanded dramatically since 1980 based on supplying large volumes of skipjack and yellowfin tuna for the canned tuna industry. Fishing operations within this highly productive zone commonly extend into the waters of Palau, the northern Solomon Islands EEZ, Nauru and western Kiribati.

Most of the vessels participating in this fishery are large single seiners of 500 to 1500 GRT from the major distant water fishing nations of the Pacific. The bulk of purse seine landings are made by Japanese, US, Taiwanese and South Korean vessels. Fishing operations by these vessels outside this equatorial zone have been few in number often consisting of occasional sets made by vessels in transit between the fishing ground and unloading ports.

Several attempts have been made to develop seine fisheries outside this zone with notable success in the Philippines and the Solomon Islands with seasonal tuna fisheries in Australia and New Zealand.

Additional attempts have been made to develop seine fisheries in the Marshall Islands, Western Samoa, Wallis and Futuna, Fiji, Tonga and French Polynesia with generally unfavorable results. The faliure to develop successful fisheries in these areas can be attributed many different factors and does not necessarily rule out the possibility of future development. An examination of the factors that contributed to the success or failure of these ventures should prove useful to further attempts to develop regional purse seine fisheries.

The Solomon Islands and Fiji have been particularly active in developing purse seine activity within their respective EEZs. Sucessful purse seine operations have been established in the Solomon Islands through joint ventures and charter arrangements. Small scale purse seine ventures have been attempted in Fiji under licensed and joint venture agreements but no locally based seine fishery has been established. A review of these activities is presented below in relation to the establishment of small scale purse seine ventures.

2. Western Pacific and Western Ranger

The New Zealand based seiners, Western Pacific and Western Ranger engaged in fishing operations in Fiji from 1981 to 1985. The vessels normally operated in the seasonal New Zealand skipjack fishery during the southern hemisphere summer months of December to April. The short duration of this tuna fishery prompted the vessel owners to investigate alternate tuna fisheries during the remainder of the year.

Fishing operations in Fiji were conducted during the winter months usually lasting from June to November or December. The only exception was during the 84/85 season when the

Western Pacific remained in Fiji through the summer season. Access to the Fiji zone was on a licensed basis and catches were delivered to the Pacific Fishing Company (PAFCO) cannery in Levuka, Fiji. The Western Pacific was active in the Fiji fishery all five years (1981-1985) while the Western Ranger only fished in Fiji waters during 1981 and 1982. The remainder of this description will concentrate on the Western Pacific as it conducted the bulk of fishing operations in the area.

2.1. Vessel description

The vessels are similar in size and design being 36 meter Marco designed purse seiners originally built in Canada for the herring fishery. The vessels were fully equipped with Marco purse winch, power block and deck machinery. The Western Pacific is a 471 GRT single seiner capable of holding around 290 mt of fish kept frozen in circulating brine fish wells. Setting operations were conducted with the aid of a large net skiff as is typical of this type of seiner. The skiff was released from the stern of the seiner with one end of the net attached during the beginning of the set and later used to tow the main vessel into position during pursing and net hauling operations. Fishing operations required a crew of twelve made up of a captain/fishing master, mate, chief engineer, second engineer and various seaman/fishermen.

2.2. Purse seine net

The nets used by the two vessels varied in size and construction over the five year period using both knotted and knotless webbing. The Western Pacific used the Western Ranger's knotless net during the 1983 season and a 1008 x 107 m knotted seine in 1984.

2.3. Operational summary

The vessels operated on a network of anchored FADs using methods developed in the Philippine payao seine fisheries. A lighted raft was used to aggregate tuna and baitfish schools around the FAD with setting operations taking place just prior to dawn. A maximum of one set was made per fishing day.

2.4. Area of operation

Over 200 FADs were set during the five seasons with the Western Pacific operating on a maximum of around 35 at one time. Most of the fishing operations concentrated on FADs deployed north of Vanua Levu to take advantage of the slight shelter provided from the southeast Tradewinds. The outside waters west and southwest of Viti Levu and the Lau Group were considered too exposed and rough for purse seining during the winter months.

2.5. FAD design

The style and construction of the FADs gradually evolved from bamboo rafts to more sophisticated and durable models. The earlier designs only lasted a few months and many FADs were lost in the first season. A great deal of time was spent on matters related to FAD construction and deployment. The final FAD design was considered to be well suited to the prevailing conditions, but even the improved design usually did not last more than one season.

The FAD rafts were constructed from eight 10cm x 4m foam filled PVC pipes clamped together with hardwood braces and diagonal struts (Figure 1). Durable plastic strapping material was suspended beneath the raft to aggregate baitfish. The previous use of coconut fronds as is typical in the Philippine payao fishery was suspended as they only lasted a short time. The PVC rafts were shackled to a large plastic mussel float which provided the primary flotation for the mooring system. The bulk of the mooring line was composed of 16 mm diameter polypropelene line with a chain counterweight added at approximately one third of the distance between the float and anchor. A 25 meter section of 8 mm galvanized

chain was added beneath the float to stabilize the raft and another chain section was attached to a 1000 kg concrete anchor to prevent abrasion on the bottom (Figure 2). The cost for materials for one unit including labor and deployment was estimated at $1,952 in 1984. The FADs were usually deployed and maintained by the fishing vessel although a barge was leased to deploy thirty FADs for the Western Pacific during the 1985 season. The FADs were designed to allow the entire system to be winched up by the fishing vessel and moved to another location.

2.6. Fishing operations

Almost all fishing operations were conducted on the FADs with a maximum of one FAD set per day. The small size of the net virtually ruled out the possibility of sucessful daytime setting on free schools and the few recorded attempts failed. Two attempts were made to set on tuna schools chummed to the surface by pole and line vessels but were apparently unsucessful. Further reports from the crew indicated that natural logs or free schools suitable for seining were not encountered by the vessel in Fiji waters.

The predictable nature of FAD seining lead to the adoption of a standard mode of operation during all fishing operations. An average of two or three FADs were visited per day and checked for the presence of tuna using a depth sounder and visual observations of fish and bird schools. The vessel would circle tightly around the FAD as the fishing master would assess the size and composition of the school beneath. A light raft was set on the most promising FAD before sunset. The light raft was a catamaran style float supporting a generator and four 500 watt above water lights. The effectiveness of the light raft to aggregate schools was considered essential to the operation. For this reason, fishing trips were timed whenever possible to coincide with the dark phase of the moon returning to unload during the full moon period.

The selected FAD was checked again at 0300 hours with the depth sounder. If a sufficient amount of tuna was present, the light raft and FAD raft was detached from the mussel float around 0400 hours and allowed to drift away from the mooring line to avoid the possibility of tangling the line and net during the set. If the school was too deep or scattered, two of the lights were turned off in an attempt to concentrate and raise the school closer to the surface. The set was usually made around 0430 as the horizon was barely becoming visible. The FAD raft was towed out of the net after pursing was completed and attached again to the mussel float and mooring line. The remainder of the set would be completed similar to any Marco style seining operation with the catch brailed into the refrigerated brine wells. The entire operation was usually completed by mid morning with the remainder of the day occupied with net mending, maintenance and FAD inspections. FADs were also constructed, deployed, moved or repaired.

2.7. Catches

The bulk of the catch consisted of skipjack and yellowfin tuna with minor amounts of bigeye and albacore. A relatively high percentage of yellowfin was noted in the catches ranging from one third to one half of the catch per set. The Western Pacific and Western Ranger landed a combined total of 772 and 1007 tonnes of tuna from FAD sets in Fiji waters during the 1981 and 1982 winter seasons. Catch rates were not considered sufficient to support both vessels and the Western Pacific fished alone during the 1983, 84 and 85 seasons taking 823, 577 and 693 tonnes for those years (Fiji Fisheries Division). Reported catches vary depending on the source possibly due to the difference between estimated catches on logsheet data and actual landing data obtained at the.cannery.

The Western Pacific made 26 fishing trips in Fiji during the five year period. An average trip lasted 19 days making 9.5 sets. The mean catch per trip for all five years was 110 tonnes of tuna at a rate of 11.5 tonnes per set ranging from 8.7 mt/set in 1982 to 14.6 mt/set in 1981.

Fishing effort for 1984-85 represented a complete year of operation for the Western Pacific in Fiji waters with fishing trips recorded from August 25, 1984 to July 1, 1985. Logsheet data for this period lists 10 trips landing 1239 tonnes of skipjack and yellowfin tuna and 62 tonnes of miscellaneous bycatch (Table 1). Most of this bycatch consisted of rainbow runner (*Elegatis bipinnulatus*). This catch represented an average of 12.0 mt of tuna per set, just slightly higher than the five year mean of 11.5 mt of total catch per set. No obvious seasonal trend in catch per month can be distinguished although an execptionally high catch rate of 23.3 mt/set was recorded for January.

Table 1. Catch data for the F/V Western Pacific in Fiji waters 8/84 to 7/85.
(SJ = Skipjack, YF = Yellowfin, catch in metric tonnes)

Date	#Days	#Sets	SJ/YF(mt)	Bycatch(mt)	SJ/YF/Set
Aug 84	16	8	133	23	16.6
Sep	18	13	149	7	11.5
Oct	14	11	99	0	9.0
Nov	19	16	186	0	11.6
Jan 85	19	9	210	2	23.3
Feb	19	7	93	0	13.3
Mar	16	7	69	2	12.3
Apr	25	14	69	2	4.9
May	18	9	135	3	15.0
June	18	12	79	22	6.6
TOTAL	**182**	**103**	**1239**	**62**	

Bycatch consisted mostly of rainbow runner, mahimahi and mackerel tuna with considerable variation in abundance between years or particular FADs. Sharks, barracuda, wahoo and triggerfish were noted in smaller but more stable concentrations. The abundance of bycatch, particularly mahimahi and rainbow runner increased noticeably during the winter months and the occurance of mahimahi disappeared completely during the summer. The amount of bycatch was usually quite low in the range of 2 to 3 tonnes per trip.

2.8. Constraints to Fishing Success

2.8.1. Net

The size of the net was often stated as one of the main limitations to greater catches. The length was considered satisfactory for FAD seining but several sources felt that the net depth of just over 100 m was too shallow for Fiji waters. An FAO fisheries consultant evaluated the operations of both NZ seiners and concluded that the net should be deepened to at least 220 m to allow an effective fishing depth of 150 meters.

2.8.2. FADs

The New Zealand crew was inexperienced in seining around FADs and a great deal of time and money was spent gaining this experience in the first few years of the fishery. Early FAD designs were inadequate for the open sea conditions and many were lost or damaged. FAD construction, deployment, replacement and repair occupied a great deal of the vessel time detracting from searching of fishing time. The final FAD raft and mooring line configuration (Figure 1) was considered well suited for the rough sea conditions in Fiji and appropriate for the fishery. The final design could also be easily retreived and moved to more productive locations.

2.8.3. Vessel equipment

The freezing capacity was considered to be too low and mechanically unreliable. Occasionally, large schools were present on the FADs but the vessel had to wait for previous catch to cool in order to continue with fishing operations.

Fishing operations were restricted by the lack of an operational sonar. This required the seiner to drive directly over or beside an FAD in order to estimate the school size by echo sounder. It was also impossible to monitor the position and depth of the school during and immediately prior to the set.

2.8.4. Low tuna abundance

Fishing operations were restricted to the winter months during the first four years coinciding with the period of lower tuna abundance in Fiji waters. This has often been cited as a reason for the low catches with speculation that fishing would be much better during the summer months. Results from the final year were rather inconclusive in this respect with catches fluctuating throughout the year.

Comments in the logbook of the Western Pacific sum up most of these points. Six of the most common reasons given for a poor set or low catch were:

1. Rough sea conditions - could not set
2. Skiff sticking on stern ramp preventing the set
3. Full moon or bright moon conditions
4. Fish school located upcurrent from FAD making set difficult
5. FADs missing
6. Schools not aggregating under light raft or too deep for net to capture.

3. HERON

The Mar Fishing Company of Zamboanga, Philippines engaged in a six month trial fishing venture in Fiji during the first half of 1989. The company operated the F/V HERON in Fiji waters under a joint venture arrangement with the Pacific Fishing Company. PAFCO is interested in the development of small scale seining in Fiji to enhance the availability of raw material for canning throughout the year and to increast their supply of yellowfin tuna. Mar Fisheries owns and operates a small fleet of medium sized purse seine vessels fishing on anchored FADs in the Philippines and PNG.

The Mar Fishing Company is required to submit monthly fishing reports to the Fiji Ministry of Primary Industries and catch reports to Fiji Fisheries Division. An observer from the Fiji Fisheries Division was on board the vessel during every fishing trip to observe the operation and collect accurate catch data. Most of the information in this account was supplied by the Fiji Fisheries Division.

3.1. Vessel description

The vessel is a typical 36 meter Marco style single purse seiner very similar to the New Zealand Western Pacific. Fishing operations were conducted with a Marco power block, purse winch, deck winches and machinery. Setting and brailing operations are conducted with a large seine skiff as is typical of the Marco style operation.

The HERON operates with a full crew size of 24 which is considered very large for a vessel of this size. The Western Pacific is the same size and style as the Heron and operated efficiently with a crew of only 11 or 12. Duties on board are apparently very specific with a designated captain, fish captain, navigator, mate, chief engineer, 2nd engineer, 3rd

engineer, deck boss, cook, radioman, etc.

A 975 HP General Motors V8 diesel main engine powers the ship at a cruising speed of 9 knots. Three 275 HP GMC auxiliary engines supply electrical and hydraulic power. The freon refrigeration system is powered by three Carrier compressors cooling recirculating brine in the fishwells. The catch is kept in a frozen condition in six fishwells with a total capacity of 220 tonnes.

3.2. Net

The net carried by the HERON measures 1130m x 250m and is composed of a combination of Japanese style knotless webbing and heavier knotted net. The bulk of the net is made up of lightweight braided knotless netting of twine size 24 to 42 which creates a smaller, lighter net easier to accommodate with the available space and hauling machinery. The end of the net where the catch is concentrated prior to brailing on the vessel is constructed of heavy knotted netting with twine size ranging up to #96.

3.3. Operation summary

All fishing operations were conducted on anchored FADs set just prior to dawn. The Heron worked in conjunction with the Roy J Watts; a 550 gross ton refrigerated carrier vessel. Catch was transferred to the Watts or delivered directly to the PAFCO cannery in Levuka. The vessels began fishing operations in February 1989.

3.4. Area of Operations

The Roy J Watts brought FAD materials and already constructed FADs to Fiji where the crew finished FAD construction. The vessel deployed 82 FADs around the main Fiji Islands mostly to the east and south of the Fiji group. FAD deployments were restricted to areas outside territorial waters to limit interaction with other gear types. FADs were set east and southeast of the Lau Group, south of Matuku and Kadavu Islands and west of Viti Levu north to the Yasawa Group. FAD deployments were made by the Watts relying on charted depths as the vessel is not equipped with a depth sounder capable of reading to the necessary depth. The FADs were in place by February and fishing operations began in mid February, 1989.

3.5. FAD design

The operation used a combination of Philippine style bamboo and steel payaos with polypropelene mooring lines. The steel FADs consisted of a steel raft measuring 2 feet x 4 ft x 10 ft surrounded by a bamboo frame moored with 17 mm polypropelene line. The outer bamboo frame served to assist the light boat in tying alongside the FAD and to reduce abrasion from the steel raft. A 50 kg counterweight was placed in the mooring line to prevent the line from floating to the surface. Galvanized steel cable (3/4 in dia) extended 30 meters below the raft and 40 meters above the concrete filled oil drum anchors. Weighted lines are suspended beneath the rafts with natural plant material attached to attract and hold baitfish.

3.6. Fishing operation

The fishing operation was similar to the system used by the Western Pacific except a lighted tow boat was used in place of the light raft. The seiner was also equipped with sonar allowing better estimates of school size and position. The most promising FAD was selected to be set the following day on the basis of the sonar and depth sounder readings. The light boat with two crewmen aboard tied up to the chosen FAD by 1700 hours and the lights were usualy turned on at sunset. The seiner would remain approximately one mile away from the FAD during the night keeping lights to a minimum to avoid drawing the fish away from the FAD.

At 0300 the sonar would again be used to determine the size and position of the school. Instead of allowing the light boat to drift away from the FAD line, the anchored FAD raft was towed quickly away from the light boat leaving the fish schooled around the light. The FAD was then released about 300 meters upcurrent and the set made around the light boat and school. Most sets were made between 0430 and 0450 and were finished within 3 -4 hours. The rest of the day is spent with net and FAD maintenance and checking FADs for the next morning set.

3.7. Catches

Fishing operations began in February with trip information available for this report covering the period 13 February to 11 May, 1989. A total of 33 sets were made during this three month period landing 449 tonnes of skipjack and yellowfin for an average of 13.6 mt per set (Table 2).

Detailed trip information was available for February and March when 20 sets yielded 288 tonnes at an average of 14. mt per set. The catch from individual sets ranged from one tonne to 62 tonnes.

Most of the catch consisted of 2.0 - 2.5 kg skipjack (86%) with only 14% yellowfin ranging from 2.5 to 8.0 kg. One tonne of bigeye and albacore was recorded in the February catch.

The Fiji Fisheries Division observers reported very small amounts of bycatch consisting of sharks, rainbow runner and dolphinfish. No undersized tuna were reported in the catch.

Table 2. Catch data for the F/V HERON seining on FADs in Fiji waters Feb - May 1989.
(SJ = Skipjack, YF = Yellowfin, BE = Bigeye, AL = Albacore, in metric tonnes)

	No. Sets	SJ	YF	BE/AL	TOTAL	Catch/Set
Feb 89	4	38	12	0	50	12.5
Mar. 89	16	209	28	1	238	14.8
Apr to May 11	13				161	12.4
TOTAL	33				449	13.6

3.8. Discussion

The average catch per set of 13.6 mt of tuna was an improvement over the operations of the Western Pacific but the Heron still managed to make only 33 sets during a three month period. This was still an improvement over the 9 set/month average of the Western Pacific.

The Fisheries Division observers stated that rough weather caused the most significant constraint to fishing operations. The fishing trips were shortened or curtailed by tropical cyclones and low pressure systems causing high winds, rough seas, large swells and strong currents. These conditions did not always prevent sets but caused the net to tangle or collapse causing the catch to be gilled in the net or damaged. The rough weather also contributed to the loss or movement of several of the FADs.

A detailed report of the first trip was compiled by the Fisheries Division observer. Only eight days were spent fishing or searching with nine days spent sheltering from rough weather. Eighteen FADs were checked with sonar with only 5 indicating good school prospects resulting in four sets. Eleven FADs were missing from their deployed location and could not be found.

The observers recommended that purse seining with FADs be allowed inside the territorial waters due to the calmer sea conditions increasing the number of fishable days and length of FAD deployments. The inside waters were felt to have larger, more stable tuna resources and closer to operational bases.

4. Summary of Fiji Operations

The Western Pacific and the Heron are very similar in size and both are equipped with Marco style purse seine gear. The Heron had the advantage of a larger net, sonar, a large crew experienced in FAD seining techniques and the assistance of a large carrier vessel. These advantages apparently assisted the Heron to do slightly better than the Western Pacific with an average catch of 13.6 mt/set and up to 16 sets in a single month of operation.

This mean catch value is not significantly larger than the five year CPUE value of 11.5 mt/set of the Western Pacific and may indicate the range of catch potential of this type of vessel in Fiji. This would indicate the possibility of taking between 100 and 200 mt/month on FADs or 1500 to 2000 tonnes per year. Further purse seine fishery developments should be able to realize a profit at this level of harvest.

This level of catch can be met or exceeded by increasing the catch per set, increasing the number of sets per month, reducing operating costs or increasing the value of the landed catch. The experience of the Western Pacific and Heron have indicated that the following factors can favorably influence these objectives.

4.1. Increased catches

1. Larger, deeper net
2. Sonar
3. Crew experienced in tropical FAD seining
4. Powerful depth sounder for accurate FAD deployments

4.2. Increased number of sets

1. Minimise time spent on FAD construction and replacement
2. Experiment with setting in the evening just before sunset as well as morning
3. Use purse seine gear better adapted to operation in rough seas (Triplex or Petrel)
4. Obtain permits to set FADs in sheltered inside waters

4.3. Reduce expenses

1. Smaller crew size
2. Fewer expatriate crewmembers
3. Use smallest vessel possible that can handle equipment, net and storage capacity
4. No carrier - it is doubtful that a single seiner can support the expense of a carrier

4.4. Increased value of catch

1. Good refrigeration systems
2. Investigate high quality tuna markets
3. Develop market for high quality bycatch or local markets for common bycatch

Figure 1. PVC FAD raft used by the F/V Western Pacific in Fiji waters 1984.
(source R.L. Thoms, Western Fishing Group manager)

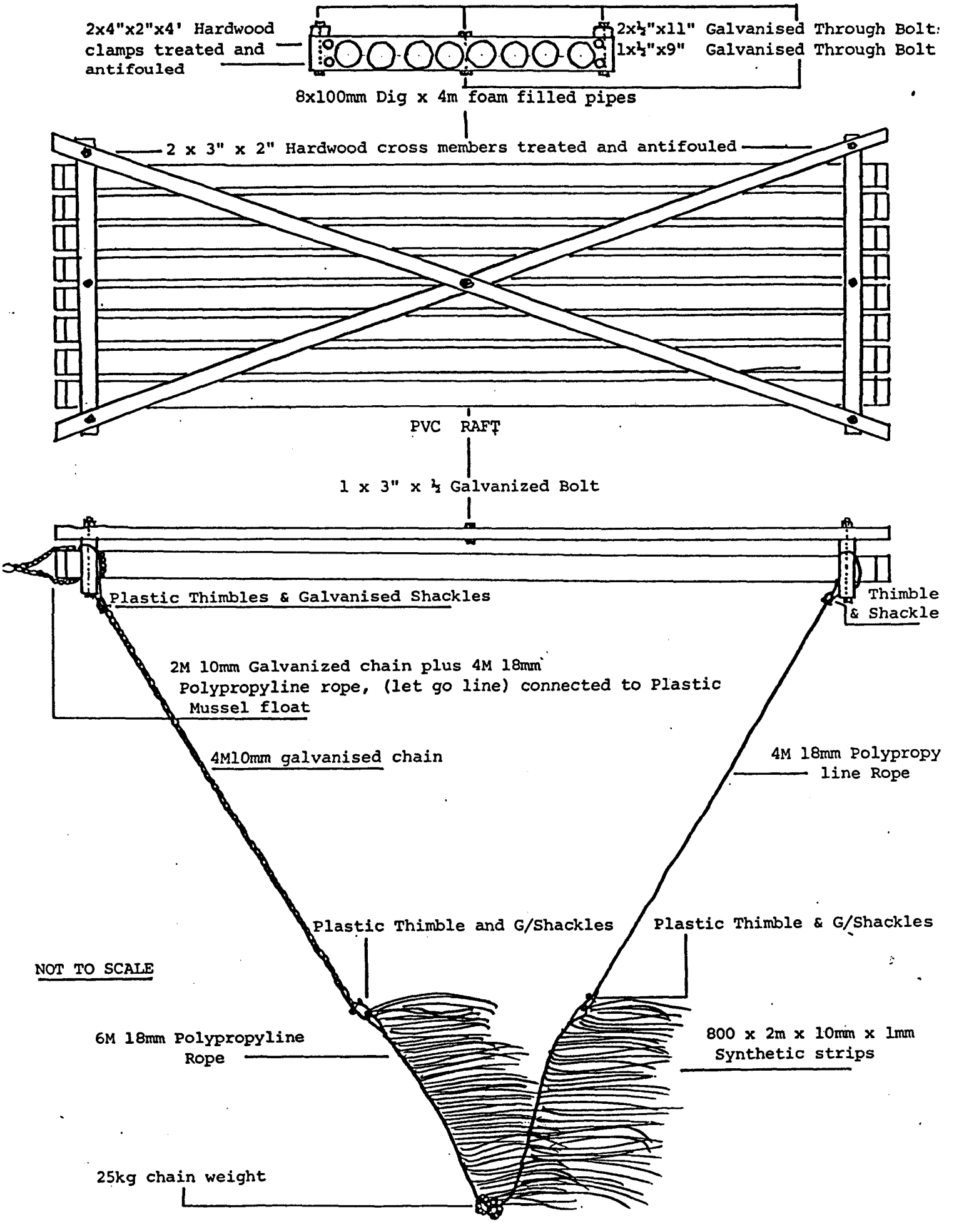
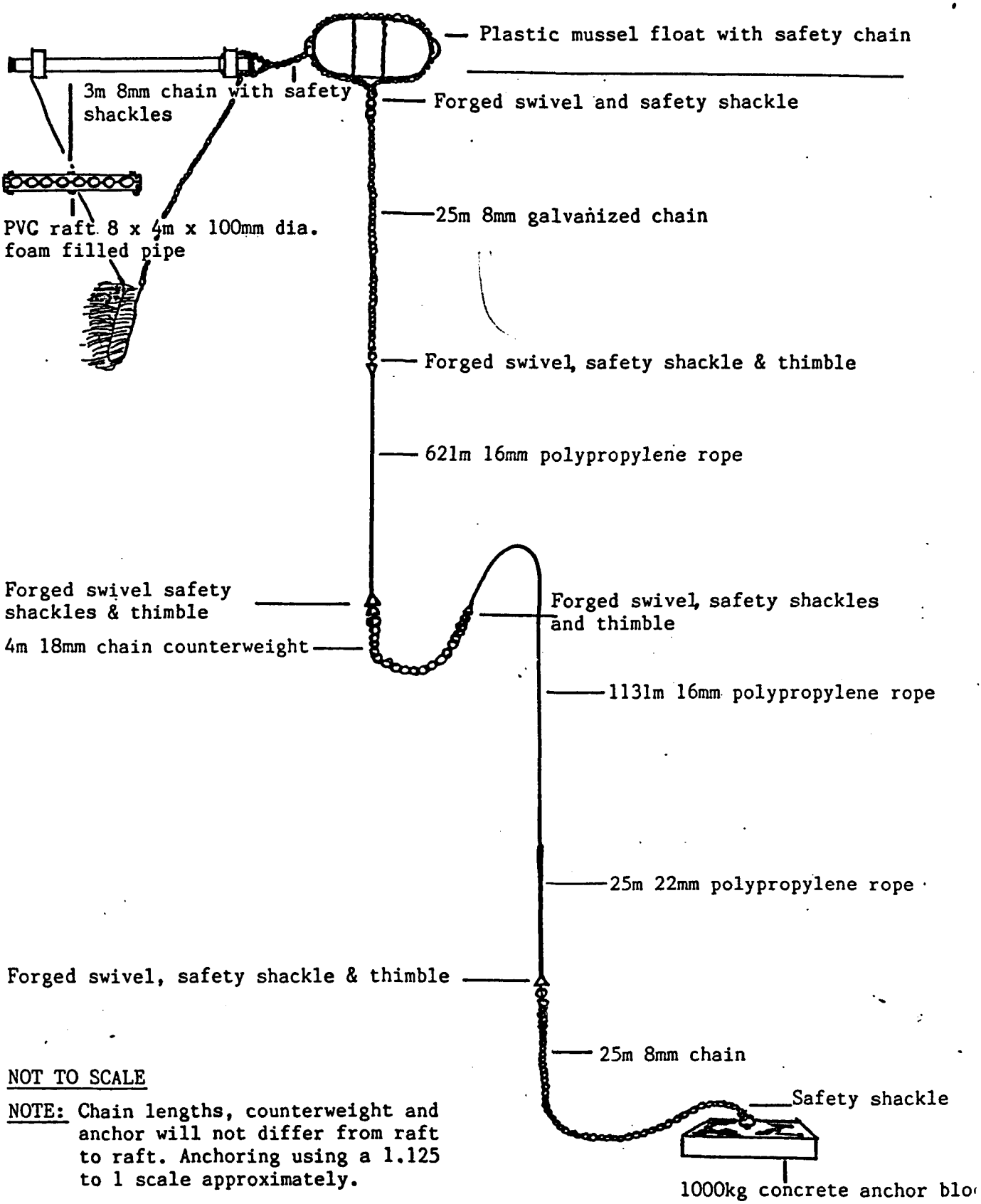


Figure 2. FAD mooring system used by F/V Western Pacific in Fiji waters. 1984.
(source R.L. Thoms, Western Fishing Group manager)



NOT TO SCALE

NOTE: Chain lengths, counterweight and anchor will not differ from raft to raft. Anchoring using a 1.125 to 1 scale approximately.