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ON FAD DEPLOYMENT AND VERTICAL LONGLINE FISHING IN PALAU

14 November 1991 – 31 October 1992

by

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This unpublished report forms part of a series compiled by the Capture Section of the South Pacific Commission's Coastal Fisheries Programme. These reports have been produced as a record of individual project activities and country assignments, from materials held within the Section, with the aim of making this valuable information readily accessible. Each report in this series has been compiled within the Capture Section to a technical standard acceptable for release into the public arena. However, they have not been through the full South Pacific Commission editorial process.

On 6 February 1998 the South Pacific Commission (SPC) became the **Pacific Community**. The Secretariat of the Pacific Community (retaining the acronym SPC) is now the name for the body which administers the work program of the **Pacific Community**. The names have changed, the organisation and the functions continue.

This report was prepared when the organisation was called the South Pacific Commission, and that is the name used in it. Please note that any reference to the South Pacific Commission, could refer to what is now the Secretariat of the Pacific Community, or, less likely, to the Pacific Community itself.

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Particular thanks to the Government of Palau for its co-operation during the visit.

SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development Project (DSFDP) visited Palau from 14 November 1991 to 31 October 1992. The Marine Resources Division (MRD) requested technical assistance to conduct vertical longline trials for the capture of high value tunas around offshore Fish Aggregating Devices (FADs) and to further develop the FAD programme initiated by the Palau Community Action Association in 1990.

Priority activities for the project included: adapting vertical longline gear to suit various vessel designs in Palau; conduct vertical longline trials and train fisheries officers and local fishermen in this fishing technique; train fisheries officer and local fishermen to tuna handling procedures with the aim of promoting the landing of quality catches for the export sashimi market; conduct bait fishing trials with the aim of supplying a future vertical longline fishery; conduct bottom contour surveys to locate suitable sites for future FAD deployments; determine FAD designs suitable for the offshore marine environment of Palau; and deploy FADs in sites located from bottom contour surveys.

Two vertical longline systems were designed for MRD vessels. A vertical longline drum similar to the manual drum developed in Western Samoa was designed and fabricated by the Masterfisherman for the 12 m MRD vessel, *Mesekiu*. The Melekeok Fishermen's Co-operative vessel, *Sebus*, was outfitted with vertical longline gear as well. A smaller version of the vertical longline drum was designed and fabricated for the 6 m MRD fibreglass vessels.

A total of 12 vertical longline fishing trips yielded 17 fish with a total weight of 703.5 kg over 33 individual sets; an average of 58.6 kg/trip and 21.3 kg/vertical longline. The majority of the catch were sharks. A total of 18 troll fishing trips yielded 1045.0 kg of fish with an average of 58.1 kg/trip. A total of 8 bait fishing trips yielded 45.5 kg of suitable bait with an average of 5.5 kg/trip.

Twelve local fishermen, including MRD fisheries officers, were trained in vertical longline fishing techniques. A FAD workshop was conducted for 15 representatives of the Palau Community Action Association to provide information regarding the present status of the FAD programme, purpose of bottom contour surveys, alternative FAD configurations, and models for monitoring and maintaining FADs. A technical workshop in the operation of Global Positioning Systems (GPS) was conducted for MRD fisheries officers and local fishermen. MRD fisheries officers were trained to conduct bottom contour surveys using a GPS and depth sounder to locate suitable FAD sites.

A total of 10 bottom contour surveys were conducted to locate sites suitable for FAD deployments. Areas surveyed included both the east and west coasts and Angaur. A total of 6 suitable offshore FAD sites were identified from the site survey work.

Two deep water FADs were deployed offshore on the west coast at sites located from the bottom contour surveys. The FADs were fabricated using refurbished coast guard buoys from Hawaii for flotation devices and catenary curve moorings using a combination of polypropylene and nylon ropes. One shallow water FAD was designed and deployed offshore from Ngiwal village. Materials for an Indian Ocean design FAD were ordered for the site located offshore from Ngaraard village. Four submerged monofilament FADs were ordered for two sites located offshore from Ollei.

A para-anchor was fabricated for the *Mesekiu* using material from a surplus military parachute.

RÉSUMÉ

La Commission du Pacifique Sud a accompli une mission à Palau dans le cadre de son projet de développement de la pêche au demi-large, du 14 novembre 1991 au 31 octobre 1992. La *Marine Ressources Division* (MRD) a sollicité une aide technique pour la réalisation d'essais de pêche à la palangre verticale de thons ayant une valeur commerciale élevée, à proximité de dispositifs de concentration du poisson (DCP) mouillés au large et pour la poursuite du programme de DCP lancé par la *Palau Community Action Association* (Association de Palau en faveur d'actions socio-éducatives) en 1990.

Le projet comportait les activités prioritaires suivantes : l'adaptation de palangres verticales aux bateaux de la flottille de Palau, en tenant compte de leur différence de conception; la conduite d'essais de pêche à la palangre verticale et la formation d'agents des services des pêches et de pêcheurs locaux à cette technique de pêche; la formation d'un agent des services des pêches et de pêcheurs locaux aux procédures de manipulation du thon afin de promouvoir le débarquement de prises de qualité *sashimi* destinées au marché d'exportation; la conduite d'essais de pêche de poissons-appâts en vue d'approvisionner une future pêcherie à la palangre verticale; la réalisation d'études bathymétriques afin de repérer des sites qui conviendront plus tard au mouillage de DCP; la détermination de modèles de DCP convenant à l'environnement marin de zones situées au large de Palau; et le mouillage de DCP sur des sites localisés grâce aux études bathymétriques.

Deux systèmes de palangre verticale ont été mis au point pour les bateaux de la MRD. Un enrouleur de palangre verticale semblable à l'enrouleur manuel créé au Samoa-Occidental a été conçu et fabriqué par le maître de pêche pour le *Mesekiu*, bateau de 12 mètres de la MRD. Le *Sebus*, navire de la coopérative des pêcheurs de Melekeok, a également été équipé d'une palangre verticale. Une version plus petite de l'enrouleur de palangre verticale a été mise au point et fabriquée pour les embarcations en fibre de verre de 6 mètres de la MRD.

En tout, 12 sorties de pêche à la palangre verticale ont permis de capturer 17 poissons d'un poids total de 703,5 kg, lors de 33 poses différentes, soit une moyenne de 58,6 kg/sortie et de 21,3 kg/palangre verticale. Les prises étaient, en majeure partie, des requins. En tout, 1 045 kg de poisson, soit une moyenne de 58,1 kg/sortie, ont été capturés lors de 18 sorties de pêche à la traîne. En tout, 45,5 kg de bons poissons-appâts ont été pris lors de huit sorties de pêche organisées à cet effet, soit une moyenne de 5,5 kg/sortie.

Douze pêcheurs locaux, dont des agents de la MRD, ont été formés aux techniques de pêche à la palangre verticale. Un atelier sur les DCP a été organisé à l'intention de 15 représentants de la *Palau Community Action Association* afin de les informer sur l'état d'avancement du programme de DCP, l'objet des études bathymétriques, les différentes configurations possibles et les modèles de surveillance et d'entretien des DCP. Un atelier technique sur l'exploitation des systèmes mondiaux de localisation par satellite (GPS) a été organisé à l'intention d'agents des services des pêches de la MRD et de pêcheurs locaux. Les agents des services des pêches de la MRD ont été formés à la conduite d'études bathymétriques à l'aide d'un GPS et d'un sondeur pour localiser des sites de mouillage de DCP satisfaisants.

En tout, dix études bathymétriques ont été menées, notamment sur les côtes est et ouest et à Angaur. En tout, six sites de DCP ont été repérés au large, à la suite de ces études.

Deux DCP de grande profondeur ont été mouillés au large de la côte ouest, sur des sites localisés à l'issue d'études bathymétriques. Ils ont été fabriqués à l'aide de bouées de gardes-côtes de Hawaii qui ont été remises à neuf et qui ont servi de flotteurs, le mouillage à courbe caténaire étant constitué de cordages en polypropylène et en nylon. Un DCP de petite profondeur a été mis au point et mouillé au large de Ngiwal village. Du matériel pour un modèle océan Indien destiné à être mouillé au large de Ngaraard village a été commandé. Quatre DCP immergés, à monofilament ont été commandés pour deux sites au large de Ollei.

Une ancre parachute a été fabriquée pour le *Mesekiu* à l'aide de tissu récupéré sur un parachute militaire.

CONTENTS

1. INTRODUCTION

The South Pacific Commission's Deep Sea Fisheries Development Project (DSFDP) is a mobile village level development project which operates in the Pacific Islands at specific request and which has the following objectives:

- to promote the development and expansion of artisanal fisheries throughout the region, based on fisheries resources which are at present under-utilised;

- to develop and evaluate new simple technology, fishing gear and techniques suitable for the use of village fishermen, which will enable fishermen to substantially increase catches while reducing dependence on costly imported fuel; and

- to provide practical training in appropriate fishing techniques to local fishermen and government extension officers.

The DSFDP had operated in Palau on three previous occasions. The first visit (Taumaia & Crossland 1980) was conducted in 1979 and 1980, focusing on the introduction of deep-bottom fishing techniques and training local personnel, whilst investigating the commercial viability of beep-bottom fishing under the conditions experienced in Palau. The second visit (Taumaia & Cusack 1997) was conducted in 1983, and also focused on the exploitation and evaluation of the deep-water snapper resource with training of a government development team to continue training activities with local fishermen after the completion of the project.

The third visit to Palau (Chapman 1997) was conducted in 1987 and 1988 with a continued focus on exploitation of the deep-bottom resource. However, this project was specifically looking for new fishing grounds and offshore seamounts. This was achieved by using a deep-water echo-sounder to survey likely areas for their suitability as fishing grounds. In addition to this work, the Masterfisherman demonstrated the use of alternative fishing techniques, such as a vertical longline, to Marine Resources Division staff.

During this assignment in 1991, it was agreed that, at the request of the Palau government, the South Pacific Commission would provide the service of a Masterfisherman to assist in introducing alternative and productive fishing techniques for the capture of high value tunas around offshore Fish Aggregating Devices (FADs) and further develop Palau's FAD programme. Under the Commission's DSFDP, Masterfisherman Peter Watt was assigned to work with the Marine Resources Division from 14 November 1991 to 31 October 1992. The specific objectives of this project were:

- to adapt vertical longline gear to suit various vessel designs in Palau and provide training and demonstration in the use of vertical longlines;

- to conduct demonstration and training in handling procedures with the aim of promoting the landing of high quality catches for export markets;

- to conduct bait fishing trials with the aim of supplying bait for a possible future vertical longline fishery;

- to conduct bottom contour surveys to locate suitable sites for future FAD deployments; and

- to determine FAD designs suitable for the offshore marine environment off Palau and deploy FADs in sites identified during bottom contour surveys.

2. BACKGROUND

2.1 General

Palau is a small island country located between 06º 50' N and 08º 50' N latitude, and 134º 08' E and 134º 40' E longitude (Figure 1). The main island group of Palau consist of over 200 rock islands surrounded by a barrier reef enclosing a large lagoon estimated to be approximately 1,500 square kilometres. The barrier reef

surrounding the lagoon stretches over 400 kilometres. Populated islands of main importance include Koror, Babaldaob, Peleliu, Angaur and Kayangel. There is also a small group of islands to the south, the Southwest Islands. In 1990 the population of Palau was 15,122, comprising 12,321 Palauans and 2,801 non-Palauans. Approximately, 70 per cent of the population is concentrated in Koror and the remainder live on Peleliu, Babaldaob, Kayangel and the Southwest Islands. In 1991, 4,032 foreign labourers resided in Palau and approximately 32,700 tourists visited, of which half were Japanese.

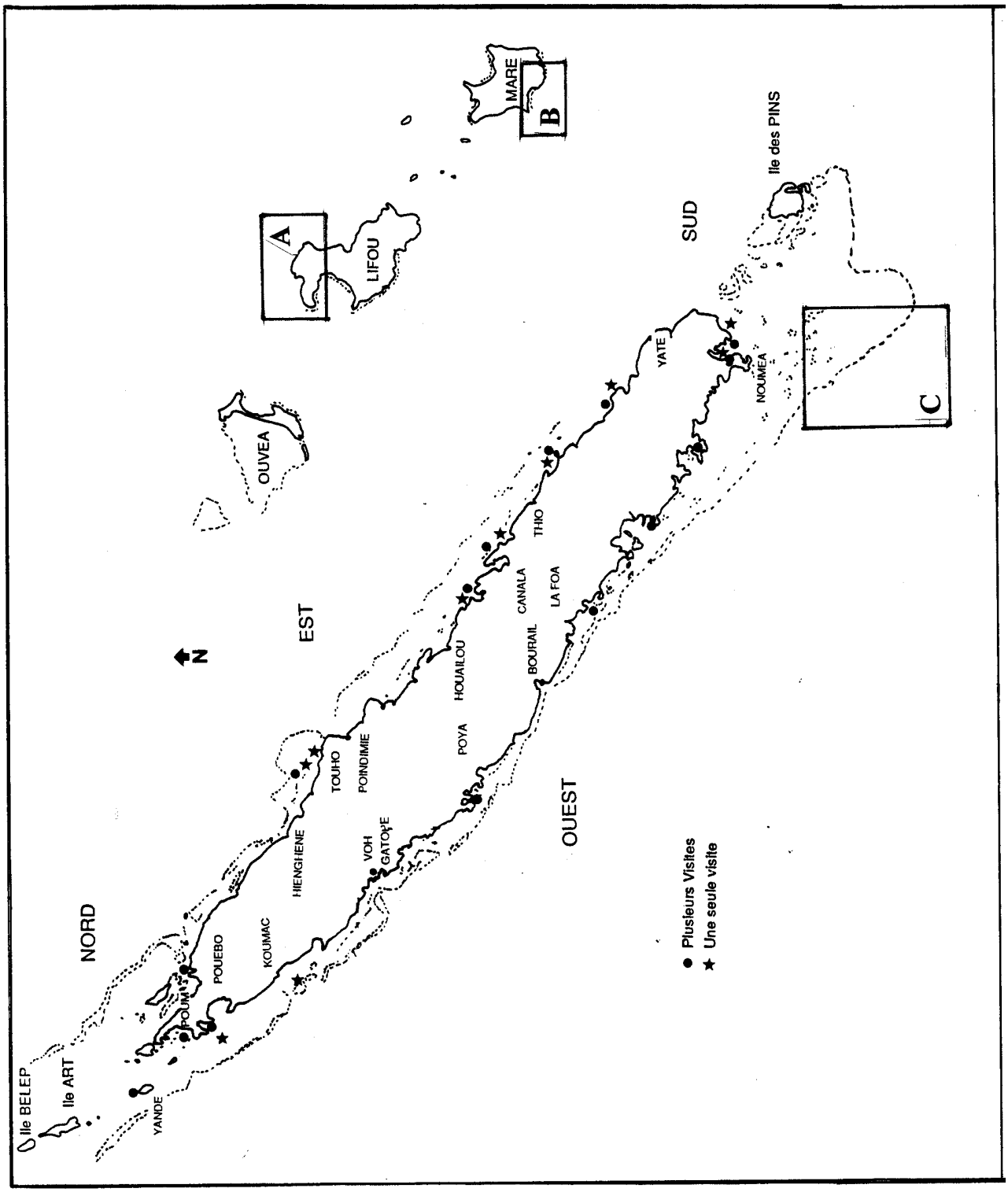

Figure 1: The Republic of Palau

The local fishery is comprised mostly of small fibreglass vessels under 10 m, powered by outboard engines. In 1982, the Japanese International Co-operation Agency (JICA), donated to the Palau Government eight 12 m fibreglass fishing vessels powered by diesel engines. Ice plants were also donated by JICA and were placed in strategic villages to support the fishing vessels. At present, there are 3 vessels still operational and actively partaking in fishing operations. One of these vessels, *Mesekiu,* is used by the Marine Resources Division (MRD) for research and development projects. Approximately, 550 individual fishermen participate in the local fishery. Fish are either sold to four main markets in Koror or are exported to Guam and Saipan. An estimate of 450 mt of reef fish, mangrove crab, and lobster were harvested and sold in 1991 (Anon 1992). Of the 450 mt, 250 mt were sold locally and 200 mt were exported. This was an estimated US $1,100,000 income for Palau's local fishermen. The average local retail price for reef fish in Koror is US $3.30/kg ($1.50/lb as it is sold in Palau). In addition, an estimated 750 mt of fish were harvested from the inshore reefs and lagoons for subsistence in 1991 (Anon 1992).

At present, the majority of fishing activities are conducted either inside the lagoon or within one mile of the outer reef. Due to the consistent fishing pressure by the local fishermen on these areas the Palau Community Action Association (PCAA) in co-operation with MRD initiated an FAD programme in 1990. The intention of the programme was to encourage the local fishermen to exploit pelagic resources further offshore. Five FADs were deploy offshore from villages on the east and west coasts.

2.2 Tuna Fishery

The tuna fishery in Palau for the most part relies on the participation of foreign offshore fishing vessels to support the industry. Foreign fishing companies desiring to operate within the Republic of Palau's 200 mile Exclusive Economic Zone (EEZ) are required to negotiate with the Palau Maritime Authority (PMA). During 1991, there were four fishing agreements negotiated allowing a total of 370 longline and 37 purse-seine vessels to fish within Palau's EEZ. These agreements were negotiated with the Fisheries Associations in Japan, the United States in the Multi-Lateral Fisheries Treaty, the Palau Marine Industries Corporation (PMIC) and Palau International Traders Incorporated (PITI).

A total of 86 permits were issued for purse-seine vessels; 37 to the Fisheries Associations of Japan and 49 to the United States. Purse-seine catches in Palau were quite small in 1990; the Japanese fleet landed a total of 1,810 mt and the United states fleet landed 10,239 mt (Williams 1991).

A total of 370 permits were issued to longline vessels in 1991; 98 to the Japanese, 240 to the Taiwanese and 32 to the Chinese. Most of the vessels were between 20 and 50 GRT (gross registered tonnage). All the foreign longline vessels tranship their catches from Palau to either Japan or Taiwan. Sashimi grade yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*), were sent by air freight to Japan, while the by-catch was frozen, stored in Palau and later shipped to Taiwan for canning. Some vessels freeze the by-catch onboard and transport the fish back to their home ports where a higher price is paid than in Palau. Approximately, 2,800 mt of sashimi quality tuna were sent air freight to Japan in 1991 (Williams 1991). This was 44 per cent of the total catch landed in Palau for transhipment. The value of the fish was estimated to be between US $25 and $30 million. The value of frozen by-catch, 3,500 mt, was unknown.

The permit fee in Palau for foreign longline vessels under 50 GRT is US $900 and for vessels over 50 GRT is US $1,400 per annum. The licenses are non-transferable and 70 per cent of the fee must be paid up front when the number of permits of a company is decided upon.

Local fishermen rarely focus their fishing efforts specifically for the capture of tunas. Periodic trolling to and from bottom fishing grounds or spear fishing grounds is the most common practice for catching pelagic species. At present, it is not economical to specifically target pelagic species due to the high cost of fuel and low price paid by local retailers for tunas. The average price paid by the Palau Federation of Fishing Associations (PFFA) to the fishermen for tuna is US $0.77/kg ($0.35/lb). When fishermen do catch tunas they either sell them directly to restaurants for a higher price, keep them for bait or take them home to their families. There is one local pole-and-line vessel operated by Mr Kuniyoshi. A total of 87,870 kg (193,310 lb) were landed by this vessel in 1990. From the total catch only 13 per cent were sold to PFFA, with the remainder being sold at Kuniyoshi's fish market. The tunas sold by Kuniyoshi to PFFA were 8.8 per cent of the total sold to PFFA in 1991.

2.3 Fish Aggregating Devices

The first FAD programme in Palau was initiated by MRD in 1980. Six deep-water FADs were deployed offshore on the east and west coasts. The flotation device or buoy for these FADs consisted of a foam filled tractor tire with a 4.8 m length of 10 cm galvanised steel pipe braced through the middle to act as ballast for the buoy and a support for a radar reflector and a flashing light (Figure 2). The mooring system consisted of a 12 mm galvanised chain bridle attached to the buoy, 30 m of 12 mm galvanised upper chain, 16 mm x 3 strand polypropylene rope (length determined at a 1.6 scope ratio of site depth), and 15 m of 12 mm galvanised chain attached to a one tonne cement block. Ball-bearing swivels and shackles were used in strategic locations. Three metres of galvanised chain was shackled to the mooring rope 50 m from where it was attached to the upper chain to ensure that the rope did not float to the surface and become a hazard to shipping or fishing vessels. Strips of 6 mm net webbing were attached under the buoy to act as aggregators.

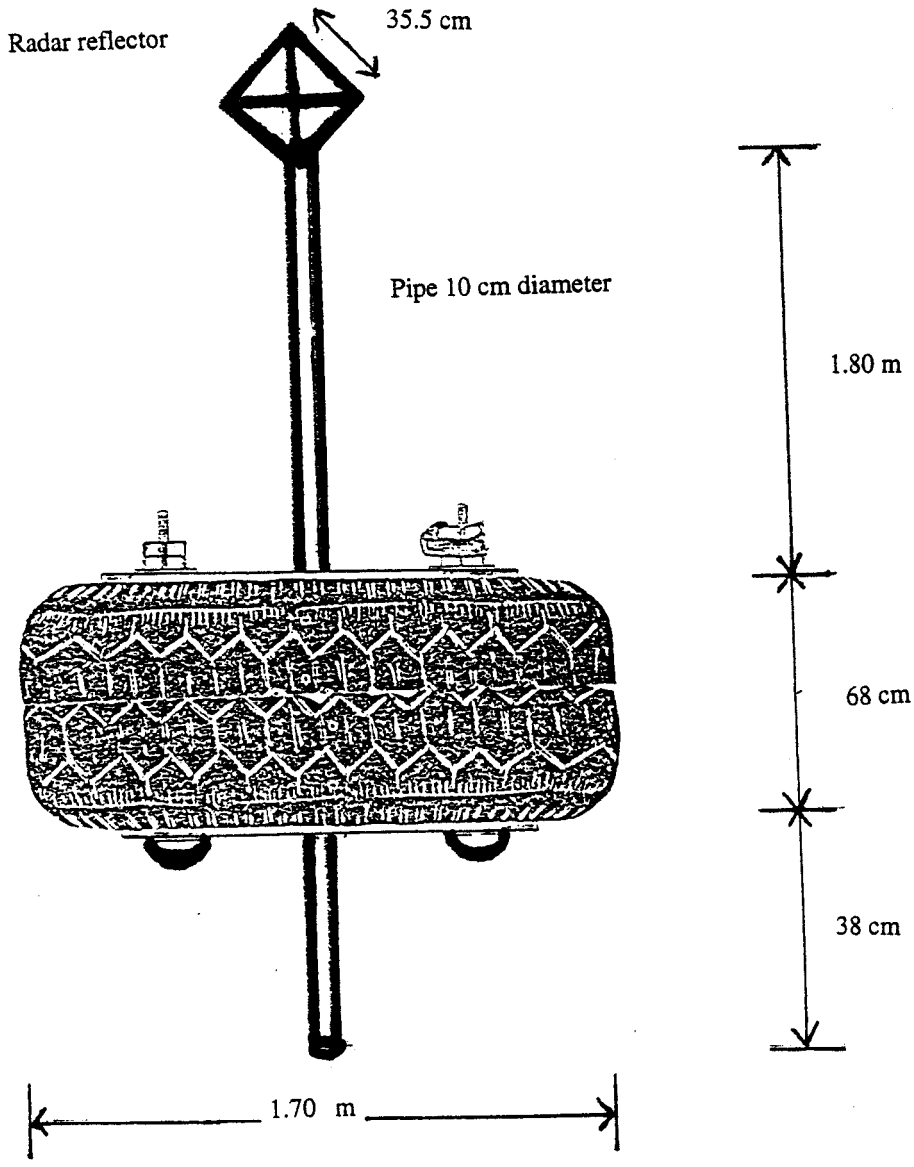

Figure 2: Tractor tyre design FAD buoy used in Palau in 1980

The FAD sites were selected as a result of bottom contour surveys conducted by MRD staff while aboard the Scripps Institute of Oceanography research vessel, *Alpha Felix* and the Shimohoseki University Fisheries training vessel, *Tenyo Maru*. Position and respective bottom depths for the six FADs deployed in 1980 are presented in Table 1.

Table 1: Position and depth for the six FADs deployed off Palau in 1980.

Buoy	Position	Depth (m)
1	07º 13' N by 134º 37' E	1,750
2	07º 28' N by 134º 44' E	2,022
3	07º 38' N by 134º 26' E	660
4	07º 31' N by 134º 19' E	600
5	07º 19' N by 134º 08' E	1,040
6	07º 05' N by 134º 10' E	860

After the FADs were deployed a minimal number of fishing trips were recorded around them and there was no record of the longevity or productivity of each FAD.

A second FAD programme was initiated by MRD in 1990. Bottom contour surveys were conducted to locate FAD sites with the MRD fisheries vessel using a Furuno echo-sounder model FE-814 with a maximum depth range of 2,080 m and a Satellite Navigator model Si Tex*A310. Also a hand bearing compass was used to chart FAD site positions with land marks. Eight FAD sites were located for the east and west coasts. Position, depth, distance off-shore from the nearest reef and the local name are presented in Table 2 for these eight sites.

Table 2: Location of the eight FADs sites selected in 1990 with West referring to FAD sites on the west coast and East to those on the east coast.

Buoy	Position	Depth (m)	Distance	Name
West–1	07º 42.0' N by 134º 26.0' E	1,671	6.9 nm	Ollei
West–2	07º 20.2' N by 134º 08.6' E	1,450	4.8 nm	Ulong
West–3	07º 03.7' N by 134º 13.8' E	989	2.0 nm	Ngedebus
East–1	07º 07.7' N by 134º 26.6' E	1,491	2.2 nm	Udel
East–2	07º 13.2' N by 134º 33.6' E	1,633	3.0 nm	Mutremdiu
East–3	07º 24.8' N by 134º 40.7' E	1,234	1.8 nm	Ng-Debard
East–4	07º 32.5' N by 134º 41.2' E	1,574	1.9 nm	Ngiptal
East–5	07º 37.9' N by 134º 41.0' E	787	2.2 nm	Galap

Eleven FAD mooring systems were ordered for the eight sites located from the bottom contour surveys. Two FADs were deployed in mid-September 1990 on the west coast. The flotation device for the two FADs were a catamaran raft design (Figure 3). The rafts were constructed in Palau using plywood for the exterior shell with timber framing and polystyrene foam for flotation. Plastic pressure floats were also placed inside the hulls for added flotation. The mooring system consisted of a 12 mm galvanised chain bridle, 30 m of upper chain, 19 mm x 12 strand nylon rope with 22 mm x 12 strand polypropylene rope for the mooring line, 15 m of 16 mm galvanised bottom chain and a 1 t cement block for an anchor. Shackles, swivels and Samson nylite rope connectors were used in strategic locations.

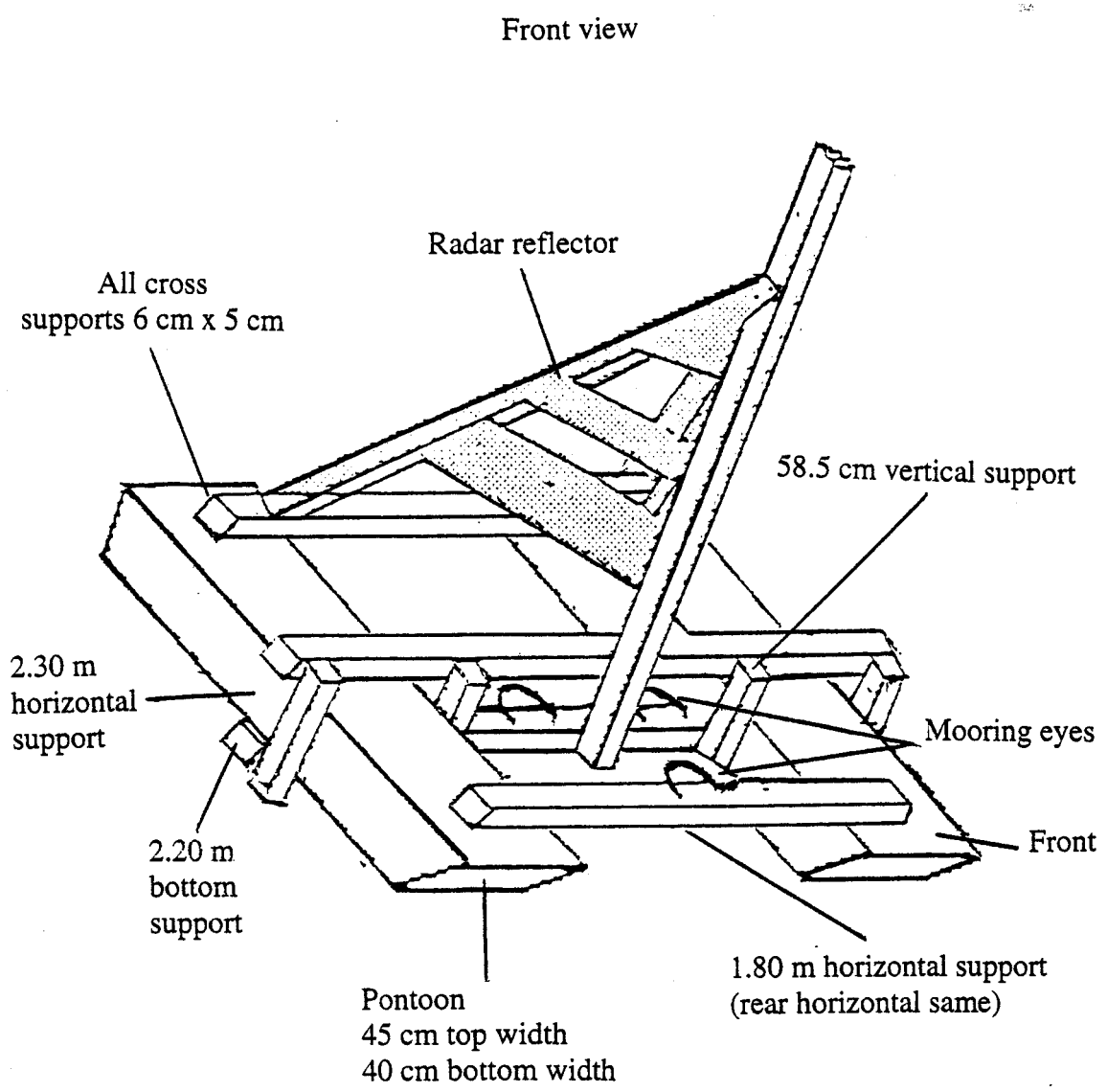

Figure 3: Plywood catamaran raft design used as the buoy on several FADs deployed in 1990

One FAD was deployed 6.9 nm offshore from the exterior reef of Ollei. The raft capsized during deployment and the cross beam timbers supporting the two raft pontoons were damaged. The raft and upper mooring were winched aboard the deployment vessel and the raft replaced. When the MRD fisheries officers returned to the FAD site a week later the raft had disappeared.

Another FAD was deployed approximately 3 nm offshore from the exterior reef of Ulong. This FAD remained on-station for approximately 4 months before it was damaged during a tropical storm. The pontoons of the catamaran raft were leaking so Styrofoam floats were attached to the raft to provide additional buoyancy. This only kept the raft afloat temporarily as the FAD was lost soon after the repair.

Five FADs were later deployed off the east coast in July 1991. The flotation device for the FADs was a refurbished steel coast guard buoy from Hawaii. A 10 cm diameter galvanised steel pipe with an eye on the bottom end was welded through the buoy to attach a swivel for the mooring (Figure 4). A flashing light was fitted onto the other end of the galvanised pipe. The mooring system consisted of 15 m of 12 mm galvanised upper chain, 19 mm x 12 strand nylon rope and 22 mm x 12 strand polypropylene rope for the mooring line, 15 m of 19 mm galvanised bottom chain and a 1 t cement block for the anchor. Shackles, swivels and Samson Nylite rope connectors were used in strategic locations.

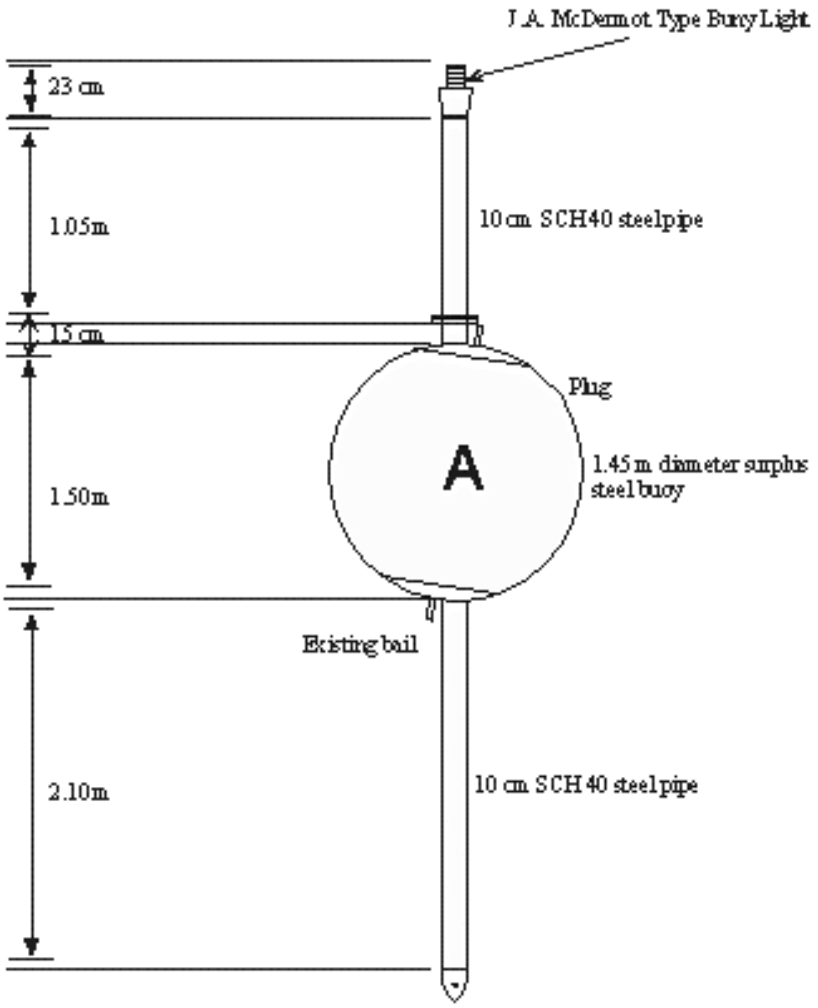

Figure 4: Spherical steel coast guard buoy with pipe mast and counter weight used on 5 FADs deployed of the east coast in July 1991

The FADs were deployed relatively close to the exterior reef, the average distance offshore was only 1.5 nm. The steep bottom contour of the exterior reef prohibited the FADs from being deployed further offshore. Three to four miles offshore depths of 2,500 to 4,000 m were recorded with an echo-sounder. The FADs in a short period of time started drifting from the FAD sites. Six months after the arrival of the Masterfisherman, all five FADs were lost. Four of the FAD upper mooring components were recovered. Examination of the recovered mooring ropes indicated that the ropes had chaffed off against the steep exterior reef wall near the bottom of the mooring during periods of strong onshore winds. Also a shackle connected the upper mooring chain to the nylon rope failed due to corrosion from electrolysis. The shackle was fabricated with dissimilar metals, a galvanised steel bow with an alloy bolt and nut.

3. PROJECT OPERATIONS

3.1 Boats and equipment

The principal vessel used by MRD for bottom contour surveys to locate FAD sites and conduct fishing trials was the *Mesekiu.* The vessel was one of 8 vessels donated to the Palau government by JICA in 1982. The particulars of the vessel are the following:
Hull material: fibreglass

Dimensions: length 11.16 m
breadth 2.57 m
draft 1.58 m

Gross tonnage: 3.20 t

Main engine: Yanmar 4 cycle high speed diesel with fixed pitch propeller

Capacity: fish hold 3.20 m^3
fuel tank 211 gal

Speed: 9 knots maximum

Equipment: Magnetic compass, Furuno depth sounder model FE-814, Satellite Navigator model Si Tex A-310, Global Positioning System (GPS) JRC model 4110, two trolling booms, space for six wooden Samoan handreels and a hydraulic line hauler.

The *Mesekiu* was outfitted by the Masterfisherman and MRD staff with a vertical longline drum and related fishing gear (Figure 5). The drum was designed during a previous assignment in Western Samoa by the Masterfisherman (Watt et al 1998). Two structural changes were made in the Palau longline drum compared to the original design of the Samoan drum. Another plywood spoke support wheel was built into the drum to provide additional strength to the spoke wheel to ensure the spokes would not collapse from the combined pressure of the monofilament line when wound onto the drum wheel. Larger 22 mm sealed bearings were used as they slipped snugly over the 12 mm galvanised steel drum axle (similar to Figure 6). The vertical longline drum was mounted on the deck behind the wheelhouse of the vessel (Figure 5). Two 25 cm x 5 cm timbers were bolted to the underside of each gunwale to act as supports for the vertical longline drum. Two 10 cm x 5 cm timbers were bolted together forming an inverted 'V'. The timbers were then bolted on the outside of the transom to hold a plastic pulley that was used for setting and hauling vertical longlines. A plywood branchline box was fabricated to fit between the port stern hatch and the gunwale.

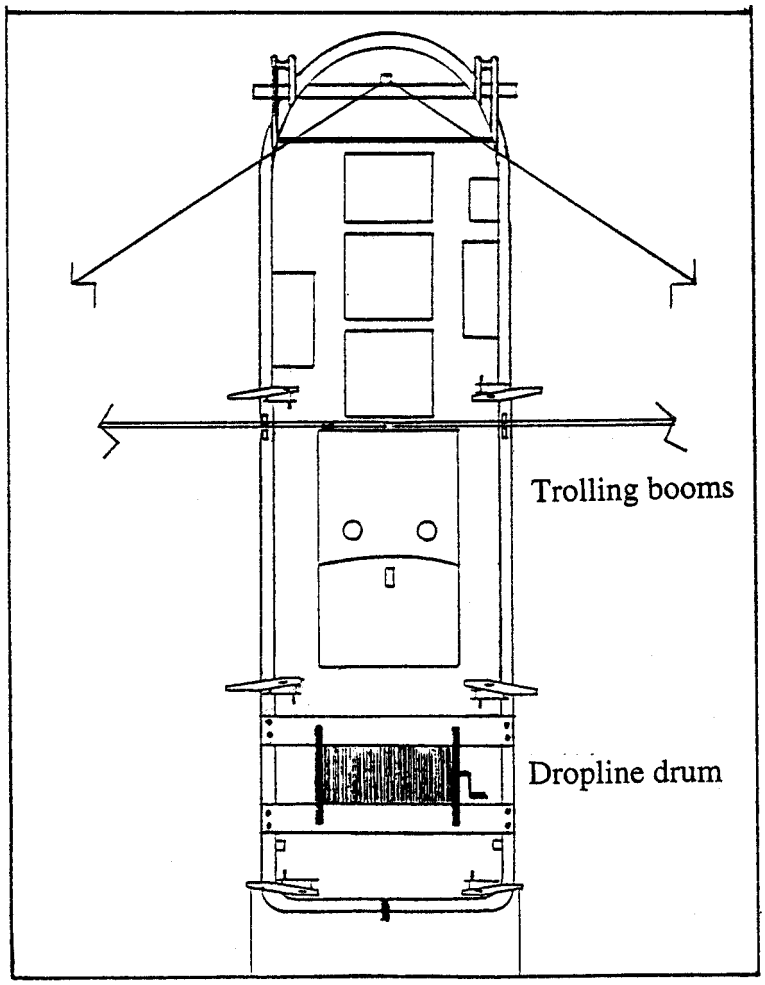

***Figure 5: Mounting of the vertical longline drum behind the cabin on* Mesekiu**

The 7 m MRD fibreglass Yamaha vessel powered by a 115 hp outboard engine was used to conduct fishing trials and monitor the FADs. The trolling with monofilament lines was the main fishing activity of the vessel. A smaller version of the Western Samoa vertical longline drum was designed and fabricated for this vessel during the project (Figure 6). For detailed construction notes on making such a drum refer to Watt et al (1998). Measurements for constructing the smaller version of the Palau vertical longline drum are provided in Table 3.

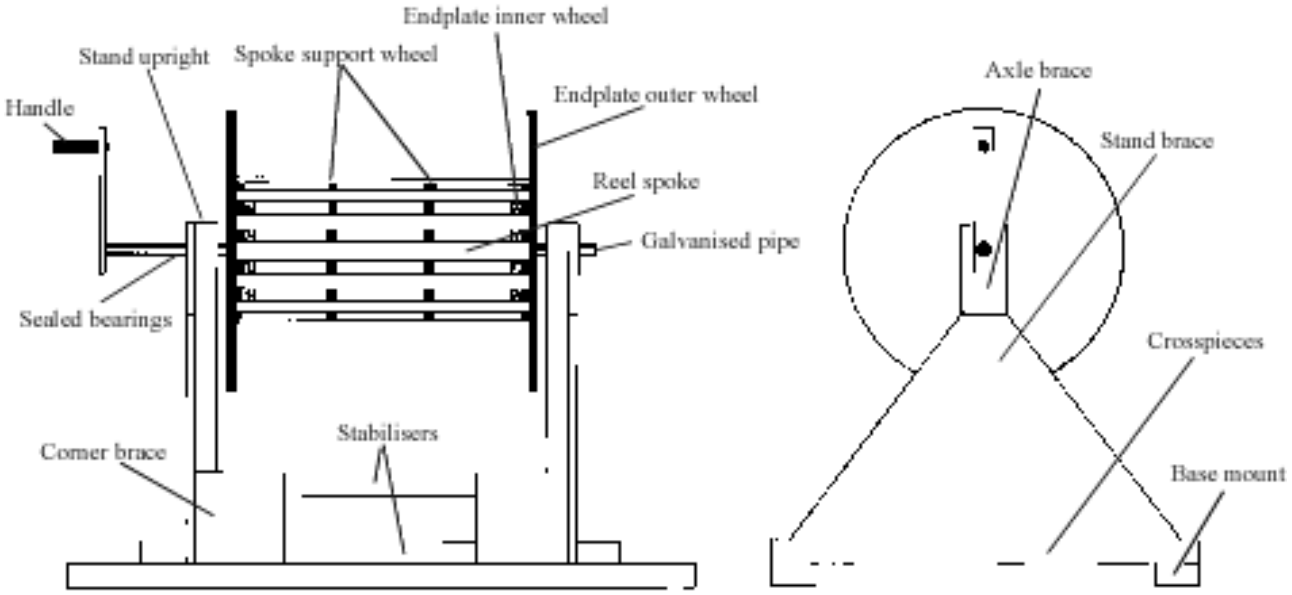

Figure 6: Vertical longline drum and stand used in Palau showing the different components

Table 3: Materials list with measurements for constructing the vertical longline drum and stand used in Palau

Item	Size	Number of pieces
Endplate outer wheel	50 cm diameter	2
Endplate inner wheel	30 cm diameter	2
Spoke support wheel	30 cm diameter	3
10 cm x 5 cm endplate block	20 cm	2
2.5 cm x 5 cm reel spoke	40 cm	18
2.5 cm x 5 cm stabilisers	37.5 cm	2
12 mm galvanised pipe	60 cm	1
22 mm sealed bearings		2
axle handle	25 cm	1
Stand components:		
10 cm x 5 cm stand upright	55 cm	2
10 cm x 5 cm base mount	75 cm	2
10 cm x 5 cm crosspiece	50 cm	2
50 cm	10 cm x 45 cm x 75 cm	2
12 mm plywood stand brace	20 cm x 55 cm	2
12 mm plywood corner brace	10 cm x 15 cm	2
12 mm plywood axle brace		

The vertical longline drum had a maximum holding capacity of four 3.5 mm monofilament vertical longlines. Two 5 cm x 20 cm timbers were bolted lengthways to the drum stand base mounts. The timbers were cut to extend 10 cm over the outside edge of each gunwale of the 7 m vessel. Two lengths of 10 cm x 5 cm timbers were bolted under the two timbers protruding over the gunwales to stop the drum from sliding back and forth. Four 'G-clamps' were used to secure the drum mount to the gunwales of the vessels. Two 50 cm lengths of 10 cm x 5 cm timbers were bolted together to from an inverted 'V' and these were bolted upright onto the ends of the drum mounts. The inverted 'V' timbers were used to fasten a plastic pulley for setting and hauling the vertical longlines.

Vertical longlines (Figure 7) were fabricated using the following components:

Surface float: standard 300 mm plastic pressure float with 10 cm stainless steel longline clip;

Flagpole: 4 m bamboo pole, 4 pieces of 2.5 cm steel re-bar 24 cm long each;

Mainline: 15 pieces of 3.0 or 3.5 mm monofilament 10 m long each, 1 by 10 cm stainless steel longline clip, 14 McMahon Heavy Duty No. 12 swivels;

Branchlines: 10 cm stainless steel longlines clips with swivels, 2.0 or 2.5 mm monofilament, swages, No.4 Tuna Circle hooks; and

Sinkers: 4 pieces of 2.5 cm diameter steel re-bar 24 cm long each, rubber inner tube strips, 1 by 10 cm stainless steel longline clip, 24 cm kuralon rope.

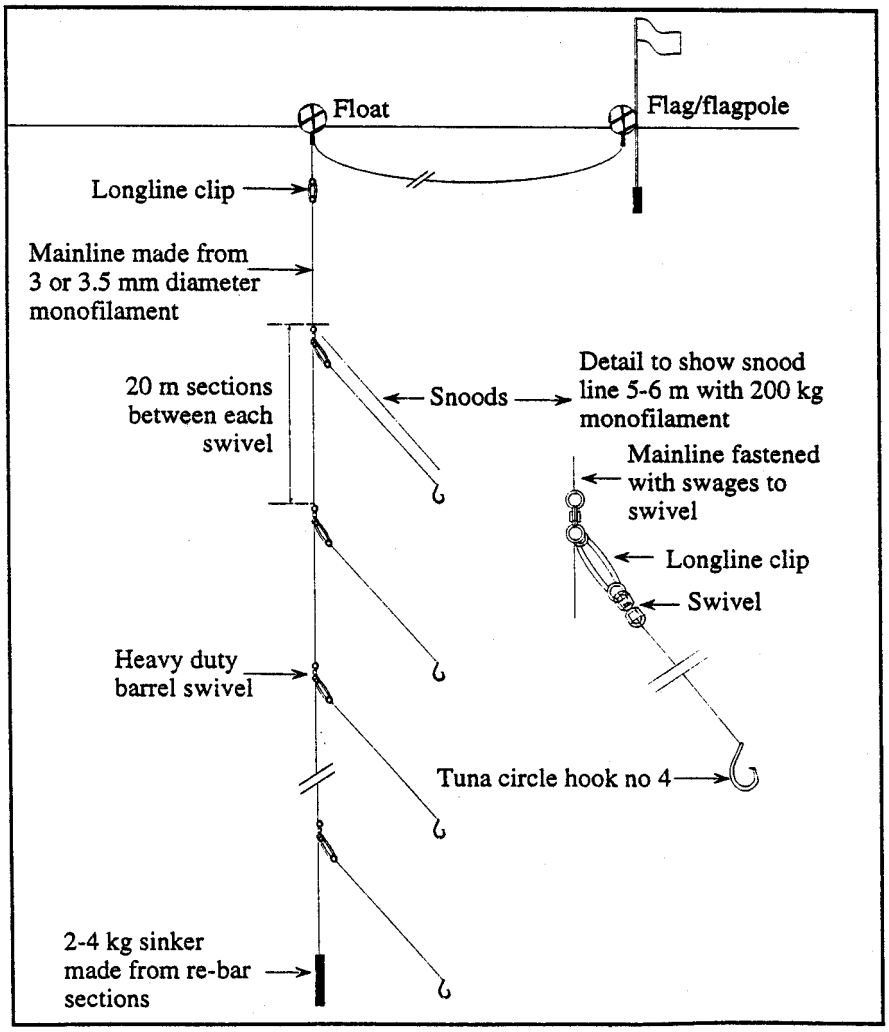

Figure 7: Construction of the vertical longlines used in Palau showing main components

Two other fishing methods were used during this project. Trolling was conducted using lures trolled from the Samoan handreels, some via the trolling booms. Bait fishing trials with light attraction at night used multiple hook rigs which were fabricated or bought from local fishing gear suppliers.

3.2 Training Activities

Training activities for the project were multifaceted as they included vertical longline fishing, bait fishing, FAD site surveys, and fabrication and deployment procedures for FADs.

Exhaustive FAD site surveys were conducted using a Global Positioning System (GPS) and depth sounder to record latitude and longitude positions and depths to determine the bottom contours of Palau's exterior reef areas. The MRD Fisheries Development Officer, Pablo Siangeldeb, was trained in the operation of this electronic equipment to map bottom contours. Also, a GPS training workshop was conducted to train MRD Fisheries officers and persons from the private sector in the operation of commercial GPS units.

MRD Fisheries Officers were trained in fabrication and deployment procedures including proper mooring component selection, mooring configuration and on-board handling procedures. The skill of 12 strand rope splicing was also taught.

Six members of the MRD staff and four crew members from the Melekeok Fishing Co-operative fishing vessel, *Sebus*, were trained in vertical longline fabrication and fishing techniques.

3.3 Disposal of Catch

Fish caught during the vertical longline trials and trolling offshore or around the FADs were distributed amongst the MRD staff.

3.4 Data Collection

The South Pacific Commission requires the use of a standard logsheet to record data pertaining to catch, effort, weather conditions, and detailed fishing activities. However, a logsheet was specifically drafted for the vertical longline fishing trials and bait fishing trials (Appendix 1a) as the standard SPC bottom-fishing and trolling logsheet was found to be inappropriate for recording data specific to vertical longline and bait fishing. Weather conditions, current direction and speed, time required to set and haul vertical longlines, number of hooks set, species, length and weight of catch were recorded on each logsheet. Numeric codes were utilised for data details (Appendix 1b). Additional reports describing fishing activities, fishing locations and other pertinent information were completed for each trip.

4. FISHING ACTIVITIES

4.1 Vertical Longline

The vertical longline gear described in Section 3.1 was deployed around offshore FADs and offshore from the exterior reefs in areas where tunas were known to congregate. All of the longlines were deployed from the MRD vessel, *Mesekiu.* The vertical longline trials were unsuccessful in that only sharks and few pelagic species were caught. A total of 703.5 kg of fish were caught; 693.0 kg were sharks and the remaining 10.5 kg was made up by 1 mahi mahi (*Coryphaena hippurus*) and 2 rainbow runner (*Elagatis bippinnulatus*). Three types of bait were used, squid, soma and terekrik (*Selar crumenophthalmus).* All baits were unsuccessful in catching tunas. A summary of vertical longline catches is listed in Table 4 while detailed trip records are contained in Appendix 2.

Table 4: Catch from vertical longline trials with all weights estimated

No. of Sets	No. of longlines	No. of hooks	Total kilos	kg/set	kg/longline
12	33	495	703.5	58.6	21.3

When the project began it was assumed that the FADs were not aggregating large yellowfin and bigeye tunas as the five FADs were deployed too close to the reef and the season for catching tuna had already passed. Most of the tuna longline vessels fish in Palau's EEZ from April to September. In April and May 1992, two FADs were deployed offshore on the west coast near Ulong Passage and Ngeremlengui Passage. The FAD deployed 7.5 miles offshore from Ngeremlengui Passage quickly aggregated mahi mahi, small yellowfin and skipjack tunas. Four months after deployment an estimated 30 tons of tunas were caught around the FAD. Unfortunately, during this period only small tunas aggregated around the FAD and vertical longlines were unsuccessful in catching large tunas in mid-water.

4.2 Trolling

Trolling activities were conducted during every fishing trip. The majority of trolling effort was conducted around FADs but open water and reef trolling also contributed to the catch. A total of 18 trolling trips produced 1045.0 kg of fish. A summary of trolling catch is detailed in Table 5 while detailed catch records are contained in Appendix 2.

Table 5: Summary of trolling catch taken during the project with all weights estimated.

Trolling type	No. of fish	Total kilos	kg/trip
Trolling FAD	414	967.5	53.8
Open-water and reef trolling	14	77.5	4.3
Total	428	1045.0	58.1

As can be seen from Table 5, the majority of the trolling catch was taken in the vicinity of FADs. During FAD trolling, three lines were used for 26 hours in total giving a catch per unit of effort (CPUE) of 12.4 kg/line-hour. The CPUE was calculated according to only hours fished at the FADs, travelling time to and from the FADs was not included.

4.3 Bait Fishing

Bait fishing trials were conducted in various locations inside the lagoon and outside the exterior reef for *terekrik* (*Selar crumenophthalmus* – big-eyed scad). Fresh *terekrik* is considered one of the best baits for catching large tunas. The first trials for bait proved to be unproductive but once good grounds were located catches improved dramatically. The best area located for catching bait was Ngeremlengui Passage during the new moon phase, using multiple hook jigs. A net was also used to catch bait but only sardines were caught. A summary of bait catches is detailed in Table 6 with detailed trip record contained in Appendix 3.

Table 6: Summary of bait catches during the project with all weights estimated

No. of trips	No. of fish	No. of *terekrik*	Total kilos	kg/trip
8	436	155	43.7	5.5

Although the results of the bait fishing trials were not as productive as expected, an average of 50 to 60 pieces of *terekrik* were jigged a night during the new moon phase in Ngeremlengui Passage. This would be sufficient to set 4 to 6 vertical longlines. If the vertical longline fishery developed some local fishermen could focus on the capture of bait and sell it to vertical longline fishermen.

5. SPECIES COMPOSITION OF THE CATCH

Vertical longline fishing proved to be ineffective in catching the target species *Thunnus albacares* and *Thunnus obesus*. The majority of the catch was sharks which have no commercial value and therefore the identification of the different sharks caught was not recorded. As already stated in the previous section, the only saleable species caught on the vertical longline were 1 mahi mahi (*Coryphaena hippurus*) and 2 rainbow runner (*Elagatis bippinnulatus*) totalling 10.5 kg in weight.

Eight species of fish were caught whilst trolling, with only three of these species taken around the FADs. Table 7 summarises the catch by species for the two trolling styles, FAD trolling, and open water and reef trolling.

Table 7: Species composition of the trolling catch with all weights estimated

Trolling style	Species	Number of fish	Total weight (kg)
Open water and reef	Mahi mahi (*Coryphaena hippurus*)	1	3.0
	Wahoo (*Acanthocybium solandri*)	5	50.0
	Barracuda (*Sphyraena barracuda*)	5	14.0
	Rainbow runner (*Elagatis bippinnulatus*)	1	1.0
	Trevally (*Caranx lugubris*)	1	3.5
	Frigate mackerel (*Auxis thazard*)	1	6.0
	Sub-total	**14**	**77.5**
FADs	Yellowfin tuna (*Thunnus albacares*)	305	832.0
	Skipjack tuna (*Katsuwonus pelamis*)	105	127.0
	Mahi mahi (*Coryphaena hippurus*)	4	8.5
	Sub-total	**414**	**967.5**
	Total trolling catch	**428**	**1045.0**

6. FAD ACTIVITIES

6.1 Bottom contour surveys

Bottom contour surveys were conducted on the east and west coasts of Palau using the equipment specified in Section 3.1. The areas surveyed were between 3 and 7 miles offshore from the exterior reefs and between 600 and 1,500 fathoms. Note: all depth sounding recorded during the site surveys were recorded in fathoms as that is the depth measurement the Palauans were use to, and therefore what is recorded in this section of the report.

Some areas were omitted from the surveys as previous periodic soundings indicated the exterior reef slope was too steep to safely deploy FADs. The bottom contour survey procedure consisted of the *Mesekiu* following a zigzag pattern over a selected area recording depths, latitude and longitude every 2 to 4 minutes. The survey vessel changed it's course when either the depth exceeded 1,500 fathoms or was less than 600 fathoms. If survey records indicated there was a slope suitable for a potential FAD site in an area more

extensive surveys were conducted to determine whether the seabed in the area was flat enough to safely deploy an FAD.

A total of 10 bottom contour surveys were completed around Palau (Figure 8) during the project. The name of the survey area, latitudes and longitudes perimeters, minimum and maximum depths of each survey are recorded in Table 8, while the actual soundings and positions in each of the 10 locations are provided in Appendix 4.

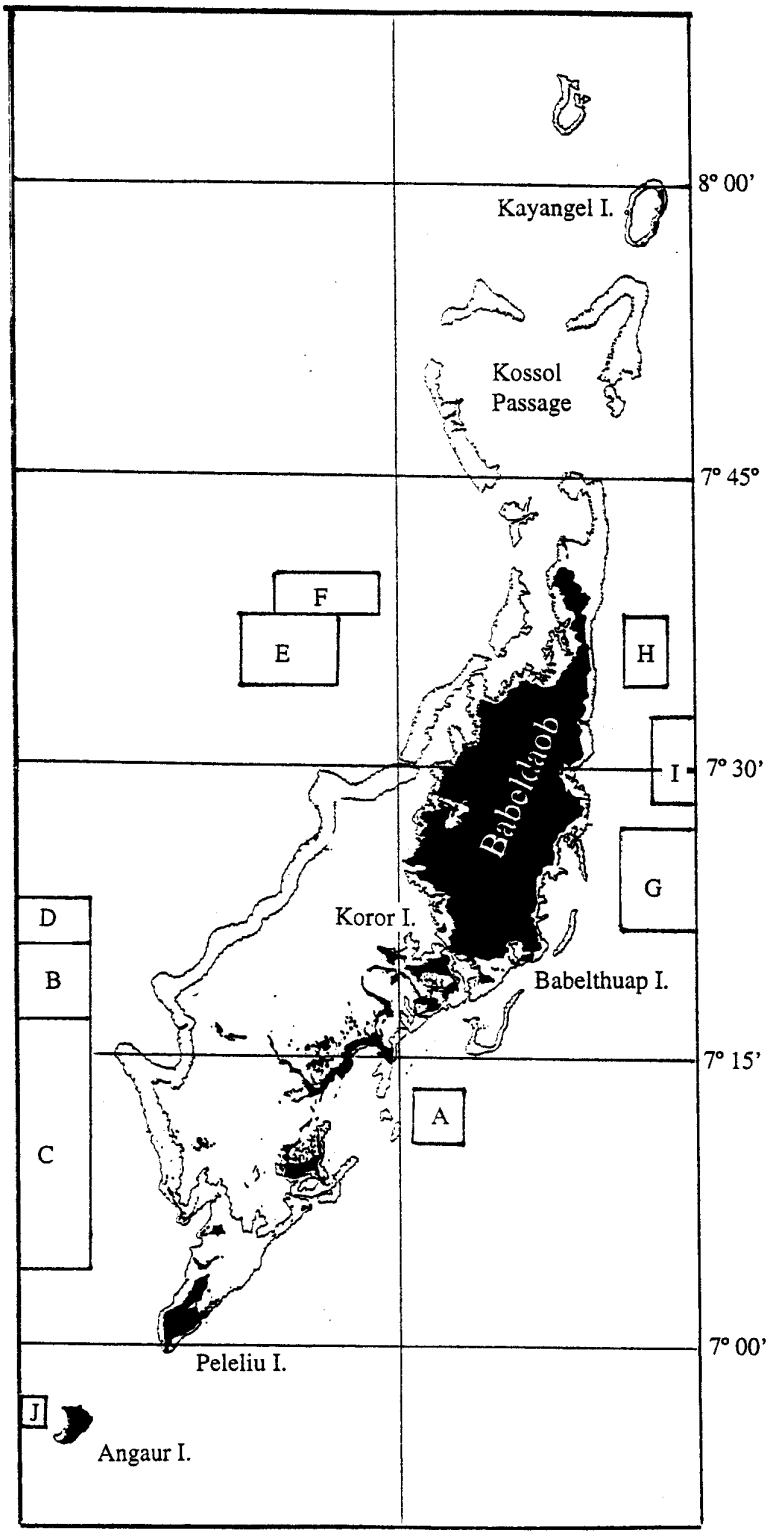

Figure 8: Approximate location and perimeters for the 10 areas surveyed to locate suitable FAD sites around Palau

Table 8: Summary of the perimeters for the 10 areas surveyed when looking for suitable FAD deployment sites

Survey area	Lat/long perimeters	Min/max depths (f)
Koror (A)	07º 09.00'–07º 12.00' N 134º 29.00'–134º 32.00' E	775–1,410
Ulong (B)	07º 17.50'–07º 20.75' N 134º 08.00'–134º 11.25' E	550–980
Ulong South (C)	07º 05.00'–07º 18.25' N 134º 08.00'–134º 11.00' E	670–875
Ulong North (D)	07º 18.00'–07º 21.50' N 134º 08.00'–134º 11.25' E	620–960
West Passage (E)	07º 36.00'–07º 40.50' N 134º 20.00'–134º 24.50' E	208–750
Ollei (F)	07º 39.75'–07º 42.00' N 134º 21.75'–134º 27.75' E	227–1,000
Ngchesar (G)	07º 21.50'–07º 27.50' N 134º 40.50'–134º 44.25' E	1,000–1,600
Ngaraard (H)	07º 34.50'–07º 38.50' N 134º 41.25'–134º 44.00' E	750–1,500
Melekeok (I)	07º 27.50'–07º 34.75' N 134º 42.50'–134º 44.50' E	1,000–1,600
Anguar (J)	06º 53.50'–06º 54.75' N 134º 06.25'–134º 07.75' E	20–200

The bottom contour surveys revealed that the outer slopes for most of the exterior reefs on the east and west coasts were too steep to safely deploy FADs. A small offshore bank was located west of Ngeremlengui Passage. This bank is approximately 7.5 nm offshore from the exterior reef, is 5 nm long and rises to 210 fathoms.

Five suitable FAD deployment sites were located on the west coast with only one suitable site located on the east coast. The site name, latitude and longitude and depth are listed in Table 9.

Table 9: Locations and depths for the six suitable FAD deployment sites located during survey work

Site name	Lat/long	Depth (f)
Ngemelis	07º 06.94' N 134º 10.28' E	780
West Passage	07º 37.62' N 134º 22.52' E	700
Ollei	07º 40.45' N 134º 23.75' E	715
	07º 41.45' N 134º 24.57' E	860
	07º 40.21' N 134º 26.12' E	740
Ngaraard	07º 35.66' N 134º 42.20' E	1,080

6.2 FAD deployments

Two FADs were deployed on the west coast on sites located from the bottom contour surveys. The Koror state inter-island cargo vessel was chartered for the deployments. These FADs used 2 of the refurbished coast guard buoys from Hawaii which were recovered from the east coast FADs that drifted off station after deployment in 1991. Replacement moorings for the FADs deployed in 1991 were used for the two FADs. An inshore FAD was deployed offshore from Ngiwal village. The FAD site name, latitude and longitude, depth and distance offshore are listed in Table 10.

Table 10: Location, depth and distance offshore of the three FADs deployed by the project

Site Name	Lat/long	Depth (f)	Distance (nm)
Ngeremlengui	07º 37.62' N 134º 22.52' E	700	7.5
Ngemelis	07º 06.95' N 134º 22.52' E	780	3.5
Ngiwal	07º 31.25' N 134º 39.40' E	100	1.0

6.3 FAD designs

The cost of deploying a FAD mooring with a refurbished coast guard buoy from Hawaii for a flotation device was approximately US $6,500.00. Since these FADs drifted off-station only a few months after deployment and the replacement cost was so high, alternative inexpensive FAD designs were ordered with the intention of comparing the performance and longevity of each mooring systems. Two alternative FAD mooring systems were chosen for experimentation, the *McIntosh* FAD design (Figure 9) which consists of submerged floats with monofilament mooring line and the *Indian Ocean* FAD design (Figure 10) which consists of semi-submersible multiple floats with a catenary curve mooring.

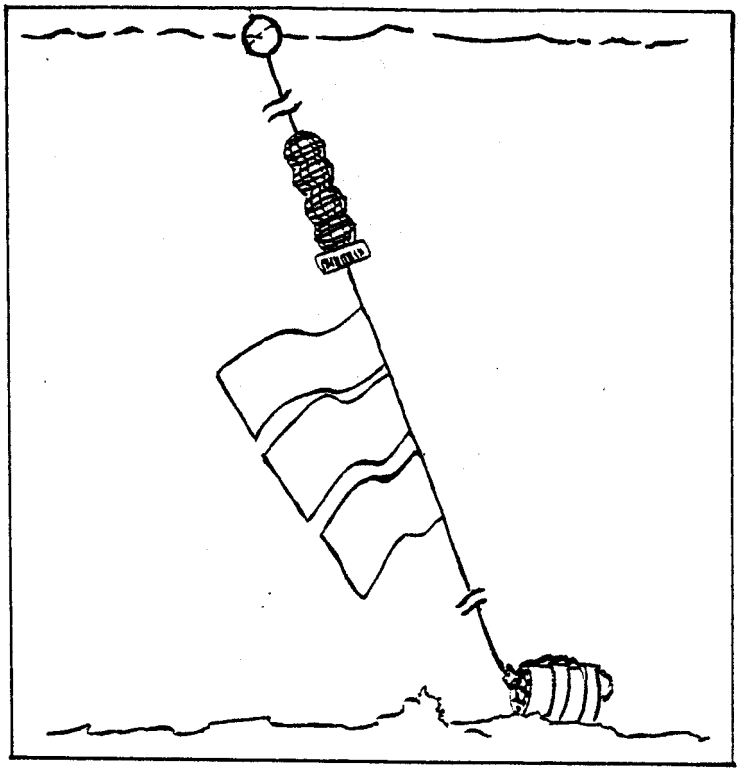

Figure 9: **McIntosh** *submerged float FAD design trialed by the project*

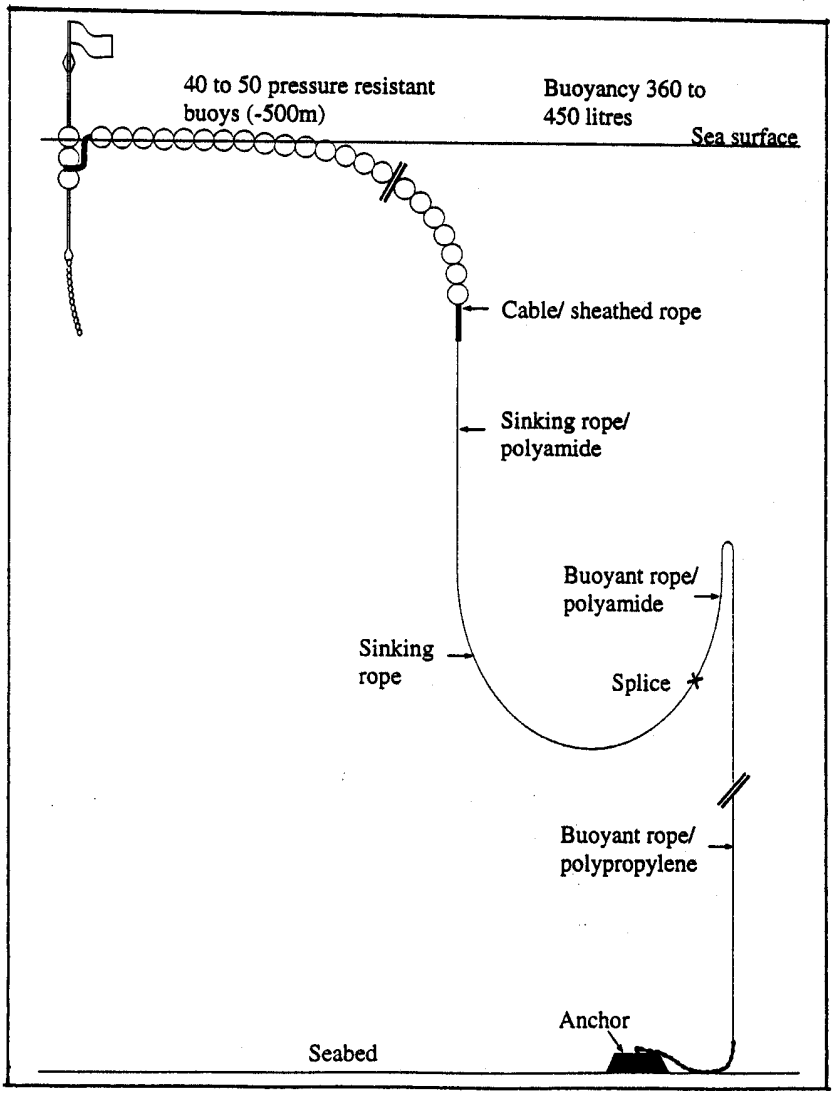

Figure 10: **Indian Ocean** *FAD design trialed by the project*

The *McIntosh* submerged float FAD (Figure 9) consists of four hard plastic pressure resistant floats bolted and laminated together end to end. A canister containing coiled 3.2 mm monofilament line is bolted to the bottom of the last pressure float. The monofilament line is cut to length for specific FAD site depths to ensure the floats remain at least 10 m below the sea surface. Attached to the top end of the monofilament line are three 1 m x 1 m flags that act as fish aggregators. The anchor consists of a 10 m length of 12 mm galvanised chain shackled to a 250 kg weight. The advantages of this FAD mooring system are: the entire FAD mooring system is submerged below the sea surface and therefore the mooring is not affected by the waves on the surface; the FAD can be deployed from a relatively small vessel; the mooring line is lifted off the bottom by the pressure floats and therefore there is no risk of the line chaffing off on the seabed; and cost of the FAD mooring system was only US $1,200.

The *Indian Ocean* FAD (Figure 10) consists of 50, five litre purse-seine floats strung onto a 20 m length of PVC coated steel cable. A flag pole with a swivel is shackled to an eye at one end of the cable while the mooring rope is shackled with a swivel to an eye at the other end of the cable. The mooring rope is fabricated from 19 mm, 12 strand nylon rope and 22 mm, 12 strand polypropylene rope. The FAD is anchored with 10 m of 19 mm galvanised chain shackled to a 1 t cement block. Advantages of this FAD mooring system are: the flotation device submerges under the sea surface during periods of strong currents or stormy weather; the string of floats create less drag on the mooring system than the Hawaiian coast guard buoy; and the cost of the FAD mooring system is only US $4,200. This design has been further refined since this project and details of the refined mooring system can be found in an SPC manual, Gates et al (1996).

An inshore FAD was designed and fabricated to aggregate bait fish to assist the Melekeok Fishing Co-operative fishermen. The FAD was fabricated using the following materials:

- 15 m length of 5 cm diameter 3 strand polypropylene rope;
- 10 pressure resist longline floats;
- 20 m of kuralon rope for fastening the floats to the polypropylene rope;
- 50 pieces of frayed 2 m length of 16 mm 3 strand polypropylene rope for aggregators;
- 1 x 19 mm galvanised swivel;
- 3 x 16 mm galvanised shackles;
- 2 nylite rope connectors;
- 60 m of 19 mm 3 strand nylon rope;
- 200 m of 19 mm 3 strand polypropylene rope;
- 2 x 7.5 litre lift, plastic pressure resistant floats;
- 2 m flagpole;
- 10 m of 12 mm galvanised chain; and
- 250 kg engine block.

Flotation Device Fabrication

A 15 m length of 5 cm diameter 3 strand polypropylene rope was laid out in a “U” shape then an over-hand knot forming a 30 cm loop was tied into the bend of the rope. Ten pressure resistant longline floats were placed every 60 cm inside the “U” section of the rope. Kuralon rope was passed through the holes in the ears at the opposite ends of each buoy and lashed to the polypropylene rope. After the buoys were tightly secured to the polypropylene, the two ends of the polypropylene rope were lashed together. Frayed 2 m lengths of 16 mm 3 strand polypropylene rope were lashed every 5 cm along the 5 cm diameter polypropylene rope to act as aggregators. Figure 11 shows the flotation device after fabrication.

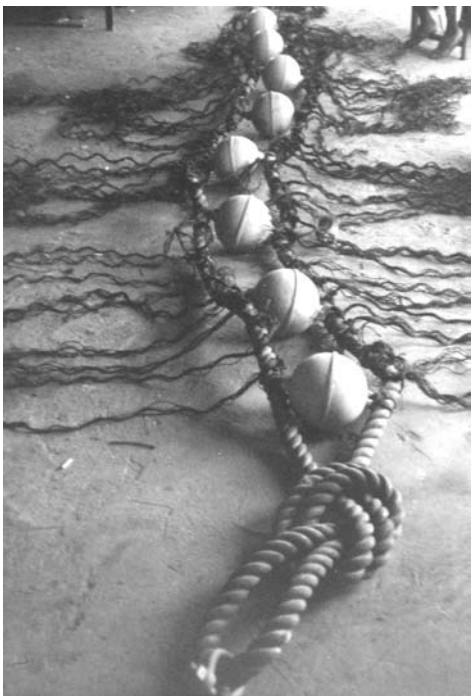

Figure 11: Flotation device fabricated for the inshore FAD for attracting bait

Mooring System

A 16 mm shackle with a 19 mm swivel was bolted through the loop in the bend of the 5 cm polypropylene rope of the flotation device. A nylite rope connector was shackled to the swivel for the mooring rope which consisted of 60 m of 19 mm, 3 strand nylon rope spliced to 200 m of 19 mm, 3 strand polypropylene rope. Two 7.5 litre lift pressure resistant floats were lashed approximately 20 m from the end of the polypropylene rope to ensure the mooring rope did not chaff on the seabed. The end of the polypropylene rope was shackled to 10 m of 12 mm galvanised chain and a 250 kg engine block for an anchor.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The vertical longline trials around FADs and in open water proved to be unsuccessful in catching high value *Thunnus albacares* and *Thunnus obesus* during the Masterfisherman's visit in Palau. There are a number of possible explanations for this:

1) The FADs which were deployed by the Masterfisherman during his visit were only on station for 1 month. Although the two FADs were successful in aggregating tunas, especially the FAD deployed 7.5 nm offshore from Ngeremlengui Passage, only small sized fish were caught. Possibly the FADs required a longer period of time on station to aggregate larger tunas in mid-water depths. Vertical longline fishing is a proven method for catching large tunas, particularly in Western Samoa and the Cook Islands, and should also be productive in Palau. These two countries have had on-going FAD programmes for many years and have established FAD sites which have proven to be productive in aggregating large quantities of pelagic fish. Possibly, it requires a longer period of time for large tunas which tend to feed more in the mid-water depth ranges to establish a migratory link with FADs than smaller surface feeding tunas.

2) The El Nino current has possibly changed the migratory patterns of pelagic species in 1992. Few schools of large tunas were sighted offshore within 5 nm of the exterior reef by local fishermen. A sports fishing derby was held in April 1992 in Palau with over 30 boats participating. During the three day derby only two *Thunnus albacares* over 20 kg were caught and no billfish. Trolling outside the exterior reefs continued to be so poor throughout the remainder of the year that many fisherman changed to bottom fishing inside the lagoon.

Bait fishing trials for *terekrik (Selar crumenophthaimus)* indicated that using multiple hook jigs was a marginally productive method. An average of 50 to 60 pieces of *terekrik* could be caught at night during the new moon phase in lagoon areas and reef passages known to aggregate sufficient quantities of bait fish. The most efficient method for catching bait is using a net with a small mesh size when the fish are schooling near the shoreline of islands or reefs. These areas are controlled by local fishermen from nearby villages and fishermen from other islands are prohibited to fish on their bait grounds. If vertical longline fishing were to become a viable fishery in Palau, bait fish would have to be supplied from the villages controlling the bait grounds or imported baits used.

Bottom contour surveys conducted on the east and west coasts indicated that there were few suitable areas to deploy deep water FADs; three FAD sites were located near a bank approximately 8.0 nm offshore from Ngeremlengui Passage, one site 3.5 nm offshore from Ngemelis Island, and one site 3.5 nm offshore from Ngaraard village. Since there are so few areas suitable for deep water FADs an inshore FAD programme might prove to provide the local fishermen with greater opportunities to catch small pelagic fish for bait and food. Some of the deep water FADs which were deployed in July 1991 drifted inshore and the mooring ropes became caught on the seabed near the exterior reefs. These FADs aggregated schools of rainbow runner, small skipjack tuna, small yellowfin tuna and trevalies. It would be feasible to fabricate inexpensive inshore FADs similar to the one deployed offshore from Ngiwal and place them in strategic locations near fishing villages.

Two deep water FADs were deployed on the west coast and one inshore FAD on the east coast during the Masterfisherman's visit to Palau. The two deep water FADs, offshore from Ngemelis and Ngeremlengui were productive in aggregating tunas but the catches around the Ngeremlengui FAD far exceeded those around the Ngemelis FAD. The possible explanation for this was that the Ngeremlengui FAD was deployed much further offshore, 7.5 nm compared to 3.5 nm. Also there was a bank which rose to approximately 200 fathom 0.5 nm further offshore from the FAD site. The area around the bank is known as a good fishing ground for tunas and other pelagic species by local fishermen. The Ngemelis FAD possibly will be more productive in aggregating fish after it has been on station for a longer period of time. If this FAD does not become more productive with time the site should not be considered again for future FAD deployments.

The FAD mooring systems using refurbished coast guard buoys from Hawaii which were deployed in 1991 were very expensive, around US $6,500 each. Although, the components of the mooring system were of the highest quality, all six FADs drifted off station within 6 months of deployment. Alternative, less expensive FAD designs were chosen for the next phase of Palau's FAD programme. Two FAD mooring designs were chosen, the submerged monofilament design manufactured by *McIntosh* and the submersible *Indian Ocean* design modified by the SPC's Capture Section. Both systems are less expensive than the Hawaiian buoy design and feature flotation devices which reduce the strain on the mooring. It is intended that a FAD monitoring programme be initiated after the FADs are deployed at sites located during the bottom contour surveys and compare the longevity and aggregating potentials of each FAD design to determine the most appropriate for Palau.

7.2 Recommendations

Consideration of the present commercial fisheries in Palau, the experimental work undertaken during the current visit, and the Masterfisherman's experience, prompt the following recommendations:

1) Vertical longline trials be re-established by MRD fisheries officers at the beginning of the next tuna season in April 1993. Most of the trials should be conducted around FADs to determine whether the two FADs deployed during the Masterfisherman's visit are successful in aggregating high value tunas in mid-water.

2) Fishermen from villages near bait fishing grounds should be trained in the capture of *terekrik (Selar crumenophthaimus)* with the objective of supplying bait to vertical longline fishermen.

3) Materials for the two FADs deployed on the west coast should be ordered to replace the FADs when they drift off station. Also replacement materials for the *Indian Ocean* FAD should be ordered.

4) A FAD monitoring programme should be initiated by MRD to collect data concerning each FAD site, fish catches, fish species, number of fishing trips and number of fishermen using the FAD. Data collected from each FAD can provide information to determine the productivity of the FAD and justify to the government the need for funding to establish an on-going national FAD programme.

5) Initiate an inshore FAD programme to focus fishermen's efforts on the capture of pelagic species rather than demersal species which are more susceptible to over fishing. Also, fishermen who have small vessels and are not confident fishing 5–10 nm offshore would benefit from strategically located inshore FADs.

6) Investigate the possibility of contracting a Philippine purse-seine company to deploy *payao* design FADs offshore from the exterior reefs of Palau. Philippine *payaos* are fabricated using a bamboo raft for a flotation device and 12 mm, 3 strand polypropylene rope for the mooring. These FADs cost approximately US $1,500 and might prove to be an effective FAD design for Palau.

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APPENDIX 1A

DATA COLLECTION FORMS DESIGNED FOR RECORDING INFORMATION ON VERTICAL LONGLINING AND BAIT FISHING TRIALS

(b) Vertical longline data sheet

```
Vessel                              Captain
Date                  Trip No.                Set No.
Location

Fishing Conditions:
Wind direction              Speed               Sea
Weather                  Current               Speed

Fishing Gear:
Vertical Longline                Trolling

Details:
Length of Dropline            No. of Droplines
Total No. of Hooks            Size of Hooks
Length of Snoods              Bait Type
No. of Pieces

Fishing Times:
      Setting:              Start     Finish
      Hauling:              Start     Finish

Catch Details:
Species    Length    Weight    Sex  Depth
```

(b) Bait fishing data sheet

```
Vessel.................No. of Fishermen ..........
Date..................... Trip No................
Location.

Fishing Conditions:
Wind direction..............Speed ..............Sea
Weather.............Current ..............Speed
Moon phase.

Fishing Method:
Handline.................Net ..............Other

Fishing Times:
Start.................Finish.

Catch Details:
Species         Number                Total weight
```

APPENDIX 1B

NUMERICAL CODES USED FOR RECORDING ALL DATA DURING THIS PROJECT

SPECIES CODE FOR PELAGIC FISHES

Carangidae	050
Elagatis bippinnulatus	0111
Caranx iqnobilis	0112
C. lungubis	0113
C. melampygas	0114
Coryphaenidae	066
Coryphaena equiselis	0539
C. hippurus	0540
Scombridaem	110
Acanthocybium solandri	1314
Auxis thazard	1315
Euthynnus affinis	1316
Grammatorcynus bilineatus	1317
Gynosarda unicolor	1318
Katsuwonus pelamis	1319
Rastrelliger brachysoma	1320
R. kanagurta	1321
Scomber japanicus	1322
Scomberomoruscommerson	1323
Thunnus alalunga	1324
T. albacares	1325
T. obesus	1326
Istiophoridae.	111
Istiophorus platypterus	1327
Makaira indica	1328
M. nigricans	1329
Tetrapterus angustirostr is	1330
Sphyraeidae	092
Sphvraena acutippinnis	0972
S.barracuda	0973
S. forsteri	0974
S. genie	0975
S. novaehollandiae	0976
S. obtusata	0977

****** CATEGORIES ******

***** FISHING TECHNIQUES *****
01 = VERTICAL LONGLINE
02 = TROLLING

***** BAIT *****
01 = SAURY
02 = ATULE
03 = MACKEREL
04 = SQUID
05 = OTHER

***** WIND DIRECTION *****
01 = NORTH
02 = NORTH-EAST
03 = EAST
04 = SOUTH-EAST 05 = SOUTH
06 = SOUTH-WEST 07 = WEST
08 = NORTH-WEST

***** WIND SPEED *****
01 = NO WIND
02 = 5 TO 10 MPH
03 = 11 TO 20 MPH
04 = 21 TO 30 MPH
05 = GREATER THAN 30 MPH

***** WEATHER *****
01 = CLEAR (0 TO 30%)
02 = PARTLY CLOUDY (30 TO 60%)
03 = MOSTLY CLOUDY (60 TO 90%)
04 = OVERCAST (90 TO 100%)

***** CURRENT *****
01 TO 08 SAME AS WIND DIRECTION

***** CURRENT SPEED *****
01 = NONE
02 = SLIGHT
03 = MODERATE
04 = FAST

***** SEA *****
01 = CALM
02 = MODERATE
03 = ROUGH

APPENDIX 2

CATCH RECORDS BY TRIP FOR VERTICAL LONGLINING AND TROLLING ACTIVITIES

PALAU VERTICAL DROPLINE FISHING DATA

DATE	FAD NO.	TRIP NO.	SET NO.	SET START	SET FINISH	HAUL START	HAUL FINISH	GEAR	NO. FISH	SPECIES	WEIGHT
10, 12 92	E2	1	1	6:30	7:30	9:30	11:30	1	0	0	0
10, 12 92		1						2	1	540	2.0
10, 12 91		1						2	1	540	2.0
12, 12 91	E1	2	2	7:30	8:30	10:30	11:30	1	0	0	0
12, 12 91		2						2	1	1314	7.5
12, 12 91		2						2	1	1314	15.0
12, 12 91		2						2	1	73	1.5
12, 12 91		2						2	1	973	2.0
12, 12 91		2						2	1	973	1.5
12, 12 91		2						2	1	973	3.5
19, 12 91	E5	3	3	9:10	10:00	13:00	14:00	1	1	111	2.0
12, 12 91								1	1	111	3.0
19, 12 91								2	1	1314	6.0
19, 12 91								2	1	1314	6.5
19, 12 91								2	1	540	3.0
19, 12 91								2	1	113	3.5
19, 12 91								2	1	1315	6.0
19, 05 92	W1	4	4	8:00	8:45	13:00	13:30	1	5	0000	120.0
19, 05 92		4						2	37	1325	60.0
19, 05 92		4						2	15	1319	18.0
21, 05 92		5						1	0	0	0
21, 05 92		5						2	1	1314	15.0

PALAU VERTICAL DROPLINE FISHING DATA

DATE	FAD NO.	TRIP NO.	SET NO.	SET START	SET FINISH	HAUL START	HAUL FINISH	GEAR	NO. FISH	SPECIES	WEIGHT
21, 05 92	E3	5						2	4	1319	2.0
23, 05 92	W1	6						2	5	1325	10.5
23, 05 92	W1							2	4	1319	10.0
28, 05 92		7	7	8:00	8:15	14:00	14:30	1	1	0000	150.0
28, 05 92								2	12	1325	20.0
28, 05 92								2	1	0111	1.0
03, 06 92	E3	8						1	3	0000	110
05, 06 92								2	1	0907	5.5
05, 06 92	W1	9						2	17	1325	37.0
07, 06 92								2	4	1319	8.0
07, 06 92	W1	10						2	7	1325	15.0
07, 06 92								2	3	1319	6.0
09, 06 92	W1	11	9	8:00	8:30	12:30	13:00	1	1	0000	45.0
09, 06 92								2	13	1319	16.5
09, 06 92								2	7	1325	14.5
12, 06 92	W1	12						2	21	1325	43.5
12, 06 92								2	18	1319	15.5
19, 06 92	E3	13	10	6:00	6:15	8:15	9:00	1	2	0000	240.0
26, 06 92	W1	14						2	31	1325	112.0
26, 06 92								2	10	1319	19.0
03, 07 92	W1	15						2	66	1325	162.0
03, 07 92								2	6	1319	6.5

PALAU VERTICAL DROPLINE FISHING DATA

DATE	FAD NO.	TRIP NO.	SET NO.	SET START	SET FINISH	HAUL START	HAUL FINISH	GEAR	NO. FISH	SPECIES	WEIGHT
06, 07 92	W1	16						2	5	1325	8.5
06, 07 92								2	12	1319	9.5
19, 07 92	W1	17						2	88	1325	324.0
19, 07 92								2	1	1319	1.0
21, 07 92	W1	18	11	16:50	17:10	18:40	19:00	1	1	0000	25.0
21, 07 92								1	1	0540	5.5
22, 07 92	W1	18	12	6:00	6:15	9:00	9:30	1	1	0000?	3.0
22, 07 92								2	9	1325	25.0
22, 07 92								2	15	1319	15.0
22, 07 92								2	2	0540	4.5

APPENDIX 3

CATCH RECORDS BY TRIP FOR BAIT FISHING ACTIVITIES

Date	Trip No.	Method	Moon	Start	Finish	Species	Number	Weight
07,01,92	1	HL	¼	19:00	21:00	Sc	42	7.5
08,01,92	2	HL	¼	18:45	21:30	Rf	13	2.15
09,01,92	3	HL	¼	20:15	23:30	0	0	0
16,01,92	4	NET	2/4	07:00	11:30	Sard	250	5.0
27,01,92	5	HL	¾	18:30	22:30	Rf	10	1.0
30,01,92	6	HL	¾	18:45	23:30	Sc	01	0.1
12,02,92	7	HL	¼	18:45	06:00	Sc	52	12.0
12,02,92	7	HL	1/4	18:45	06:00	Rf	8	3.0
25,02,92	8	HL	2/4	18:45	02:00	Sc	60	13.0

APPENDIX 4

INDIVIDUAL SOUNDINGS WITH LATITUDE AND LONGITUDE POSITIONS FOR EACH OF THE 10 LOCATIONS SURVEYED

EAST OF KOROR HARBOUR (survey area A)

Area Surveyed: 700-1,450 fathom contours
Latitude: 07º 09.00'–07º 12.00'
Longitude: 134º 29.00'–134º 32.00'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 10.59 N 134 29.70 E	780	07 11.10 N 134 30.13 E	850	07 11.65 N 134 30.37 E	795
07 10.22 134 29.83	858	07 10.96 134 30.23	900	07 11.65 134 30.22	775
07 10.11 134 29.91	900	07 10.81 134 30.34	930		
07 09.88 134 30.07	980	07 10.48 134 30.57	1,000		
07 09.80 134 30.15	1,040	07 09.87 134 30.91	1,280		
07 09.83 134 30.17	1,000	07 09.53 134 31.17	1,380		
07 10.05 134 30.25	1,000	07 09.42 134 31.33	1,440		
07 10.32 134 30.34	1,010	07 09.63 134 31.52	1,410		
07 10.55 134 29.88	840	07 09.88 134 31.61	1,310		
07 10.86 134 29.49	720	07 10.12 134 31.42	1,260		
07 11.19 134 29.58	780	07 10.62 134 31.05	1,120		
07 11.57 134 29.79	710	07 10.95 134 30.83	960		
07 11.50 134 29.99	770	07 11.28 134 30.56	830		

ULONG (survey area B)

Area Surveyed: 700–750 fathom contours
Latitude: 07º 17.50'–07º 20.75'
Longitude: 134º 08.00'–134º 11.25'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 20.36 N 134 08.66 E	980	07 19.20 N 134 10.85 E	660		
07 20.26 134 08.90	940	07 19.33 134 10.58	720		
07 20.17 134 09.59	870	07 19.44 134 09.42	660		
07 19.92 134 10.37	845	07 19.54 134 09.31	680		
07 19.99 134 10.70	740	07 19.03 134 09.17	690		
07 20.38 134 10.74	740	07 19.02 134 09.03	720		
07 20.44 134 10.64	760	07 18.74 134 08.86	720		
07 19.93 134 10.75	725	07 18.48 134 08.70	740		
07 20.09 134 10.80	720	07 18.11 134 08.94	660		
07 20.30 134 11.20	620	07 18.10 134 08.70	740		
07 20.97 134 11.11	720	07 17.80 134 08.73	740		
07 20.31 134 10.69	760	07 18.77 134 08.95	700		
07 20.19 134 10.87	720	07 18.82 134 09.90	550		
07 19.87 134 10.86	720				
07 19.80 134 11.00	640				

ULONG SOUTH (survey area C)

Area surveyed: 700–850 fathom contours
Latitude: 07º 05.00'–07º 18.25'
Longitude: 134º 08.00'–134º 11.00'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 18.06 N 134 08.95 E	670	07 09.69 N 134 10.21 E	810	07 05.63 N 134 10.98 E	760
07 17.18 134 08.36	830	07 09.23 134 10.84	720	07 05.23 134 10.95	750
07 17.55 134 08.82	760	07 08.75 134 10.82	760	07 05.13 134 10.46	820
07 16.85 134 08.77	840	07 08.60 134 10.09	850		
07 15.96 134 08.97	760	07 07.99 134 10.71	750		
07 15.45 134 08.69	800	07 07.86 134 09.83	850		
07 14.69 134 09.03	765	07 07.57 134 10.06	840		
07 13.95 134 08.79	875	07 07.49 134 10.71	750		
07 13.70 134 09.45	740	07 07.00 134 10.65	750		
07 12.89 134 09.24	820	07 06.85 134 09.97	840		
07 12.71 134 09.68	780	07 06.11 134 10.48	820		
07 11.57 134 10.31	740	07 05.93 134 10.89	750		
07 10.31 134 10.65	720	07 05.89 134 10.72	800		
07 10.84 134 10.22	820	07 05.86 134 10.38	840		
07 10.22 134 09.96	830	07 05.67 134 10.71	800		

ULONG NORTH (survey area D)

Area Surveyed: 700–950 fathom contours
Latitude: 07º 18.00'–07º 21.50'
Longitude:134º 08.00'–134º 11.25'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 19.89 N 134 09.11 E	890	07 20.95 N 134 10.85 E	770		
07 19.87 134 09.42	840	07 20.95 134 10.66	800		
07 19.86 134 09.84	800	07 20.93 134 10.41	880		
07 19.83 134 09.93	770	07 21.50 134 10.61	860		
07 19.85 134 10.25	785	07 21.50 134 10.81	800		
07 19.82 134 10.45	840	07 21.46 134 11.03	760		
07 19.81 134 10.66	780	07 19.74 134 09.97	740		
07 19.81 134 10.77	720	07 19.40 134 09.86	620		
07 20.23 134 10.77	780	07 19.20 134 09.30	720		
07 20.23 134 10.50	820	07 19.26 134 09.00	790		
07 20.23 134 10.40	880	07 19.26 134 08.70	850		
07 20.28 134 10.13	960	07 19.00 134 08.47	850		
07 20.53 134 10.24	920	07 18.96 134 08.54	800		
07 20.55 134 10.46	840	07 18.96 134 08.69	760		
07 20.57 134 10.52	800	07 18.96 134 08.73	740		
07 20.57 134 10.65	760				

WEST PASSAGE (survey area E)

Area surveyed: 200–800 fathom contours
Latitude: 07º 36.00'–07º 40.50'
Longitude: 134º 20.00'–134º 24.50'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 36.24 N 134 23.14 E	610	07 39.20 N 134 23.56 E	668	07 37.86 N 134 21.70 E	700
07 36.73 134 23.40	624	07 38.70 134 22.96	618	07 37.42 134 21.65	750
07 37.34 134 23.59	643	07 38.26 134 22.34	625		
07 37.87 134 23.86	640	07 37.73 134 21.75	725		
07 38.31 134 24.05	618	07 37.44 134 21.64	770		
07 38.70 134 24.37	615	07 37.66 134 21.14	723		
07 39.00 134 24.75	700	07 37.90 134 21.05	600		
07 38.14 134 23.89	605	07 38.62 134 21.37	380		
07 37.58 134 23.41	666	07 39.13 134 21.65	270		
07 37.00 134 22.99	680	07 39.55 134 22.13	255		
07 36.85 134 22.80	685	07 39.74 134 22.27	210		
07 37.46 134 23.00	682	07 40.23 134 22.60	360		
07 38.07 134 23.31	680	07 40.40 134 22.54	333		
07 38.71 134 23.49	640	07 39.66 134 22.35	208		
07 39.30 134 23.80	670	07 38.99 134 22.08	300		

WEST COAST – OLLEI (survey area F)

Area Surveyed: 220–1,000 fathom contours
Latitude: 07º 39.75'–07º 42.00'
Longitude: 134º 21.75'–134º 27.75'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 39.79 N 134 22.21 E	227	07 40.65 N 134 24.51 E	780	07 41.96 N 134 23.00 E	750
07 39.81 134 22.07	255	07 40.85 134 24.57	805	07 41.94 134 23.20	700
07 39.81 134 21.83	285	07 41.00 134 41.07	815	07 41.97 134 23.40	740
07 39.85 134 21.70	300	07 41.07 134 24.60	820	07 41.98 134 23.60	760
07 40.00 134 21.78	325	07 41.07 134 24.31	810	07 41.98 134 23.80	790
07 40.30 134 21.84	270	07 41.12 134 24.15	800	07 41.95 134 24.00	815
07 40.40 134 21.84	255	07 41.13 134 23.95	780	07 41.79 134 24.18	830
07 40.50 134 21.82	275	07 41.12 134 23.75	745	07 41.67 134 24.31	840
07 40.53 134 22.03	240	07 41.08 134 23.35	670	07 41.56 134 24.43	850
07 40.52 134 22.36	255	07 41.09 134 23.15	640	07 41.45 134 24.57	860
07 40.50 134 22.54	320	07 41.09 134 23.00	635	07 41.32 134 24.74	850
07 40.50 134 22.68	380	07 41.08 134 22.80	620	07 41.20 134 24.95	840
07 40.49 134 22.78	470	07 41.06 134 22.55	575	07 41.10 134 25.08	830
07 40.50 134 22.88	500	07 41.09 134 22.35	540	07 40.00 134 25.38	800
07 40.50 134 23.00	570	07 41.17 134 22.14	605	07 40.67 134 25.63	780
07 40.51 134 23.20	610	07 41.20 134 21.86	575	07 40.50 134 25.84	760

07 40.51 134 23.40	645	07 41.40 134 21.75	720	07 40.21 134 26.12	740
07 40.45 134 23.60	685	07 41.52 134 21.75	815	07 40.11 134 26.22	730
07 40.45 134 23.75	715	07 41.80 134 21.74	1,000	07 39.95 134 26.44	720
07 40.45 134 23.95	730	07 41.96 134 21.94	960	07 40.17 134 26.48	700
07 40.43 134 24.15	740	07 41.95 134 22.19	910	07 40.47 134 26.50	695
07 40.40 134 24.50	755	07 41.94 134 22.40	880	07 40.65 134 25.45	700
07 40.50 134 24.54	770	07 41.94 134 22.65	840		

EAST COAST – NGCHESAR (survey area G)

Area Surveyed: 1,000–1,600 fathom contours
Latitude: 07º 21.50'–07º 27.50'
Longitude: 134º 40.50'–134º 44.25'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 21.46 N 134 40.34 E	1,010	07 22.86 N 134 41.83 E	1,320	07 25.17 N 134 43.27 E	1,560
07 21.42 134 40.64	1,050	07 22.85 134 42.17	1,420	07 25.38 134 43.30	1,550
07 21.26 134 40.95	1,160	07 22.88 134 42.39	1,470	07 25.63 134 43.22	1,505
07 21.17 134 41.15	1,220	07 22.86 134 42.63	1,530	07 25.84 134 43.12	1,465
07 21.11 134 41.44	1,320	07 22.83 134 42.83	1,600	07 25.94 134 43.35	1,540
07 21.04 134 41.94	1,460	07 23.41 134 42.61	1,430	07 26.01 134 43.64	1,580
07 21.02 134 42.17	1,560	07 23.96 134 42.36	1,320	07 26.23 134 43.44	1,550
07 20.96 134 42.27	1,640	07 24.30 134 42.39	1,330	07 26.76 134 43.27	1,460
07 21.46 134 42.05	1,435	07 24.39 134 42.58	1,440	07 26.91 134 43.68	1,500
07 21.61 134 42.01	1,405	07 24.41 134 42.65	1,460	07 24.02 134 43.90	1,535
07 21.62 134 42.23	1,485	07 24.40 134 42.86	1,500	07 27.09 134 44.08	1,575
07 21.63 134 42.54	1,590	07 24.41 134 43.10	1,550	07 27.11 134 44.21	1,600
07 21.65 134 42.61	1,610	07 24.43 134 43.30	1,600	07 27.36 134 44.00	1,520
07 21.97 134 42.36	1,440	07 24.81 134 43.15	1,570	07 27.55 134 43.91	1,450
07 22.16 134 42.25	1,370	07 25.04 134 42.97	1,520		
07 22.58 134 42.00	1,330	07 25.18 134 43.02	1,530		

EAST COAST – NGARAARD (survey area H)

Area surveyed: 750–1,500 fathom contours
Latitude: 07º 34.50'–07º 38.50'
Longitude: 134º 41.25'–134º 44.00'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 34.58 N 134 42.44 E	1,300	07 35.65 N 134 42.40 E	1,090	07 36.63 N 134 43.00 E	1,100
07 34.76 134 42.24	1,240	07 35.62 134 42.50	1,110	07 36.70 134 42.80	1,060
07 34.83 134 42.00	1,200	07 35.63 134 42.60	1,120	07 36.79 134 42.60	1,000
07 34.87 134 41.80	1,130	07 35.65 134 42.80	1,210	07 37.16 134 42.55	980
07 34.99 134 41.60	1,080	07 35.66 134 42.90	1,220	07 37.40 134 42.55	960
07 34.97 134 41.40	1,040	07 35.68 134 43.09	1,240	07 37.46 134 42.67	990
07 34.97 134 41.20	1,000	07 35.71 134 43.20	1,270	07 37.50 134 42.93	1,080
07 35.15 134 41.15	960	07 35.68 134 43.40	1,310	07 37.55 134 43.20	1,160
07 35.30 134 41.17	930	07 35.70 134 43.60	1,335	07 37.61 134 43.47	1,250
07 35.50 134 41.18	880	07 35.72 134 43.80	1,410	07 37.64 134 43.60	1,290
07 35.65 134 41.25	860	07 36.00 134 43.82	1,330	07 37.64 134 43.90	1,380
07 35.70 134 41.36	860	07 36.20 134 43.76	1,280	07 37.67 134 44.07	1,440
07 35.71 134 41.51	930	07 36.50 134 43.75	1,240	07 38.25 134 44.03	1,390
07 35.68 134 41.77	1,000	07 36.58 134 43.46	1,235	07 38.26 134 44.66	1,260
07 35.68 134 41.95	1,050	07 36.55 134 43.25	1,170	07 38.27 134 43.40	1,120
07 35.66 134 42.20	1,080	07 36.55 134 43.10	1,120	07 38.32 134 43.00	980

EAST COAST - MELEKIOK (survey area I)

Area Surveyed: 1,000–1,600 fathom contours
Latitude: 07º 27.50'–07º 34.75'
Longitude: 134º 42.50'–134º 44.50'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
07 27.48 N 134 43,85 E	1,410	07 30.03 N 134 43.62 E	1,530	07 32.40 N 134 42.56 E	1,180
07 27.76 134 43.75	1,370	07 30.08 134 43.73	1,540	07 32.56 134 42.58	1,190
07 27.81 134 43.85	1,420	07 30.09 134 43.89	1,680	07 32.69 134 42.90	1,280
07 27.82 134 44.05	1,480	07 30.47 134 43,63	1,520	07 32.77 134 43.04	1,340
07 27.81 134 44.25	1,560	07 30.84 134 43.42	1,450	07 32.87 134 43.27	1,370
07 27.82 134 44.40	1,600	07 31.02 134 43.36	1,430	07 32.88 134 43.40	1,400
07 28.40 134 43.96	1,565	07 31.09 134 43.46	1,500	07 32.91 134 43.50	1,440
07 28.55 134 43.86	1,420	07 31.14 134 43.74	1,560	07 32.92 134 43.67	1,520
07 28.73 134 43.60	1,560	07 31.15 134 43.81	1,600	07 33.00 134 43.87	1,560
07 28.72 134 43.36	1,290	07 31.38 134 43.70	1,580	07 33.06 134 44.02	1,600
07 28.76 134 43.90	1,220	07 31.62 134 43.64	1,520	07 33.35 134 43.98	1,680
07 29.22 134 42.82	1,200	07 31.72 134 43.41	1,430	07 33.74 134 43.65	1,640
07 29.50 134 42.74	1,200	07 31.77 134 43.22	1,370	07 33.84 134 43.48	1,600
07 29.62 134 42.84	1,230	07 31.87 134 42.97	1,280	07 34.02 134 43.20	1,520
07 29.67 134 43.00	1,280	07 31.84 134 42.74	1,200	07 34.33 134 43.00	1,450
07 29.80 134 43.26	1,320	07 32.00 134 42.59	1,160		

ANGUAR (survey area J)

Area surveyed: 20–200 fathom contours
Latitude: 06º 53.50'–06º 54.75'
Longitude: 134º 06.25'–134º 07.75'

Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)	Lat/Long in degrees, minutes and decimals of minutes	Depth (fathoms)
06 53.58 N 134 06.92 E	20	06 53.77 N 134 06.78 E	120	06 54.18 N 134 07.18 E	158
06 53.60 134 06.88	40	06 53.81 134 06.87	145	06 54.19 134 07.11	170
06 53.61 134 06.83	55	06 53.83 134 06.93	150	06 54.23 134 07.04	178
06 53.63 134 06.77	60	06 53.84 134 07.07	148	06 54.23 134 06.93	150
06 53.62 134 06.75	72	06 53.87 134 07.14	152	06 54.24 134 06.90	165
06 53.62 134 06.71	72	06 53.91 134 07.21	153	06 54.25 134 06.78	200
06 53.61 134 06.65	82	06 53.93 134 07.29	158	06 54.26 134 06.72	202
06 53.61 134 06.60	110	06 53.94 134 07.46	150	06 54.24 134 06.66	203
06 53.61 134 06.54	120	06 53.94 134 07.50	130	06 54.44 134 06.75	210
06 53.63 134 06.46	130	06 53.99 134 07.58	110	06 54.51 134 06.86	190
06 53.62 134 06.40	135	06 54.01 134 07.65	80	06 54.51 134 06.98	187
06 53.63 134 06.34	140	06 54.02 134 07.73	50	06 54.51 134 07.09	160
06 53.59 134 06.31	142	06 54.16 134 07.78	55	06 54.50 134 07.19	140
06 53.57 134 06.29	142	06 54.18 134 07.72	88	06 54.51 134 07.32	110
06 53.55 134 06.21	155	06 54.18 134 07.62	110	06 54.53 134 07.42	100
06 53.53 134 06.14	160	06 54.18 134 07.54	132	06 54.54 134 07.54	60
06 53.68 134 06.20	160	06 54.20 134 07.48	153	06 54.79 134 07.46	90

06 53.68 134 06.30	145	06 54.19 134 07.40	165	06 54.76 134 07.40	120
06 53.70 134 06.44	135	06 54.18 134 07.36	162	06 54.71 134 07.32	140
06 53.73 134 06.52	128	06 54.17 134 07.30	140	06 54.66 134 07.26	125
06 53.75 134 06.63	105	06 54.18 134 07.24	138		