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Development of Small-Scale Fisheries

EXPERIENCES WITH FISH AGGREGATING DEVICES IN SRI LANKA

BOBP/WP/54

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BAY OF BENGAL PROGRAMME BOBP/WP/54

Development of SmaII-Scae Fisheries GCP/RAS/040/SWE

EXPERIENCES WITH FISH AGGREGATING DEVICES IN SRI LANKA

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This paper discusses the experiences of the small-scale fisheries project of the Bay of Bengal Programme (BOBP) with fish aggregating devices (FADs) in Sri Lanka from 1982 to 1986.

A pilot activity was initiated in 1982-83 to design, construct, deploy and monitor a few FADs in order to test their feasibility in Sri Lanka's small-scale fishery. It was implemented in cooperation with the National Aquatic Resources Agency (NARA) of the Government of Sri Lanka. A BOBP consultant, Mr. Charles Peters, worked on the project for six months during this period. The results and analysis for 1982-83 are based on interim reports prepared by Mr. Charles Peters, Mr. S.L. Suraweera (NARA Scientific Officer) and Mr. D.T Mendis (NARA Research Assistant).

From 1983 end, the project was supervised by the author with assistance from Mr. S.S.C. Pieris, NARA Research Assistant. Technical advice was provided by Mr. G. Pajot, BOBP Senior Fishing Technologist.

The BOBP's small-scale fisheries project began in 1979. It is funded by the Swedish International Development Authority (SIDA) and executed by the Food and Agriculture Organization of the United Nations (FAO). It covers five countries bordering the Bay of Bengal — Bangladesh, India, Malaysia, Sri Lanka and Thailand. It is a multidisciplinary project, active in fishing craft, fishing gear, coastal aquaculture, extension, information and development support. The project's main goals are to develop, demonstrate and promote appropriate technologies and methodologies to improve the conditions of small-scale fisherfolk in BOBP's member countries.

This document is a working paper and has not been cleared by the FAO or by the government concerned.

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1. INTRODUCTION

The phenomenon of fish aggregation around floating objects such as driftwood, debris and discarded objects from sailing vessels as well as underwater objects such as shipwreck, rocks and reefs, has been known to fishermen and mariners since ancient days. This knowledge was used by fishing communities, particularly in South-East Asia and Western Pacific for capturing tuna, tuna-like fish, common dolphinfish and some other species. In the past, the practice prevailed mainly in the small-scale fisheries. In the last few decades, development of these ancient techniques to aggregate fish has paved the way for large commercial ventures, especially in the South Pacific. The Philippines, Western Samoa and Hawaii are some of the areas where such developments have taken place. In the Indian Ocean, mention may be made of the east coasts of India, Sri Lanka, Malaysia, Indonesia, Thailand and the Maldives, where FADs have been used from ancient times in the traditional sector or have been introduced very recently as experimental ventures. Detailed information is available in BOBP/WP/23 ("Experiences with and current knowledge of fish aggregating devices", Magnus Bergstrom).

Some of the traditional FAD types in this region are deployed in shallow waters. The mid-water FAD, made out of coconut leaves tied to a rope made of waste netting, is used on the east coast of India. A similar arrangement of coconut fronds and rope in Indonesia is known as 'Rumpon'. Unlike those on the east coast of India, these 'Rumpons' are left to drift in water for a few days for aggregation of fish before harvest starts. Traditional fishermen in Malaysia and Thailand use a similar method. The traditional FAD types in Sri Lanka are floating branches used to capture flying fish on the eastern coast.

Improvements to traditional FADs and design innovations have made possible commercially oriented fishing operations around FADs. Some of the modern designs worth mentioning are:

- the improved Payao type in the Philippines and Japan.
- the bamboo raft in the Fiji Islands and Japan.

Sri Lanka has a small-scale fishery, harvesting yellowfin tuna, skipjack and other small tuna species. As considerable fuel and time is spent in the search for tunas, the Sri Lanka Government considered a project designed to reduce the searching time and increase the revenue for fishermen.

A FAD project launched in the Maldives in 1981-82 was intended to reduce the effort and time in searching for fish, by establishing a number of FADs around the islands. The results were favourably indicative and aroused some interest in neighbouring Sri Lanka. It was thought that similar results might be obtained by adopting identical methods.

2. IMPLEMENTATION

The BOBP devised a project to design, construct, deploy, monitor and evaluate a limited number of FADs to test their feasibility in the Sri Lankan small-scale fishery. It was implemented in cooperation with the National Aquatic Resources Agency (NARA) of the Government of Sri Lanka.

The evaluation was to be based on cost-effectiveness, fish yield, fishing gear performance and fishermen's response. Simultaneously, the technology was to be transferred by training counterparts and involving fishermen.

This paper describes the studies and the results obtained from 1982-83 to 1985-86.

3. MATERIAL AND METHODS

3.1 FADs and their deployment

Factual information — location, period of survival etc. — on different types of FADs tried during successive seasons of the study is provided in Table 1. The FAD locations are also delineated in *Figs. I and* 2.

BOBP supplied the materials required to construct FADs, and undertook to bear the hire costs for boats used in various surveys and for FAD deployment during the whole period.

NARA on their part released two counterpart officers on a full-time basis, and made available their 14 ton steel vessel MV "Balaya II" for the work during 1982/83. The vessel was fitted with a sideboard mount transducer for a deep range echo sounder supplied by FAO/BOBP, and a ramp was installed to accommodate launching of anchors. These modifications, the fabrication of FAD platforms and the casting of a concrete anchor were carried out by the Ceylon Fisheries Harbour Corporation (CFHC) at its bases in Galle and Colombo.

Work in subsequent phases was carried out by the author with the assistance of a NARA research assistant released on a full-time basis. Unlike in 1982183, motorised 3 1/2 tonners were used to deploy FADs. Wherever possible, rafts and anchors were fabricated at appropriate fish landing centres. Fabrication involving welding or any engineering machines was done locally at small workshops.

Sites for FAD deployment were chosen in consultation with local fishermen. It was important to select areas of low ship traffic; at the same time they had to be areas where driftnetters were not likely to operate. Yet it sometimes happened that driftnetters started operating in areas where FADs were deployed. Fishermen's knowledge of the depth and bottom topography of the area was fairly accurate and was used to locate the deployment sites. However, lead lines were used to measure the depth as the FADs were rigged to suit predetermined depths.

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FADs were introduced with the expectation of capturing large migratory pelagic fish like yellowfin tuna and skipjack tuna. Although the FADs were to be deployed in deeper waters to aggregate these large migratory pelagics, the deployment sites were relocated inside the continental shelf area in view of the unfavourable bottom topography offshore (beyond 50 km, the normal range of local boats).

Six units of the truck tyre type were deployed, five of which were of four tyre construction; the other had five tyres as an experiment. The latter was deployed in Ambalangoda, the first five at Galle, Weligama, Tangalle, Panadura and Negombo inside the continental shelf, 20 km from the shore.

Fig. 3 is a diagram of this type of FAD. The platform consisted of an assembly of four/five truck tyres the cavity of which was filled with polyurethane foam. The suspension was made of polypropylene *(PP)* rope and the two anchors were concrete-filled galvanised iron (G.I) diesel drums of 200 litre capacity, each weighing 750 kg. A 'rudder' was attached to some FADs just below the tyres to prevent rotation-induced twist in the ropes.

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The weight of the anchors called for a specially fitted vessel for FAD deployment. The anchors were loaded on to the deploying vessel with a crane and placed on a ramp. At the deployment site, the platform was put out to sea and allowed to drift so that all the rope could be let out. Each anchor was then pushed Out from either side.

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Low cost (SAL Rs 1500*) bamboo rafts were tried in November 1983 off Panadura. One was double layered, the other two were single stacks of bamboo containing about 20 bamboos in each, of 3 m length. These bamboos were held together by the bamboos running through three coach tyres evenly placed. The ropes used for suspension were connected to concrete blocks weighing about 60 kg. A PP rope was used as the suspension in one unit, coir ropes for the other two units.

The payao type deployed in February 1984 *(Fig.* 4) was similar to the types used in the Philippines. It contained 23 full length bamboos arranged as a double layered raft. The broad end of the raft was about 3 m wide and the other ends of the bamboos were pushed through a truck tyre placed about 2 m from the narrow end. The suspension was connected by a shackle to a steel collar running around the tyre. The main suspension here was PP rope with a length of chain at either end.

Two cement concrete anchors each weighing about 120 kg and a fishstrip anchor weighing about 50 kg were used with this FAD, which was also deployed off Panadura.

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The following types of FAD units were deployed during the season off the places indicated in the brackets.

- 4 truck tyre type (Panadura)
- 2 truck tyre type (Panadura)
- bamboo raft (payao) type (Lunawa)
- twin stack bamboo raft type (Dehiwala)
- drum type (Panadura)
- log-raft type (Panadura)

The 4 truck tyre type was the same as the one used in the 1982/83 season but with certain improvements. The bamboo raft (payao) type was similar to that deployed in February 1984.

The 2 truck tyre type, the twin stack bamboo raft, the drum type and the log-raft type were meant for comparing the effectiveness of different designs.

The twin stack bamboo raft type was a structure of two stacks of bamboo connected by wooden rafters. Each stack was held by 3 coach tyres placed evenly along its length as shown in *Fig. 5.* The idea was that the spreading of buoyancy might increase the stability of the raft while providing enough water flow in between to reduce the effect of current on the raft. A stack consisted of 20 full length bamboos, providing buoyancy similar to that of the payao type rafts.

The drum type platform was made of two empty steel drums of 200 litre capacity partly filled with polyurethane foam to provide additional buoyancy in case water seeped into the drums. The drums were held together by a frame made of mild steel (MS) bars. Areas of the frame likely to be in contact with the barrel were covered with strips of bicycle tubing to prevent abrasion of the drums *(Fig. 6).*

The log-raft FAD had a 4-log platform. Two horizontal bars running through the logs held them together. To increase the width of the raft and to provide additional buoyancy, car tyres filled with polyurethane foam were inserted between the log *(Fig. 7).*

Ballast weights in the FAD units provided stability to the platforms. The weights ranged from 30 to 70 kg depending on the buoyancy of the platform and its shape. A 4 truck tyre platform required 70 kg ballast weight, for a payao type platform 30 kg was enough.

* About 27 Sri Lankan Rupees = 1 US Dollar.

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The improved version of a 4 truck tyre type was deployed off Panadura in August 1985. The aim was to see whether durability had increased after the modifications and to study the aggregation pattern during the monsoon months. Unfortunately the fishing effort in this area was very poor at that time and just when fishing was picking up, the unit was lost. Fishermen said this unit might have got entangled with the anchor line of a ship stationed close to the FAD.

The bamboo payao type FAD deployed in December 1985 was similar to other bamboo payao rafts used earlier.

A similar bamboo raft was deployed off Hikkaduwa in April 1986.

3.2 Defects in the FADs

One drawback of the first set of FADs (truck tyre type) was the high cost (about SL. Rs 19,000 each). Unless the aggregation is very significant with high value fish, the cost would not justify their deployment. The ultimate aim of transferring this technology to the small-scale fishermen so that they would build such FADs cannot be achieved if the capital costs are high. Moreover, owing to the heavy weight of the anchors, larger boats with special features were needed to deploy the FADs; and a crane to lift these heavy loads was generally not available at landing sites other than fishing harbours.

Continuation of the study was, therefore, oriented towards production of low-cost FADs. They should last the entire calm season, be simple enough for the fishermen to build and light enough to be deployed from conventional 31/2 tonners.

The second set of three small FADs deployed in 1983 was lost in 10 days probably because the raft lacked buoyancy or because the anchors were not weighty enough to keep the units in position. The anxiety to keep down the FAD cost was partly responsible for low anchor weight. In the subsequent attempt, larger rafts with buoyancy of about 200 kgf (kilogramme force) were constructed; the weight of anchors was increased to about 300 kg.

In the next phase starting from February 1984 and continuing into 1985, different types of FADs were tried in order to compare their cost effectiveness.

The deficiencies in the important components and the improvements made are as follows:

Shackles: Underwater observations on the platforms showed that the pins of shackles could get loosened because of wave action, thus disengaging a vital connection and leading to eventual FAD loss. This component was improved by fitting in an additional check nut and strengthening it by a split pin. The original shackle pins were replaced by specially machined pins to effect this improvement.

Thimbles: There was rust formation in the rope section going around the thimbles. So the section of rope running round the thimbles was covered with insulating tapes or strips of cycle tubes.

Anchors: To increase the anchor's hold on the sea bed, prongs of steel strips were attached to the base of the cement concrete anchors. Further improvement was to modify the system of interconnection between the anchors. In the earlier system the connection was done from the top of one anchor to the top of the next. As this allowed room for entanglement and overlapping among individual anchors leading to subsequent breakage, the anchors were connected in a sequence.

Intermediate weights: Earlier, the intermediate weights were tied to the main suspension. But it was found that PP rope gets chaffed if the weight rubs against the rope. Hence the main suspension was made into two pieces connected by a length of chain heavy enough for the intermediate weight.

Deployment: Difficulties were encountered in deploying even a relatively light weight anchor from 3 1/2 tonners, especially in a choppy sea. The system initially adopted was to tie each anchor to a bollard post on either side of the boat with a short length of rope and lower the anchors gently. At the moment of deployment these two ropes were cut simultaneously to release the anchors. This method was both tedious and hazardous. So a temporary platform was installed on board by laying a strong, wide plank across the beam of the vessel in such a way that each

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end protruded about half a metre out of the vessel. This was further secured (by tying) to the gunwhale or bollard posts. Each anchor was placed on either side of this plank and held in position by tie ropes or wedges. At the time of deployment, the wedges and tie ropes were removed to let the anchors roll off the plank. This method proved to be satisfactory.

Rudder: It was observed that the rudder in the tyre FAD had no significant contribution towards the alignment against currents; and in fact it got in the way of bridle chains, chaffing them in the process. The rudder was eliminated to make room for bridle chains.

3.3. Cost of FADS

The cost of the different types of FADs and the breakdown of their components is given in Table 2. The costliest was the 4-tyre type (Rs 19,000) the cheapest was the bamboo (payao) type (Rs 5,200). The cost of the other types was Rs 10,400 for the 2-tyre type, Rs 8,250 for the drum type, Rs 6,100 for the bamboo twin stack type and As 5,750 for the log-raft type. The tyre type was costlier than the others, mainly because of the higher cost of fabrication, transport, deployment, suspension, components and anchor — all of which accounted for more than 60 per cent of the total cost.

3.4 MonitorIng

In 1982/83, the monitoring officials made weekly visits to landing sites to collect data by talking to the fishermen. The fishermen were then given printed prepaid postcards, so that they could fill in information on catches and post the cards to the monitoring officials. This system did not work. Fishermen did not bother to send these cards regularly. And the interviews by officials did not bring out accurate data — the fishermen recalled some figures from memory.

In subsequent phases of the project, an official (a research assistant) visited the landing site every day to collect information, both from visual observation and from interviews with the fishermen. Where possible the actual weight of the catch was recorded.

The FAD sites were also visited every week; surface and underwater observations were carried out.

4 RESULTS

In all the seasons the catch rate around FADs was collected from the opejations of pole and

line, trolling line and drop line (hand line).

1982/83

Of the six truck type FADs deployed in 1982/83, only FAD nos 1,2,4 & 5 — those deployed off Ambalangoda, Galle, Tangalle and Panadura — survived for some time (from 241 to 323 days). The other two units deployed off Weligama and Negombo were lost within four weeks of deployment and no details of any fish catches near them could be obtained.

The catch data from around these FADs are represented in Table 3. The figures however may not reflect all or most of the catch near FADs owing to shortcomings in the data collecting procedure as mentioned earlier.

Of the total recorded catch of 6294 kg, dolphinfish contributed 4796 kg or 76 per cent of the catch. Other major contributors were rainbow runner with 415 kg (7 per cent) and yellowfin tuna with 390 kg (6 per cent).

The overall catch rate (catch per boat day) was 39 kg. The best catch was reported from Ambalangoda (58 kg) while the others reported around 30 kg. Even if the records of Tangalle were deleted, as the number of boat days reported was too small, the overall picture, as given above, does not change.

These four units, deployed in the inter-monsoonal period, withstood the southwest monsoon. Only two were recovered when fishermen reported that they were drifting away.

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The three low cost FADs deployed in November 1983 lasted just 10 days. No catch was reported during this period.

The bamboo raft FAD (payao type) deployed in February 1984 lasted about 80 days. Around this time a total of 4411 kg of fish was caught in 95 fishing days. Dolphinfish accounted for 3613 kg (82%) while rainbow runner and little tuna contributed 421 kg (10%) and 248 kg (5%) respectively. During February-May, when the FAD was afloat, April yielded the best catch rate of 61 kg, the overall catch rate being 46 kg (Table 4).

1984/85

During this season different types of FADs were experimented with and figures collected separately for the motorized 3½ tonners and the non-motorized traditional outrigger canoe, the *Oru.* The boats, operating about 2 km from FADs, employed methods different from those operating around FADs. The former were engaged in addition to pole and line, trolling line and handline, in driftnetting and bottom set longlining for oil sharks. The *Orus,* of course, whether around or away from FADs, operated only pole and line and hand line. The results are shown in Table 5.

The data show that the catch rate was the highest for the payao type bamboo raft both for the 3½ tonners (108 kg) and for the *Orus* (58 kg). The other notable ones for the 3½ tonners are 2-tyre type (70 kg) and drum type (62 kg); for the *Oru,* they are drum type (47 kg), log-raft type (40 kg) and 4-tyre type (35 kg) in that order.

These 3½ tonners — which had motors and the additional facility of operating trolling lines — had 20-60 per cent high catch rates over the *Orus* except for the log-raft type. In the log-raft type the catch rate of *Orus* was higher by 22 per cent. Since this FAD was located nearer the shore than the others and since the Oru operators did not depend on 3½ tonners to carry fish to the shore, they were able to put in more fishing time, hence the higher catch rate.

The catch rates of these two types of craft fishing around FADs were distinctly higher than those fishing away from FADs. The 3½ tonner fishing around FADs returned with catch rate of 63 kg, those fishing away from FADs only 45 kg. Similarly, the *Orus* fishing around the FADs had a catch rate of 36 kg as against the 16 kg of those operating away from the FADs. But the financial returns were higher for craft operating away from FADs because the catch was composed of higher-value fish.

As in earlier seasons, dolphin constituted the major part of the catch near every FAD unit except one. The percentage of dolphin ranged from 31 to 100 per cent among the seven units used during this period. However the contribution from rainbow runner (about 1 %) was almost negligible in contrast to their moderate contribution in earlier trials (6% - 9%). Visual observations indicated plenty of small-sized rainbow runners, but.they were not getting hooked.

The overall catch rate for this season for the pooled data of 3½ tonner and *Orus* was 53 kg, with the doiphinfish contributing 83 per cent, the little tuna and frigate tuna together about 8 per cent, the carangids 3 per cent, the rainbow runner 1 per cent and others 5 per cent.

In Table 6 the monthwise catch data of both types of craft are shown separately for different types of FADs and for those fishing away from FADs. In the 3½ tonners the best catch rates have come in January for all those types of FADs which were in operation that month. In the case of *Orus,* the best catch rates were from one of the three months, December, January and February; but in the pooled data for all types of FADs, the January catch rate was the highest.

If the data of different type of FADs were to be pooled for each month, it is seen that in respect of 3½ tonners there are two peaks in the catch rate, one in January (105 kg) the other in April-May (61 kg). All types of FADs appear to have contributed to the former, while for the latter, only the truck tyre FADs were deployed.

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The picture is roughly the same in respect of Orus although the catch rates were comparatively lower. However, in the case of 3½ tonners operating away from FADs there was only one peak catch, in January. In *Orus,* the best catch rate was in February.

Boats fishing away from FADs showed an overall catch rate of 45 kg but the fish caught was more valuable like skipjack tuna (though skipjack tuna was got only from January to March). The contribution made by dolphinfish was less than 1 per cent. Here too, the best catch rate was in January, with 79 kg: there was no second peak, as was the case in the operations near FADs.

With regard to the economics of the operation, Table 7 gives figures for the two types of craft operating both around and away from FADs. The cost of each type of FAD has been apportioned between the two types of craft on the basis of number of boat days operated. An amount of Rs.250 a day was assumed as crew share.

It may be seen that for the 3½ tonners, the net income per boat day was on the negative side in a couple of cases (one 4-tyre type and another twin stack bamboo raft) because of the very small number of boat days. Among the others, the 4-tyre type, the log raft type and the payao type showed a net income of more than Rs.200 a boat day, the best returns coming from the log raft type, ie. Rs.298. The high return from this type seems to be because there were less of dolphinfish in the catch and more of little tuna, frigate tuna and 'other' fishes which might have contained some high value fish also. The unit value realized in this case was Rs.34 a kg, whereas in the other two it was only Rs.14 and Rs.16.

Among the *Orus,* taking only the cases where data of at least 10 boat days were available, it is seen that the best returns were from the log raft type followed by the 4-tyre type.

In comparison to the earnings of 3½ tonners fishing around FADs, it would appear that they were doing much better away from FADs as far as earnings were concerned. So too was the case with *Orus.*

Most of the work conducted during the period of 1982 to 1985 was limited to the intermonsoon periods. Although the first set of trials conducted during 1982/83 covered the monsoon period, the data collection machinery was not satisfactory and it is not possible to draw a conclusion from the figures obtained. A 4-tyre FAD was therefore deployed in August 1985 off Panadura at a depth of about 45 m, about 6 km from the shore, for it was not advisable to move to the deeper area of the continental shelf which was used by driftnetters.

The weights of the anchors were increased to about 470 kg (one anchor of 350 kg and other of 120 kg) in order to withstand monsoonal drifts. In all other aspects, this FAD was similar to the 4 tyre FADs deployed earlier.

As 3½ tonners were not suitable working platforms for the monsoon period, a 10 ton gillnetter of the North-West Coast Fisheries Development Project was hired for deployment. The base of operations was the Ceylon Fisheries Corporation harbour at Mutual.

Since all the motorized boats had moved to Colombo for shelter and non-motorized craft from the Panadura area were tied up during the monsoon, very little fishing activity was seen around this FAD. However, as soon as commercial fishing in the area resumed this unit was lost. Fishermen said it got entangled with a ship's anchor line. This unit lasted 60 days; in short, the exercise failed.

Now that the advantages of the payao type bamboo raft were known, trials continued with two such rafts in 1985/86. One raft survived just 18 days. The catch rate around this FAD was 54 kg in January, 1986. Another raft lasted 43 days during AprillMay 1986; the catch rate was the highest obtained, 189 kg; only seven boat days were recorded. Around both the raft, dolphinfish was the only species caught.

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During this season, the project wanted to find out how far fishermen would cooperate in FAD work so that technology transfer could take place. A token contribution of Rs 00 per craft was sought from fishermen — negligible, compared to their earnings from fishing around FADs. In spite of personal negotiation and persuasion by project personnel, only five boat owners contributed towards the cost of FAD. Labour had to be hired for building the bamboo raft and cement anchors, and all other inputs had to be provided by the project.

5. DISCUSSION

5.1 Specles Composition

The analysis of catch data over the 3year period shows a high percentage of dolphinfish near the shallow water FADs. The percentage of dolphinfish caught elsewhere was generally insignificant. The shallow water FADs could thus be considered as a generator of a new or underfished resource. Further, such a fishery may be used to supplement the catch of óraft usually engaged in driftnetting during the lean season, and also help the traditional, non-motorized craft by reducing the time and distance of travel.

The rainbow runner was found to be an important member of the aggregated species in the first year. Thereafter the catch records appear to indicate that they had almost disappeared. It was surprising that they were not getting hooked though they were seen in plenty swimming around FADs.

An important feature that could not be explained satisfactorily was that skipjack tuna, little tuna and frigate tuna together formed a large percentage of catch taken by the 3½ tonners operating away from FADs but employing the same gear as those around FADs. The dolphinfish catch is almost negligible, compared to the catch by craft operating around FADs. The distance between the different types of FADs and the distance for those operating away from FADs was almost the same, roughly 2 km. Hence it is not known why there should be such a distinct difference between the two. It may be of interest to find out whether the skipjack and other tuna-like fishes avoid the areas where dolphinfish aggregate.

Another interesting feature is the species composition obtained from the log raft type FAD. Unlike other FADs, this attracted less of dolphinfish (only 30%) and more of little tuna, frigate tuna and other fishes (64%). This FAD was also deployed off Panadura, but closer to the shore than the others. More studies are required before an explanation can be given.

5.2 Catch Rates

The catch rates had been fluctuating widely within the same season the same type of FAD as was the case in 1982-83 and 1984/85 in the 4 truck tyre type. This can be explained because of differences in location. In the former season the average catch rate was 39 kg; in the latter 60 kg. The overall picture for the period of study is an average of 49 kg for the 3V2 tonners and the for the traditional *Orus,* 27 kg.

Since the other types have been in operation either for only one season or only for a few days, no attempt is made to discuss the results.

5.3 Duration of FADs

The best results came from the 4-tyre type of the first year, 1982-83, when 4 units out of 6 FADs survived for a period ranging from 241 to 323 days, the average being 289 days.

The next best was also with reference to the 4-tyre type in 1984-85 with a survival period of 190 days. Deleting this type, the average period of survival for the other types of FADs during this season was only 72 days.

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In 1985/86, the average period of survival was still poor, 40 days; in this season also, the 4-tyre type lasted the longest period of 59 days.

In between, in 1983, all the three FADs were lost within 6 days of deployment and in 1984, the Payao type FAD lasted 80 days.

Information is limited to only one instance in the case of log-raft type FAD, but its track record is second best with 121 days.

For the payao type bamboo raft, which was found to be the most effective, the average survival period was 51 days, with a range of 18 to 80 days.

The largest number of FADs were deployed off Panadura. Deleting the records of 1982/83, which showed the largest survival period, it is seen that the average period of survival was 85 days at Panadura and 47 days elsewhere.

The experience from the project and information from FAD projects in other countries indicate several instances of breakage and loss of FADs within a short period (less than 12 months).

Most FAD losses were "man-made" — a result of interference by fishermen from other areas. When their drifttnets got entangled in the FADs and the fishermen tried to retrieve them, the platform and the suspension got damaged. Other losses were due to frequent stealing of anchor lights, radar reflectors, flagstaff (GI pipes); so anchor lights and radar reflectors had to be withdrawn and this led to collisions. If such theft could be controlled, the FADs would survive longer.

Generally, an effort was made to avoid shipping lanes when deploying the FADs. But the increased influx of ships to Sri Lanka changed the system of shipping lanes; this made it difficult for fishermen to select suitable inshore areas for FADs. The Sri Lanka Port Authority should be consulted to avoid FAD losses due to collision with ships.

Considering that fishing around FADs would be carried out mostly during the calm intermonsoon period — and that it is primarily artisanal in character, using methods such as pole and line, hand line or trolling line — one can assume that low-cost FADs which survive at least the calm seasons (6-7 months), would be economically viable.

Three steps appear to be necessary to ensure this period of survival. The first is to see whether by increasing the cost a little, the selected FAD could be made stronger and more durable. The second is conduct of regular observations on the status of these structures and immediate attention to any repairs, replacements etc.

The third and the most important step is an effective extension service. Educating fishermen on the importance and use of such devices is very essential if maximum benefits are to be obtained. The project personnel attempted this through posters and handbills, without much success. The executive legislative body, the Ministry of Fisheries, could easily undertake the task of educating fishing communities through their network of extension services.

5.4 TIme taken for aggregation of fish

The fishermen feel that fish aggregation is much quicker in the case of bamboo (payao) raft. More observations may have to be carried out to investigate this, because available figures show that the average time for fish aggregation was 7 days for truck type and drum type FADs, 12 for bamboo (payao) type FADs and 16 for log-raft type FADs.

5.5 Involvement of fishermen

Except in the case of bamboo raft FADs deployed off Lunawa and Dehiwala, very few inputs were received from fishing communities for the construction of FADs and their deployment. This was especially the case in Panadura where a number of FADs were deployed and the fishing community benefited sizably but made almost no contribution to the work.

Though the fishermen agreed with the concept of FADs and the potential benefits, they were reluctant to cooperate by providing free labour or making their craft available. The total cost of construction and deployment could be reduced further if the fishermen cooperate. Their apathy to such experiments perhaps results from their belief that it is the government's responsibility to help them.

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If the ultimate objective is to transfer technology so that the fishermen themselves could construct and deploy FADs, the task has to be done at the preliminary stages. The Ministry of Fisheries should support extension and dissemination of the programme to achieve the objective.

6. CONCLUSIONS

1. Among the different type of FADs experimented with, the bamboo payao type was found to be the best from the standpoint of cost effectiveness, catch rate, simplicity of construction and easy deployment by fishermen. The same may to some extent be said of the log-raft type, but more trials are necessary to dra'v a firm conclusion.
2. The truck type FADs, known for attracting yellowfin tuna and skipjack elsewhere, failed to do so here, mainly because the area of deployment was rather close to the shore. On account of its high cost, and the many facilities needed for deployment, it cannot be recommended for the small-scale sector.
3. The FADs could not attract tunas and tuna-like fish perhaps because they were deployed within the continental shelf and closer to the shore. Instead they helped to unveil a potential fishery for dolphinfish *(Coryphaena hippurus)during* the lean season for drift net operation. On an average, more than 80 per cent of the catches were comprised of dolphinfish.
4. The survival period was the highest in respect of the 4-tyre type with an average of 170 days. The log-raft type ranked second (121 days), the drum type third with 86 days, and the payao type fourth (50 days). The majority of the losses was due to human interference especially by the drift net operators. Collision because of absence of anchor lights and radar reflectors was another reason for the loss of FADs.
5. The average aggregation time was seven days for truck and drum types, 12 for the payao type and 16 for the log-raft type.
6. In the case of four truck tyre types, the catch rate of 3V2 tonners varied from 32 to 62 kg with an average of 49 kg; for *Orus,* the range was 20 to 32 kg, with an average of 27 kg. For Payao, the range and average in 3½tonners were 46 to 189 kg and 64 kg respectively; for the *Orus,* only one value is available, i.e. 58 kg.
7. The season for FAD operation is November to May. The best month for aggregation is January and there could be another peaking period in April-May.
8. As for the economics of operation, the data for the 1984-85 season showed a surplus of nearly Rs.300 per boat day for the log-raft, 4-tyre and payao types. If the FAD cost is subsidized fully or partially the earnings will be substantial.
9. Boats operating away from the FADs earn more than boats operating around FADs, despite a lower catch rate. Reason: boats away from FADs are able to catch higher-value fish like skipjack, little tuna and frigate tuna, whereas boats around FADs catch very little of these varieties.
10. It can be said that shallow water FADs should be low cost structures, but not so low as to affect their survival time, should last 6-7 months during the intermonsoon calm period, and should be retrievable. Three steps have been suggested.
    a) Increase the cost to make the selected FAD stronger and last longer.
    b) Monitor operations regularly to mend repairs or defects immediately.
    c) Evolve an effective extension service to educate the fishermen.
11. If fishermen involve themselves more by extending free labour for FAD construction, lending their craft for FAD deployment, and by contributing to construction cost, the total cost of FADs would be reduced, and better vigilance would be possible, thus increasing the survival time and the catch.

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Table 1

FAD TYPES, THEIR LOCATION AND PERIOD OF OPERATION

Year FAD No.	Type	Location	Depth (m)	Distance from shore (km)	Date of deploy-ment (month/year)	Date of reported loss	Period of survival (days)	Period before aggre-gation observed (days)
1982/83								
1.	5-truck tyre	Ambalangoda	60	19	11/82	9/83	298	59
2.	4-truck tyre	Galle	64	21	12/82	9/82	295	89
3.	4-truck tyre	Weligama	75	10	12/82	1/83	23	—
4.	4-truck tyre	Tangalle	68	13	12/82	11/83	323	52
5.	4-truck tyre	Panadura	60	21	2/83	10/83	241	24
6.	4-truck tyre	Negombo	58	16	2/83	3/83	28	—
1983								
1.	Bamboo raft	Panadura	55	11	11/83	12/83	about	
2.	Bamboo stack	Panadura	45	9	11/83	12/83		
3.	Bamboo stack	Panadura	36	6	11/83	12/83,		
1984/85								
1.	Bamboo raft (Payao)	Panadura	61	13.5	2/84	5/84	80	04
1984/85								
1.	4-truck tyre	Panadura	61	13.5	11/84	5/85	190	01
2.	Log-raft	Panadura	50	11	11/84	3/85	121	16
3.	Drum	Panadura	55	10	12/85	3/85	86	07
4.	Bamboo raft (Payao)	Lunawa	58	10	1/85	3/85	62	12
5.	4-truck tyre	Panadura	61	17	1/85	3/85	70	11
6.	Bamboo raft (twin stacks)	Dehiwala	49	14	1/85	3/85	36	19
7.	2-truck tyre	Panadura	50	11	3/85	5/85	54	09
1985/86								
1.	4-truck tyre	Panadura	46	7	8/85	10/85	59	—
2.	Bamboo raft (Payao)	Panadura	61	13.5	12/85	1/86	18	05
3.	Bamboo raft (Payao)	Hikkaduwa	64	13	4/86	5/86	42	07

Table 2

COST BREAKDOWN OF FADs

Type of FAD Components	4-truck tyre (1982/83)	Log raft (Kattu-maram)	Drum	Bamboo raft (payao)	4-truck tyre (modi-fied version for deploy-ment by 3½ tonners)	Twin stack bamboo	2-truck tyre
Truck tyres	100	—			100	—	50
Empty fuel drums.							
2001	—	—	400				
Full length bamboos	—	—	—	690		560	
4 Kattumaram logs	—	1300					
6.1 Pipes	200	—	100		150	105	63
MS. Bars	1000	—	500		1000	—	950
MS. Plates	850	—	150		850	—	850
Steel cables	—	630	130	630		542	—
Polyurethane foam	1600	—	2160		2000	—	1680
Chains 12 mm	3000	375	495		3000	—	2920
Bulldog clips	—	420	420	440		400	—
Swivels	400	100	100	100	100	100	100
Shackles	1000	270	270	150	440	150	440
Thimbles	200	400	400	100	200	300	100
PP rope, 18mm dia.	1300	585	585	725	630	530	630
PP rope, 8-12 mm dia	—	—		475	200	200	200
Plastic buoy 12-13 kgf	150	175	150		150		
Concrete anchor	1 750	360	360	360	800	600	600
Grapnel anchor	250	—					
Fishplate anchor	—	200	200	225			
Intermediate Weight	300	50	10	100	400	400	400
Ballast weight	400	150	150	150	250	150	150
Miscellaneous	600	165	165	70	500	294	—
Fabrication cost	3000	175	500	300	1200	870	600
Transport	1000	—		200	400	350	100
Deployment cost (Boat hire)	1500	400	500	500	1300	550	500
	18,600	5755	8245	5215	13670	6101	10333

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Table 3

CATCH DATA AROUND FADs, 1982/1983

FAD No. and Location	Boat-days	Total Catch (kg)	Catch per-boat day (kg)	Catch composition in kg and **(%)**						
				DF	RR	LT	FT	SJ	YF	OTHERS
1. Ambalan-goda	52	2992	58	2242 (75)	154 (5)	83 (3)	111 (4)	22 (1)	379 (13)	01 (0)
2. Galle	24	665	28	631 (95)	27 (4)	—	07 (1)	—	—	—
3. Tangalle	04	126	32	84 (67)	31 (25)	—	—	—	11 (9)	—
4. Panadura	82	2511	31	1839 (73)	203 (8)	02 (0)	—	—	—	467 (19)
Total	162	6294	39	4796 (76)	415 (7)	85 (1)	118 (2)	22 (0)	390 (6)	468 (7)

Table 4

CATCH DATA AROUND FAD OF BAMBOO TYPE (PAYAO), 1984

Period	Boat-days	Total catch (kg)	Catch per boat-day (kg)	Catch composition in kg and (%)					
				DF	AR	LT	FT	SJ	OTHERS
March	59	2884	49	2536 (88)	165 (6)	108 (4)	11 (0)	19 (1)	45 (2)
April	13	793	61	656 (83)	40 (4)	69 (1)	06 (1)	08 (1)	14 (2)
May	23	734	32	421 (57)	216 (29)	71 (10)	04 (1)	20 (3)	02 (0)
Total	95	4411	46	3613 (82)	421 (10)	248 (6)	21 (1)	47 (1)	61 (1)

Key to the abbreviations used in the tables

Abbreviation	Common English Name	Scientific Name
DF	Dolphinfish	*Coryphaena hippurus*
RR	Rainbow runner	*Elagatis bipinnulata*
LT	Eastern little tuna	*Euthynnus affinis*
SJ	Skipjack tuna	*Katsuwonus pelamis*
FT	Frigate tuna	*Auxis thazard*
YF	Yellowfin tuna	*Thunnus albacares*
CR	Trevally	Different species of Carangidae

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TABLE 5
CATCH AND CATCH COMPOSITION FROM 3½ TONNERS AND ORUs FISHING AROUND AND AWAY FROM FADs, 1984185

(ON = Drift net; PL = Pole & line; HL = Hand line; TL = Trolling line; BSL = Bottom set long line)

FAD No. & TYPE	Craft Type	Boat-days	Total catch (kg)	Catch per boat-day (kg)	Catch composition in kg and (%) DF	RR	LT	FT	CR	OTHERS
FAD 1	3½ ton	119	7385	62	5688 (77)	44 (1)	460 (6)	548 (7)	349 (5)	296 (4)
(4 truck-tyre)	Oru	69	2378	35	2145 (90)	100 (4)	73 (3)	—	57 (2)	03 (0)
	Inci-dental catches	84	1979	24	1653 (84)	10 (1)	63 (3)	—	196 (10)	57 (3)
FAD 2	3½ ton	29	960	33	300 (31)	—	87 (9)	40 (4)	49 (5)	484 (50)
(Kattu-maram)	Oru	31	1249	40	1191 (95)	—	20 (2)	—	38 (3)	—
	Inci-dental catches	13	220	17	178 (81)	03 (1)	—	—	12 (5)	27 (12)
FAD 3	3½ ton	16	1105	69	880 (80)	—	180 (16)	20 (2)	—	25 (2)
(drum)	Oru	07	330	47	330 (100)	—	—	—	—	—
	mci-dental catches	15	403	27	377 (94)	—	02 (1)	—	—	24 (6)
FAD 4	3½ ton	19	2048	108	2003 (98)	28 (1)	17 (1)	—	—	
(Bamboo raft)	Oru	03	175	58	175 (100)	—	—	—	—	
	Inci-dental catches	05	76	15	69 (91)	07 (9)	—	—	—	
FAD 5	3½ ton	09	288	32	185 (64)	—	02 (1)	60 (21)	24 (8)	17 (6)
(4 truck tyre)	Oru	07	143	20	143 (100)	—	—	—	—	—
	Inci-dental catches	78	231	3	116 (50)	17 (7)	50 (22)	—	40 (17)	08 (4)
FAD 6 (twin stack bamboo raft)	3½ ton	01	35	35	35 (100)					
FAD 7	3½ ton	35	2449	70	2400 (98)	40 (2)	—	—	—	09 (0)
12 truck tyre)	Oru	03	64	21	28 (44)	—	—	—	—	36 (56)
	Inci-dental catches	08	128	16	101 (79)					— (21)
Total	3½ ton	228	14270	63	11491	112	746	668	422	831
	Oru	120	4339	36	4012	100	93	—	95	39
Away from FADs										
	DN	31	119	38	05 (0)	—	440 (37)	75 (6)	165 (14)	508 (43)
3½ ton	PL/HL/TL	513	23823	46	121 (1)	10 (0)	4496 (19)	12981 (54)	1383 (6)	4832 (20)
	BSL	31	775	25	—	—	—	—	—	775 (100)
Total		575	25791	45	126	10	4936	130561548		6115
Oru	PL/HL	40	638	16	20 (3)	06 (1)	27 (4)	—	325 (51)	260 (41)

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Table 6

MONTH-WISE CATCH DATA FROM 3½ TONNERS AND ORUs FISHING AROUND AND AWAY FROM FADs, 1984185

FAD No. & TYPE	Period	3½ Tonners			Ow		
		Boat-days	Total catch (kg)	Catch per boat-day (kg)	Boat-days	Total catch (kg)	Catch per boat-day (kg)
	Nov. 1984	03	205	68	09	170	19
	Dec.	23	1567	68	13	426	33
FAD 1	Jan. 1985	17	1528	90	36	1267	35
	Feb.	05	204	41	06	325	54
4 truck	Mar.	24	1381	55	05	190	38
tyre	Apr.	23	1379	50	—	—	—
	May	24	1184	49	—	—	—
		119	7448	62	69	2378	39
	Dec. 1984	17	461	27	03	75	25
FAD 2	Jan. 1985	05	320	64	22	1031	47
(kattu-	Feb.	04	124	31	05	133	27
maram	Mar.	03	55	18	01	10	10
(Log-raft)							
		29	960	33	31	1249	40
FAD 3	Dec. 1984	11	610	56	01	50	50
(Drum)	Jan. 1985	05	495	99	06	280	40
		16	1105	58	07	330	47
FAD 4							
(Bamboo	Jan. 1985	10	1550	155	—	—	—
raft	Feb.	07	453	65	03	175	58
payao)	Mar.	02	45	23	—	—	—
		19	2048	108	03	175	58
FAD 5							
(4 truck	Feb. 1985	02	120	60	05	118	24
tyre)	Mar.	07	168	24	02	25	13
		09	288	32	07	143	20
FAD 6 (twin stack bamboo raft)	Feb. 1985	01	35	35	—	—	—
FAD 7							
(2 truck	Apr. 1985	11	684	62	03	64	21
tyre)	May	24	1765	74	—	—	—
		35	2449	70	03	64	21
Total		228	14270	62	120	4339	36
AWAY FROM FADs							
	Nov. 1984	32	670	21	20	134	7
	Dec.	89	1840	21	03	49	16
	Jan. 1985	144	11410	79	03	27	9
	Feb.	94	4847	79	03	27	9
	Mar.	113	3694	33	—	—	—
	Apr.	80	2611	33	—	—	—
	May	23	719	31	—	—	—
		575	25791	45	40	638	16

<<

Table 7

COSTS AND EARNINGS DATA FOR 3½ TONNERS AND ORUs FISHING AROUND AND AWAY FROM FADS, 1984185

FAD No & Type	Boat	Catch days	Sale (kg)	Sale proceeds (Rs.)	Fuel cost (Rs.)	Bait cost (Rs.)	Crew share (Rs.)	Net Revenue (Rs.)	Cost of FAD (As.)	Net income (As.)	Net income per boat-day (As.)
1. 4-Tyre	3½ tonners	119	7385	137452	24365	36485	29750	46852	12045	34807	292
	Oru	69	2378	35840	—	8000	17250	10590	6985	3605	52
2. Kattu-maram Log-raft	3½ tonners	29	960	32725	5770	8280	7250	11425	2781	8644	298
	Oru	31	1249	17895	—	5000	775.0	5145	2974	2171	70
3. Drum	3½ tonners	16	1105	18270	3520	4800	4000	5950	5735	215	13
	Oru	07	330	4175	—	1200	1750	1225	2510	—1285	—
4. Bamboo (Payao)	3½ tonners	19	2048	29605	4200	10925	4750	9730	4507	5226	275
	Oru	03	175	2150	—	500	750	900	711	189	63
5. 4-tyre	3½ tonners	09	288	6960	1830	1590	2250	1290	10704	—9414	—
	Oru	07	143	2225	—	500	1750	—25	8326	—8351	—
6. Twin stack bamboo	3½ tanners	01	35	700	250	260	250	—60	6101	—6161	—
7. 2-tyre	31/2 tanners	35	2449	46875	9255	15922	8750	12948	9563	3385	97
	Oru	03	64	2925	—	600	1000	1325	820	505	168
AWAY FROM FADs											
3½ tonners											
	DN	31	1193	37495	5545	—	7750	24200	—	24200	781
	PL/TL/HL	513	23823	583431	110395	143130	128250	201656	—	**201656**	**393**
	BSL	31	775	48425	9310	5815	7750	25550	—	25550	824
ORU	PL/HL	40	638	18310	—	3000	10000	5310	—	—	**133**

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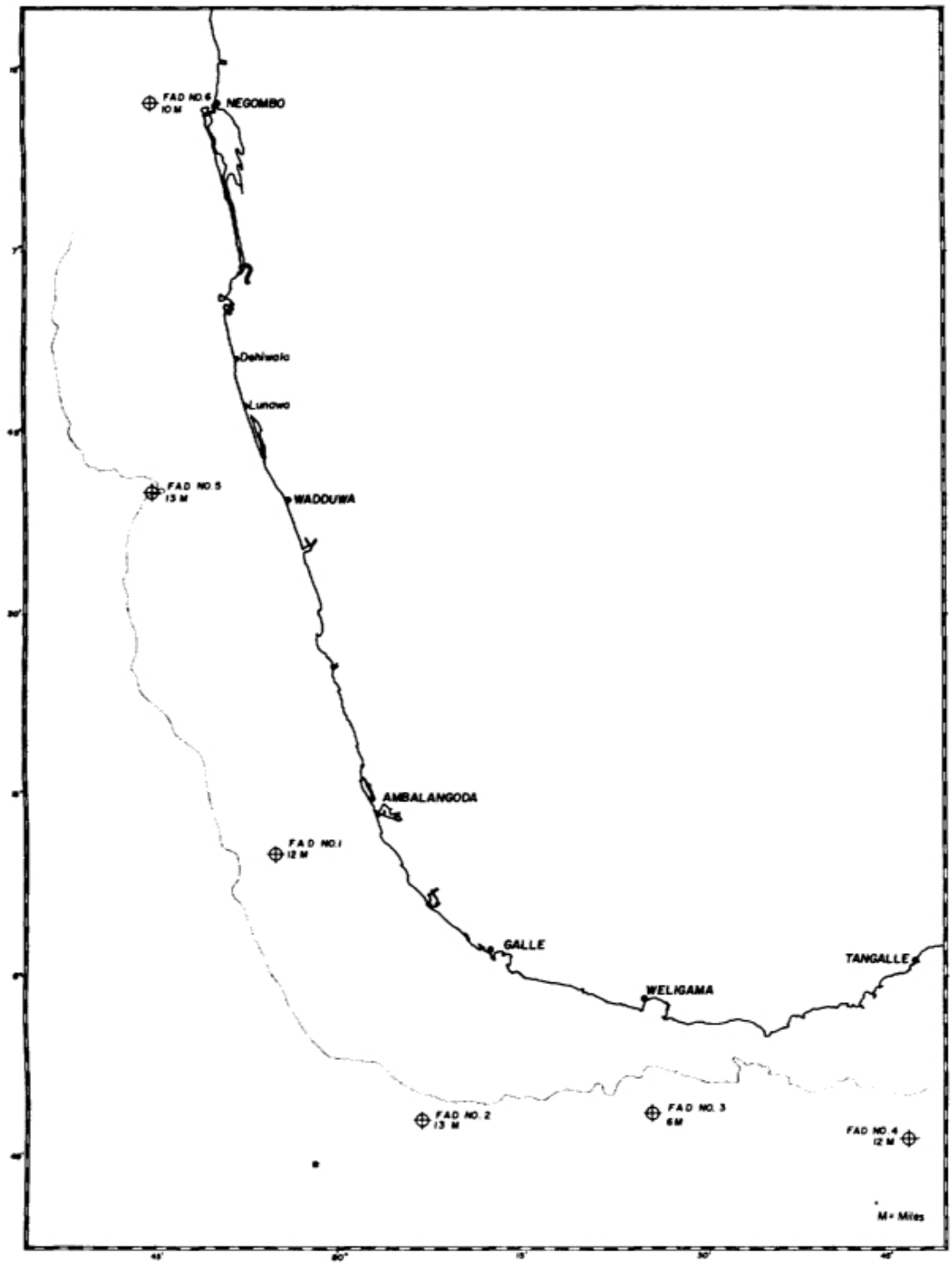
Fig 1 **FAD LOCATIONS,** 1982-83



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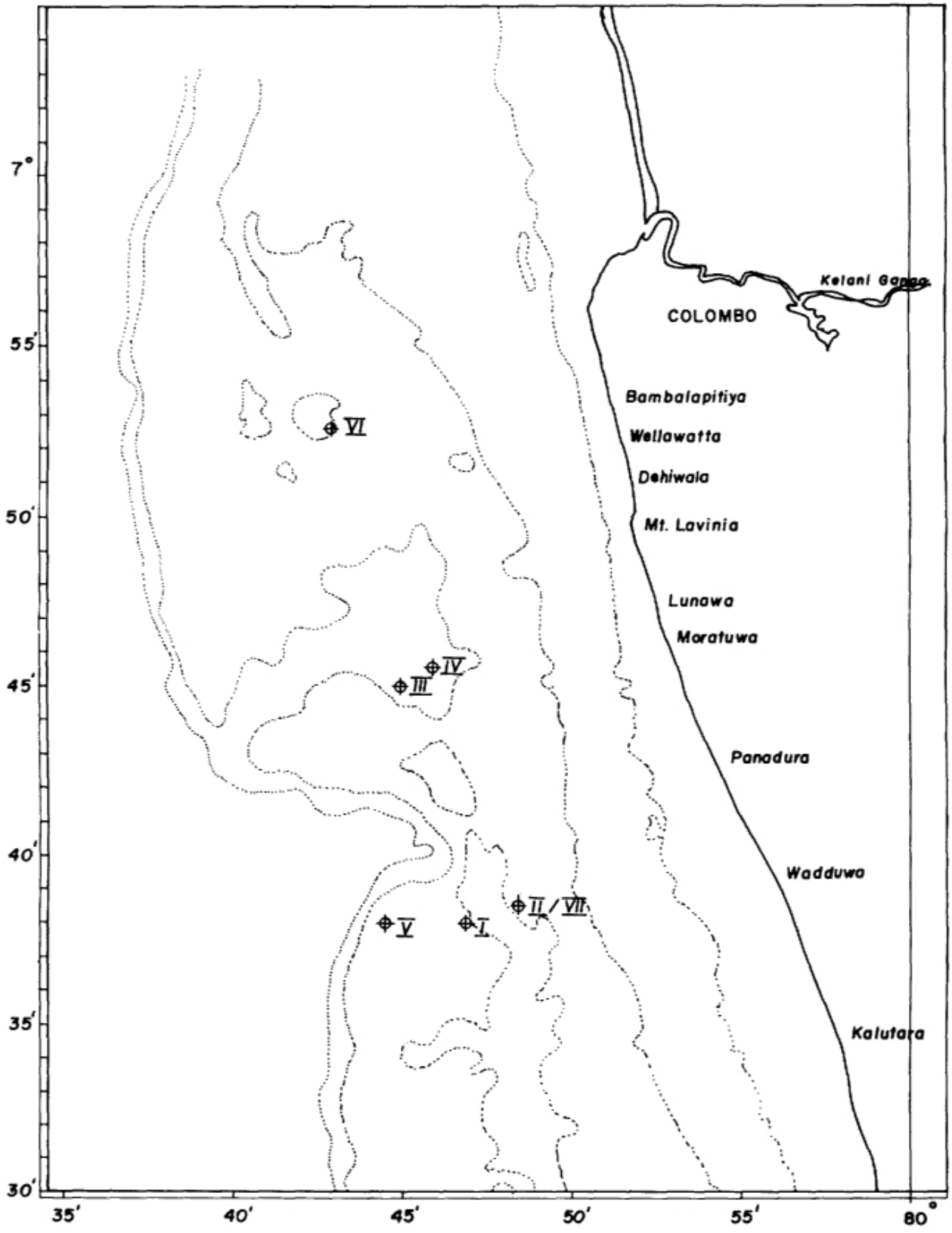
Flg 2 FAD LOCATIONS, **1984-85**



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FOUR-TYRE FAD

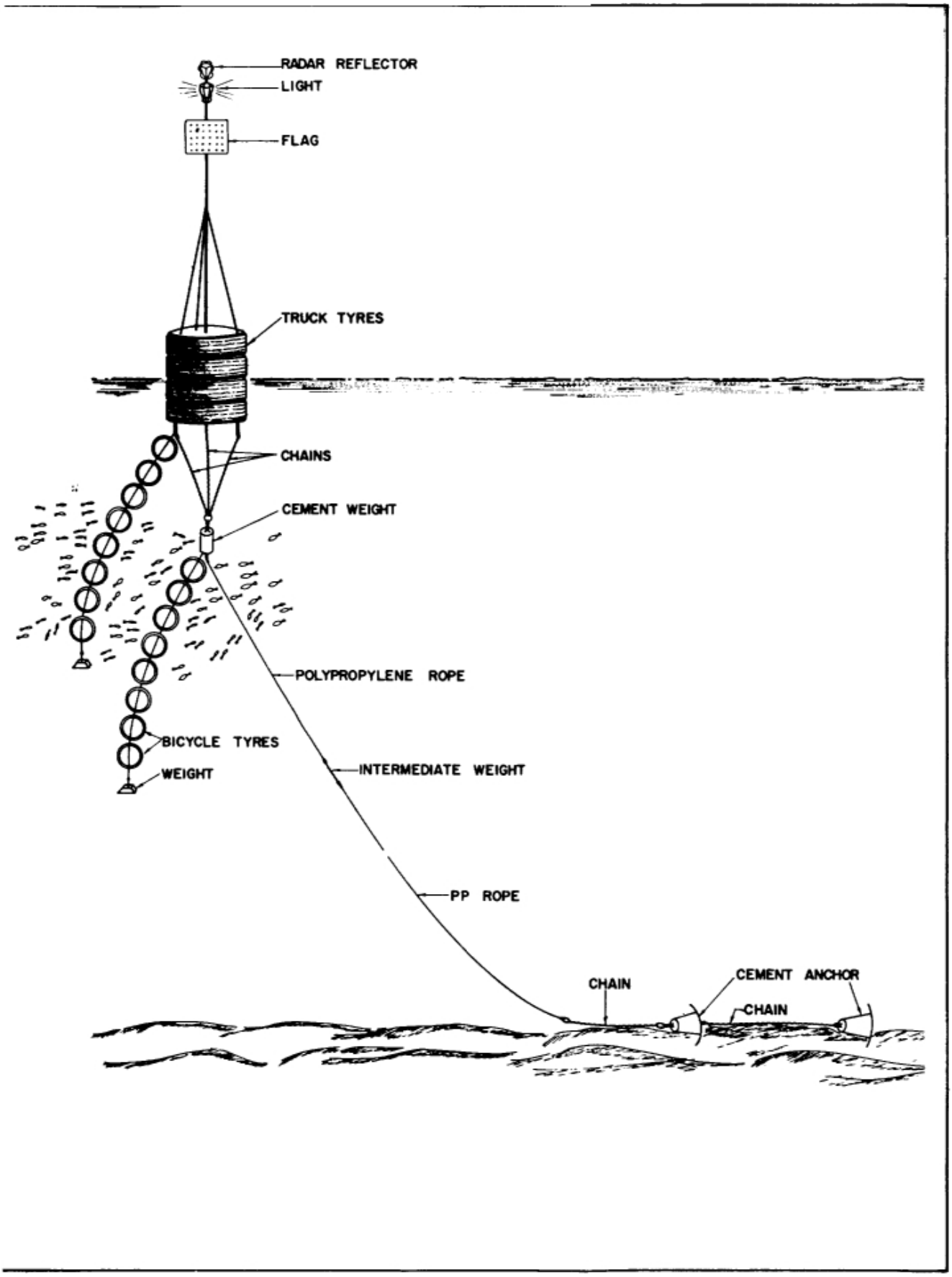

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Fig 4 **BAMBOO RAFT (PAYAO)** FAD

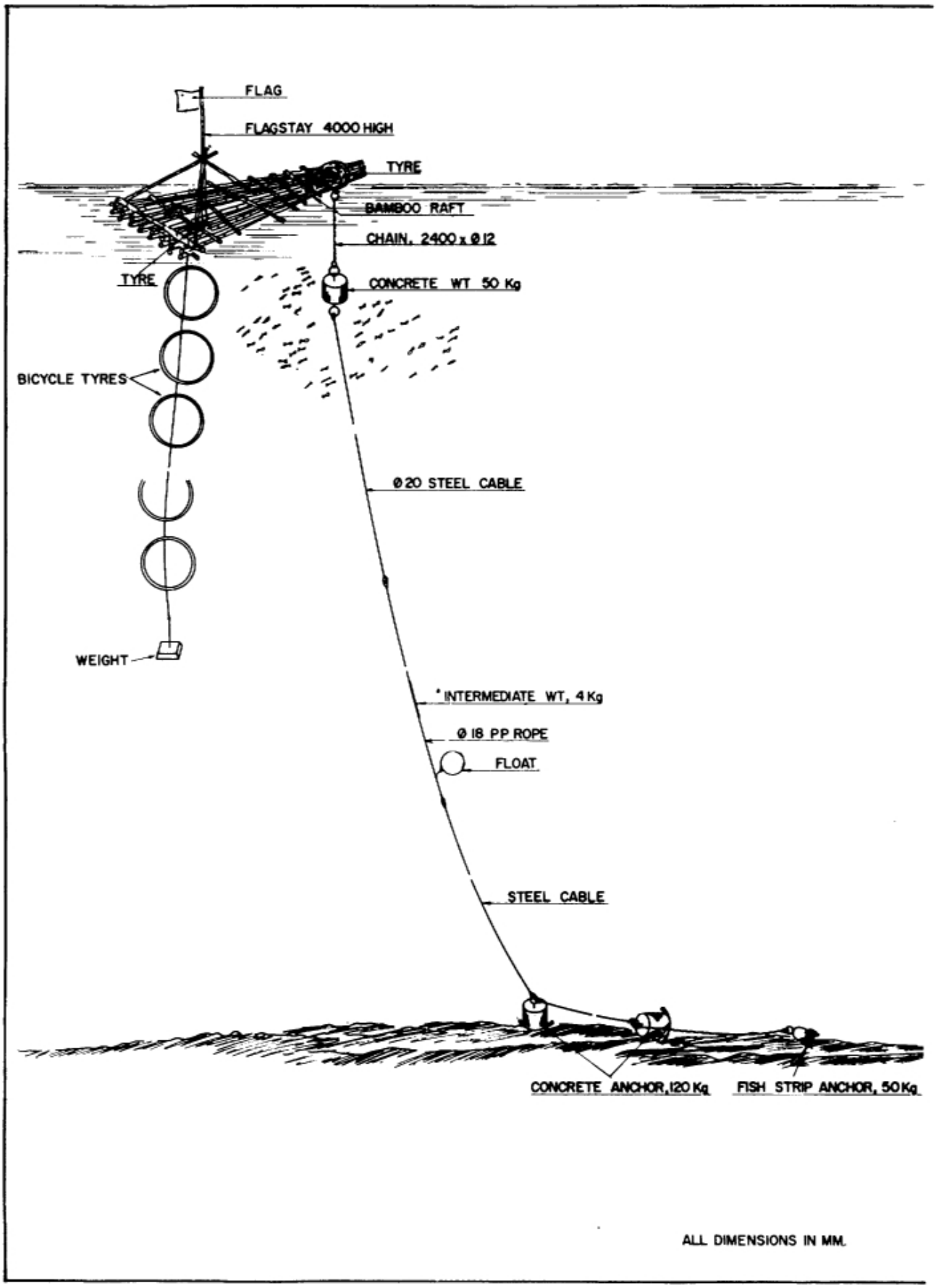
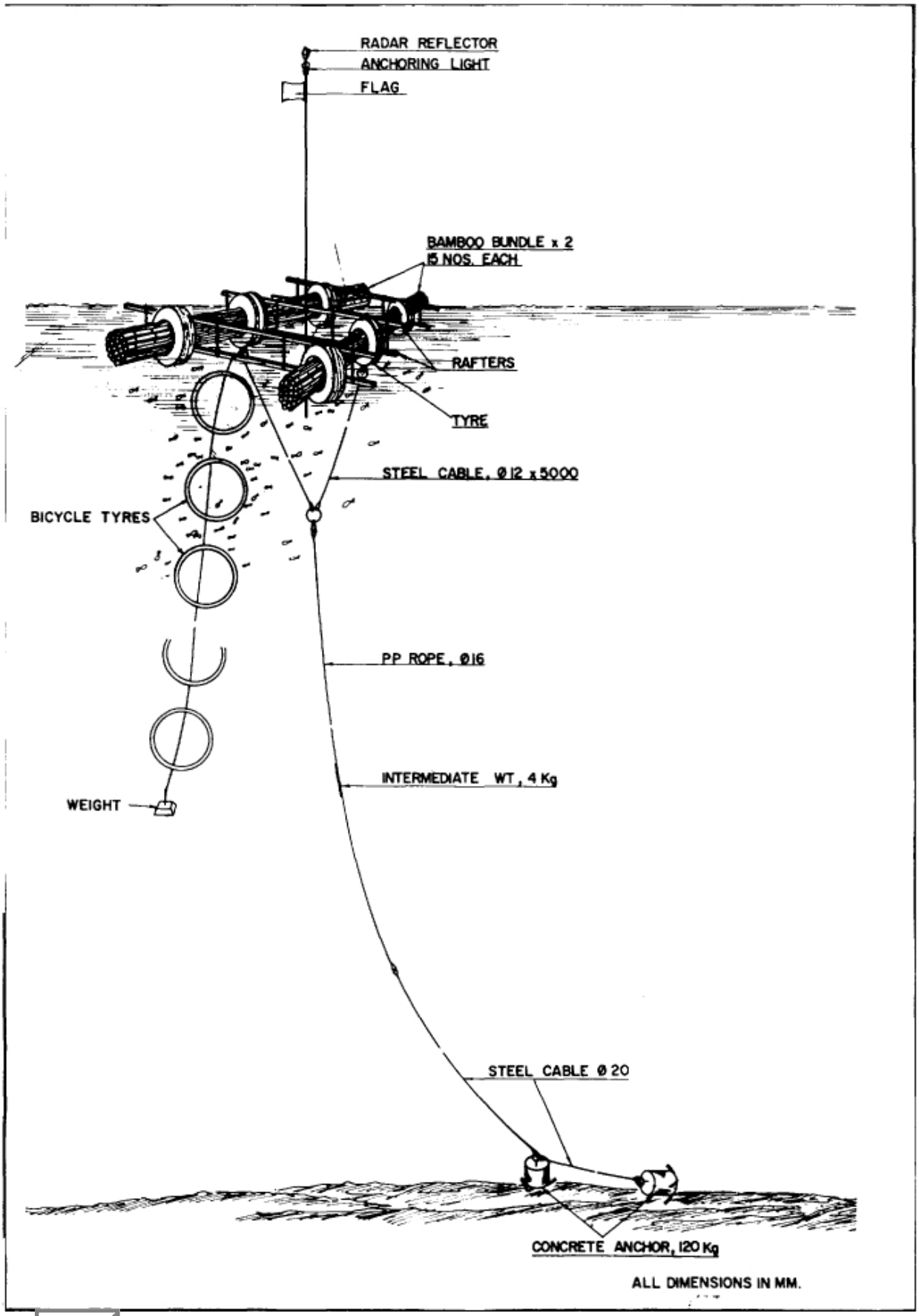
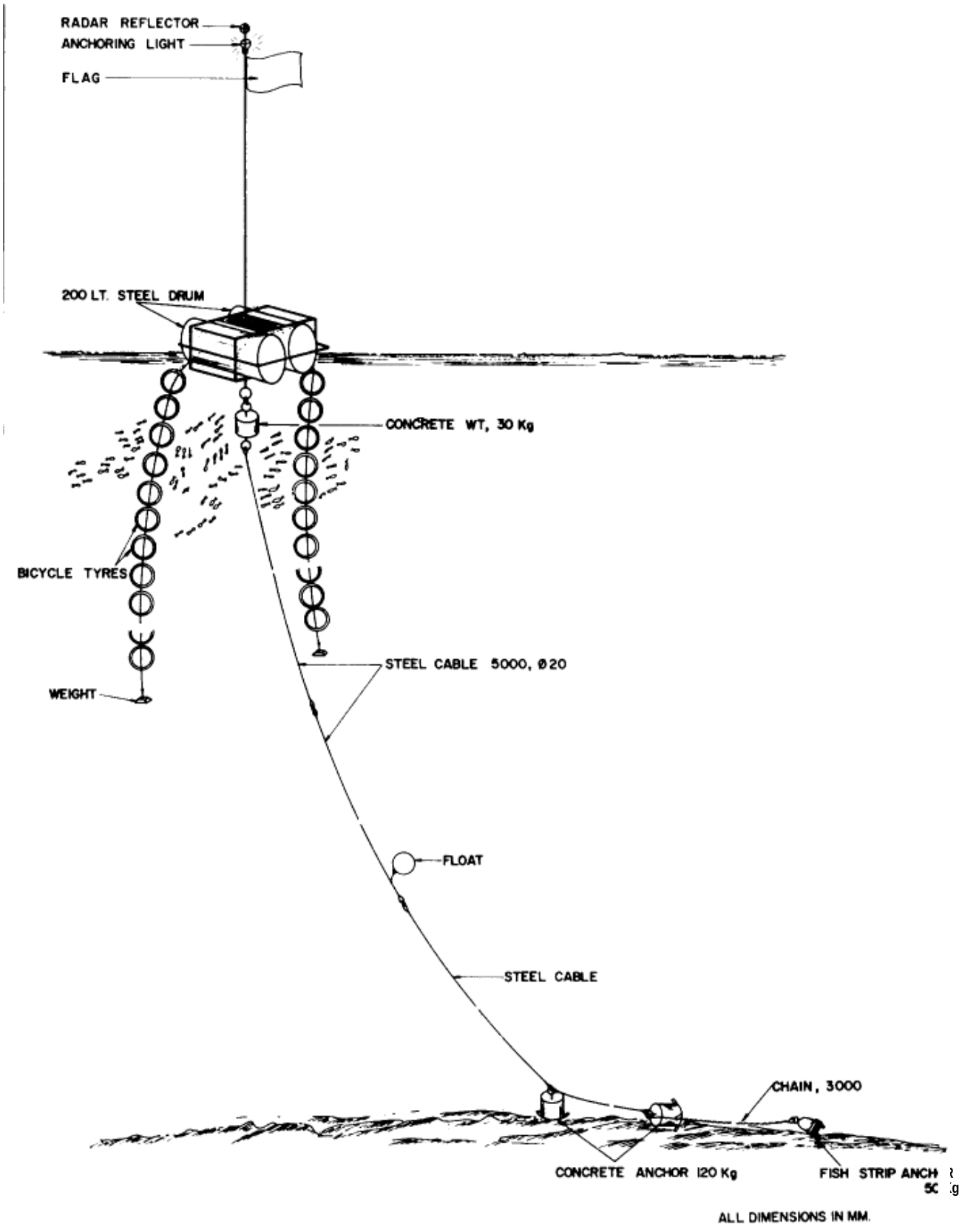


Fig 5 TWIN STACK BAMBOO RAFT



Flg 6

STEEL DRUM FAD



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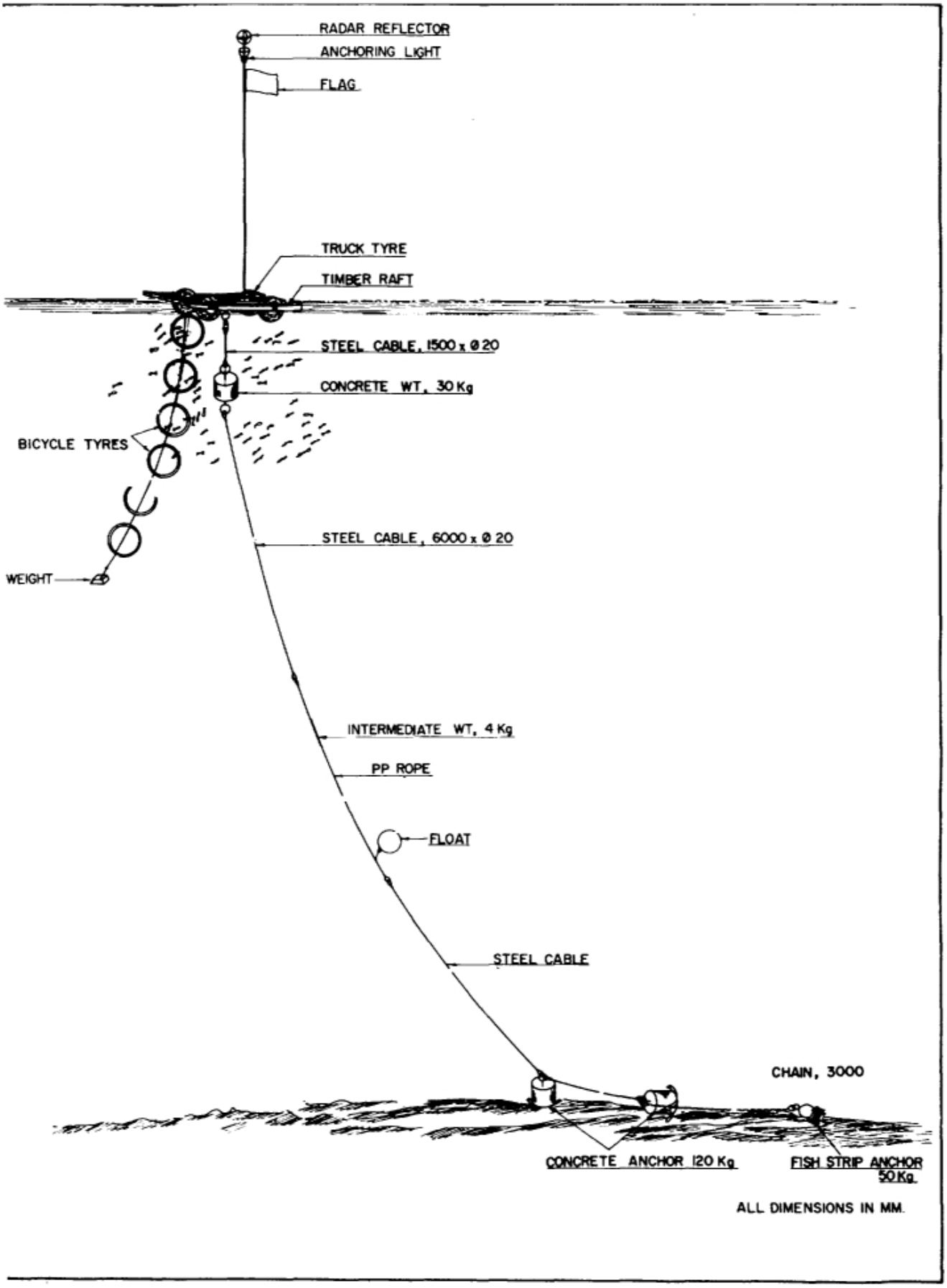
LOG RAFT (KATTUMARAM) FAD



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The BOBP brings out six types of publications:

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A list of publications follows.

Reports **(BOBP/REP/...)**

I. Report of the First Meeting of the Advisory Committee. Colombo, Sri Lanka, 28-29 October 1976. **(Published as Appendix 1 of IOFC/DEV/78/44. I, FAO, Rome, 1987)**

2. Report of the Second Meeting of the Advisory Committee. Madras, India, 29-30 June 1977. (Published as Appendix 2 of IOFC/DEV/78/44. 1, FAO, Rome, 1978)

3. Report of the Third Meeting of the Advisory Committee. **Chittagong, Bangladesh,** 1-10 November 1987. Colombo, Sri Lanka, 1978. (Reissued Madras, India, September 1980)

4. Role of Women in Small-Scale Fisheries of the Bay of Bengal. Madras, India, October 1980.

5. Report of the Workshop on Social Feasibility in Small-Scale Fisheries Development. **Madras,** India, 3-8 September 1979. Madras, India, April 1980.

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8. Pre-Feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh. G Eddie, MT. Nathan. Madras, India, **April 1980.**

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10.2 Report of the Consulation on Stock Assessment for Small-Sclae Fisheries in the Bay of Bengal. **Chittagong, Bangladesh,** 16-21 June 1980. Volume 2: Papers. Madras, India, October 1980.

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15. Report of the Consulation-cum-Workshop on Development of Activities for Improvement of Coastal Fishing Families. Dacca, Bangladesh. October 27-November 6, 1981. Madras, India, May 1982.

16. Report of the Seventh Meeting of the Advisory Committee. New Delhi, India, January 17-21, 1983. Madras, India, March 1983.

17. Report of Investigations to Improve the Kattumaram of India's East Coast. Madras, India, July 1984.

18. Motorization of Country Craft, Bangladesh. Madras, India, July 1984.

19. Report of the Eighth Meeting of the Advisory Committee. Dhaka, Bangladesh, January 16-19, 1984. Madras, India, May 1984.

20. Coastal Aquaculture Project for Shrimp and Finfish in Ban Merbok, Kedah, Malaysia. Madras, India, December 1984.

21. Income-Earning Activities for Women from Fishing Communities in Sri Lanka. Edultraud Drewes. Madras, India, September 1985.

22. Report of the Ninth Meeting of the Advisory Committee. Bangkok. Thailand. February 25-26, 1985. Madras, India, May 1985.

23. Summary **Report** of BOBP Fishing Trials **and Demersal Resources Studies in** Sri Lanka. Madras, India, March 1986.
24. Fisherwomen's Activities in Bangladesh: A Participatory Approach to Development. Patchanee Natpracha. Madras, India, May 1986.
25. Attempts to Stimulate Development Activities in Fishing Communities of Adirampattinam, India. Patchance Natpracha, V.L.C. Pietersz. Madras, India, May 1986.
26. Report of the Tenth Meeting of the Advisory Committee. Male, Maldives. 17-18 February 1986. Madras, India, April 1986.
27. **Activating Fisherwomen for Development through Trained Link Workers in Tamil Nadu, India.** Edeltraud Drewes. Madras, **India, May** 1986.
28. Small-Scale Aquaculture Development Project in South Thailand: Results and Impact. E. Drewes. Madras, India, May 1986.
29. Towards Shared Learning: An Approach to Non-formal Adult Education for Marine Fisherfolk of Tamil Nadu, India. L.S. Saraswathi and Patchanee Natpracha. Madras, India, July 1986.
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