Recovering FADs lost at a depth of 2000 m

by Marc Taquet[1], *Paul Gervain*[2] *& Alain Lagin*[1]

In Martinique, the first fish aggregrating devices (FADs) were deployed off the Atlantic coast in 1983 (Sacchi & Lagin, 1983). These heavyweight devices comprised a large floating component in order to provide as much shade as possible under the FAD. At that time, shade was often referred to as one of main aggregating factors for large pelagic species. These initial trials rapidly demonstrated the usefulness of such devices for small-scale local fishing and were naturally followed by other deployments. Between June 1983 and February 1997, 53 FADs were set around Martinique by IFREMER (French Institute of Research for Ocean Development) as part as of various research programmes. Over this period, the experience acquired in Martinique and other tropical regions established certain rigging principles, thereby improving FAD performance. In spite of the progress made, however, losses are still too frequent. Technological research on FADs was therefore included in IFREMER's programme on large pelagic species around Martinique (1995–1997). Two research topics have been selected:

- modelling FAD behaviour under the influence of currents, and
- identifying the devices' weak points.

Theoretical modelling work was supplemented by a series of measurements carried out at the IFREMER test site in Boulogne-sur-mer. These experiments made it possible to study the drag coefficients of the various types of FAD raft currently in use (e.g. single floating part, string of buoys). In order to facilitate the use of the model, a more user-friendly computer interface on Windows will be designed during the second phase of the study, to begin in early 1998.

To increase the lifespan of these devices is one of the common goals of all fisheries development teams responsible for building, deploying and maintaining a group of FADs. A choice must first be made among the three major types of devices depending on the buoyancy required: heavyweight FADs (more than 300 l), medium-weight FADs (between 150 and 300 l), and light-weight FADs (less than 150 l). All the components of the device will be determined by this initial choice: e.g. the weight of ballast, the breaking strength of ropes, chains, and connecting pieces, the amount of appendages.

Without any clearly-established correlation between the size of the device and that of its associated aggregations of fish, it can be assumed that the choice of the type of FAD is entirely guided by a concern for a long lifespan. A comparison of two types of devices as different as the 'Nirai' of Okinawa (Kakuma, 1997), which costs a million dollars, and the ultra-light FADs of Guadeloupean fishermen, which consist of 6 mm rope and some empty detergent containers, costing about 3000 French Francs (≈ US$ 550), well illustrates the range of technical options available for probably comparable aggregating effects.

The cost of a group of FADs and their maintenance depends on:

- the type of FAD,
- the materials chosen (e.g. the choice between different qualities of rope or buoys, or between stainless and galvanised steel for connecting pieces, can make the cost vary by up to a factor of 10), and
- the devices lifespan.

It is therefore very important to identify accurately weaknesses and the consequences of the failure of any one component on the survival of the device (Detolle et al., 1996).

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Martinican managers preference quickly turned towards lightweight devices (Figure 1). The Regional Marine Fisheries Committee manages a group of about 20 devices for professional fishermen. This programme, designed to assist fisheries development, is funded by the Martinique Regional Council. These devices have generally given very satisfactory results. Their use by professional fishermen, particularly off the Caribbean coast, is increasing. Very large aggregations of certain species, like blackfin tuna (*Thunnus atlanticus*), are frequently observed during the fisheries cruises

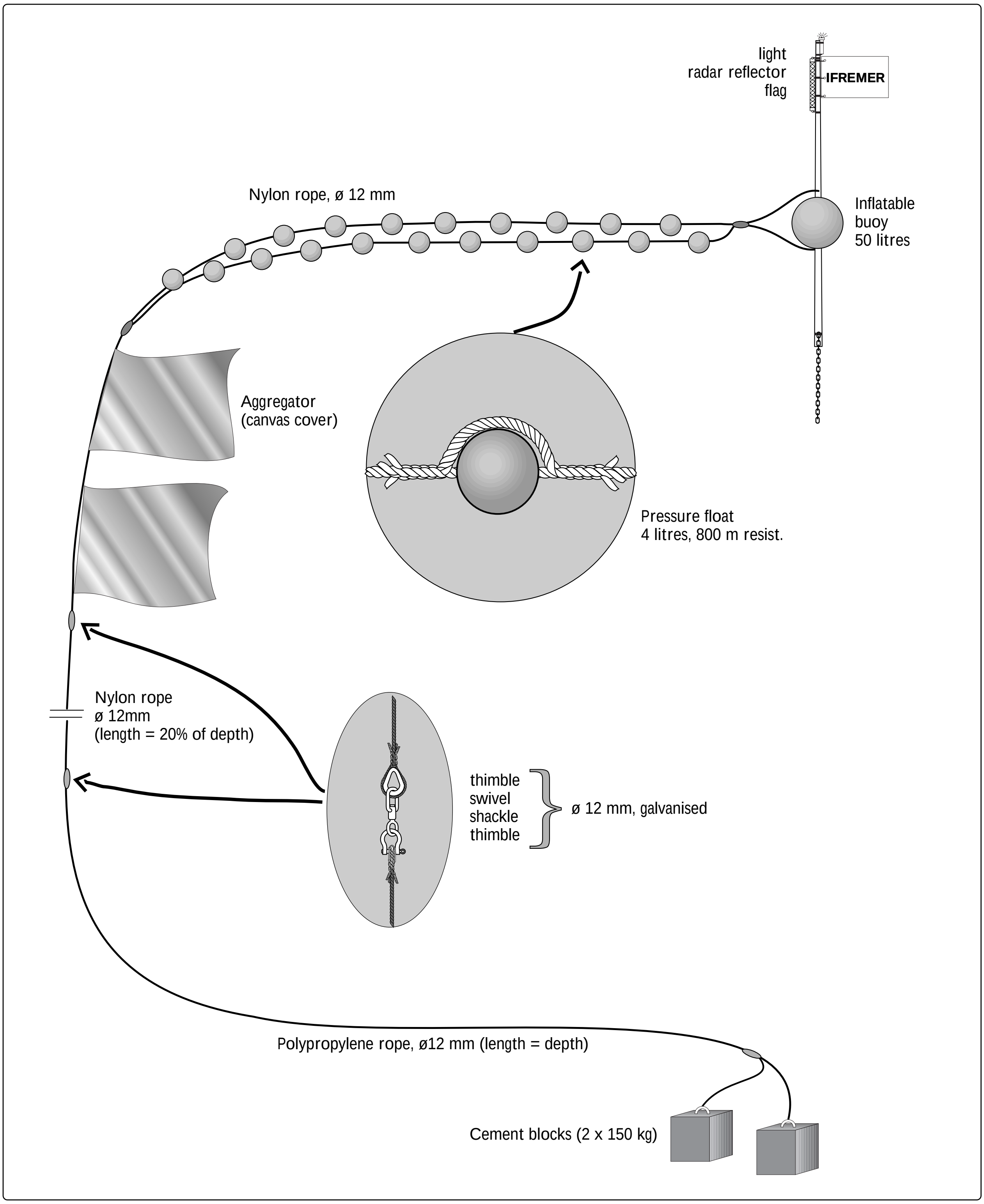

Figure 1

Design of the Martinican FAD

which IFREMER carries out on a monthly basis as part of their study of large pelagic species around Martinique. To avoid disturbance of professional fishing practices, all technical or biological work is being conducted around experimental devices, specially deployed for the purposes of the study.

To make a device more reliable, direct observation to assess the causes of failure of the various components is necessary. While these observations are relatively simple to carry out on the upper part of the device, the same cannot be said for the mooring line. Some damaged drifting FADs have been

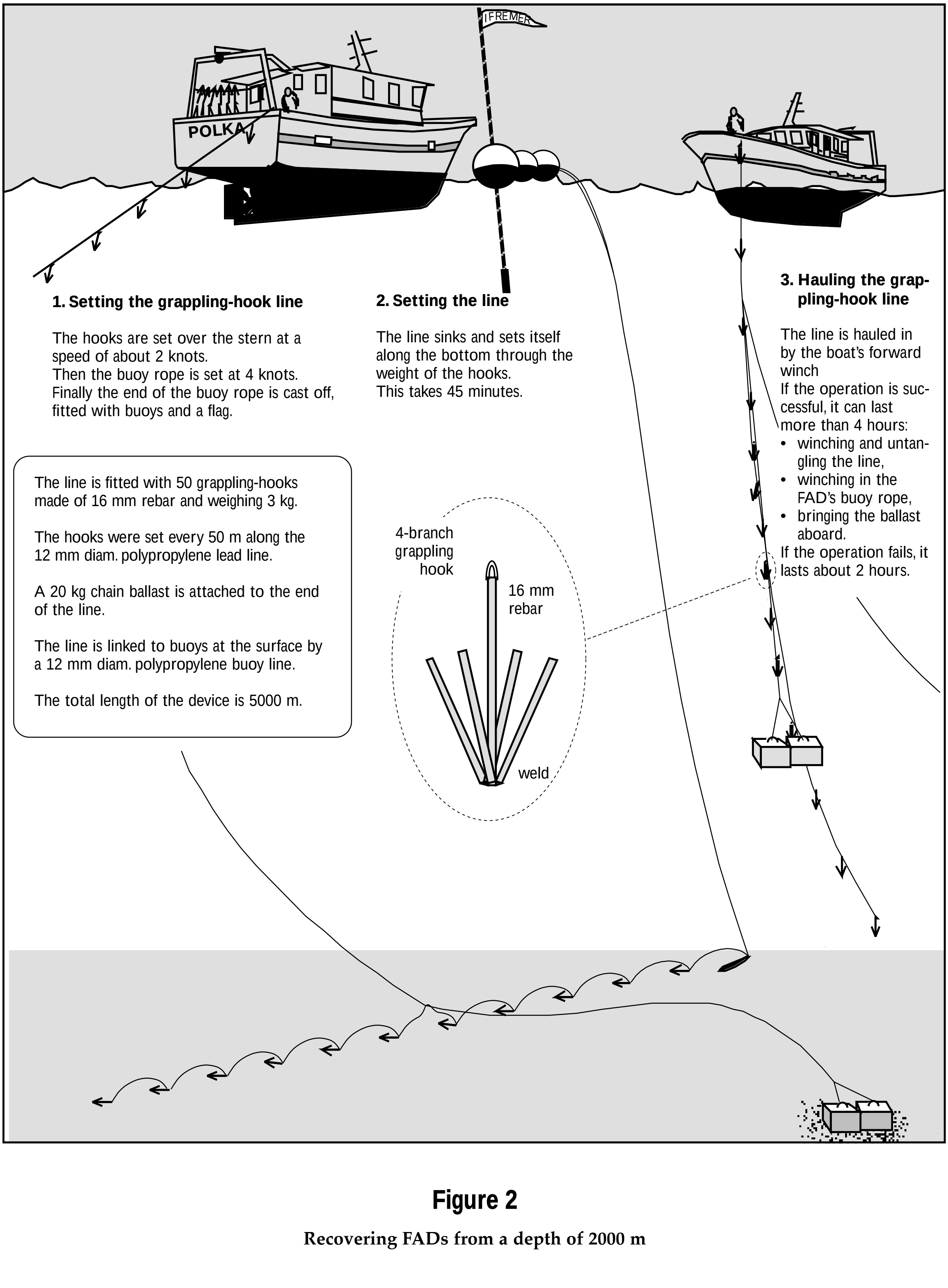

Figure 2

Recovering FADs from a depth of 2000 m

found by fishermen, in these cases, inspection of the recovered part is of particular interest. In most cases, the cause of failure can be identified. Around Martinique, these recoveries have confirmed the theory that accidental loss due to boats and wire leaders is common. Problems due to the use of certain materials or to design faults have been identified and corrected. Unfortunately, many devices are never found again and so doubt persists on the location and cause of failure.

The theory that most FAD losses are accidental naturally implies that mooring line failures either occur very close to the raft (when caused by boats) or in the upper 200 m (when caused by fishing lines). The parts of the FAD which remain on station after failure deserve attention for two reasons: i.e. identification of the causes of loss and observation of the state of wear and tear of the deep-water parts. Encouraged by the results obtained by the *Polka* during the recovery of lines of fishing traps lost at a depth of 500 m last May, we initiated a campaign to recover lost FADs.

The tool used was a line of grappling hooks 5000 m long (Fig. 2). At the depth at which the grappling hooks must work, it is not possible to drag the gear, because the movement of the boat would raise the grappling hooks instead of dragging them along the bottom. Also, the power required to drag the gear would make it very difficult to be sure whether or not the line had hooked the FAD. There would be a risk of not hooking the device if the grappling hooks slipped over the rope and a risk of breakage if the hooks did catch. The technique selected was to lay the line on the seafloor at the presumed location of the FAD's mooring line, then to slowly haul in the line using a winch. A stabilisation period of 45 minutes is allowed between setting and hauling to be sure that all the hooks have settled onto the bottom.

The success of the operation is closely linked to the accuracy with which the FAD's position is known. In fact, in order to lay the line at the right spot, the exact position of the anchor must be known and an educated guess about the position of the remaining part of the FAD's mooring line must be made. This position can depend on how the FAD was built. If the rope is buoyant and has no dense intermediate parts , it will probably stretch out in the direction of the current.

During this cruise, we decided to lay the grappling line perpendicular to the general current by staying at less than 1000 metres from the supposed position of the anchor. We worked on two sites, at each of which two FADs were moored between August 1995 and February 1997. In the interests of data comparability, we generally kept the same mooring site when replacing a lost FAD. The line-setting trajectories were determined using a computer-generated map prepared with the Karto software (Y. Cadiou, 1994) (Figure 3). During the monthly cruises, GPS checks are carried out on a regular basis in order to obtain a scatter of points representing the various possible positions of the FAD, depending on the currents. These checks facilitate the search for FADs which have a swing radius of about 1500 metres.

The 13 attempts carried out during the cruise allowed 3 of the 4 FADs present in the work zone to be recovered in their entirety. Examination of the material recovered

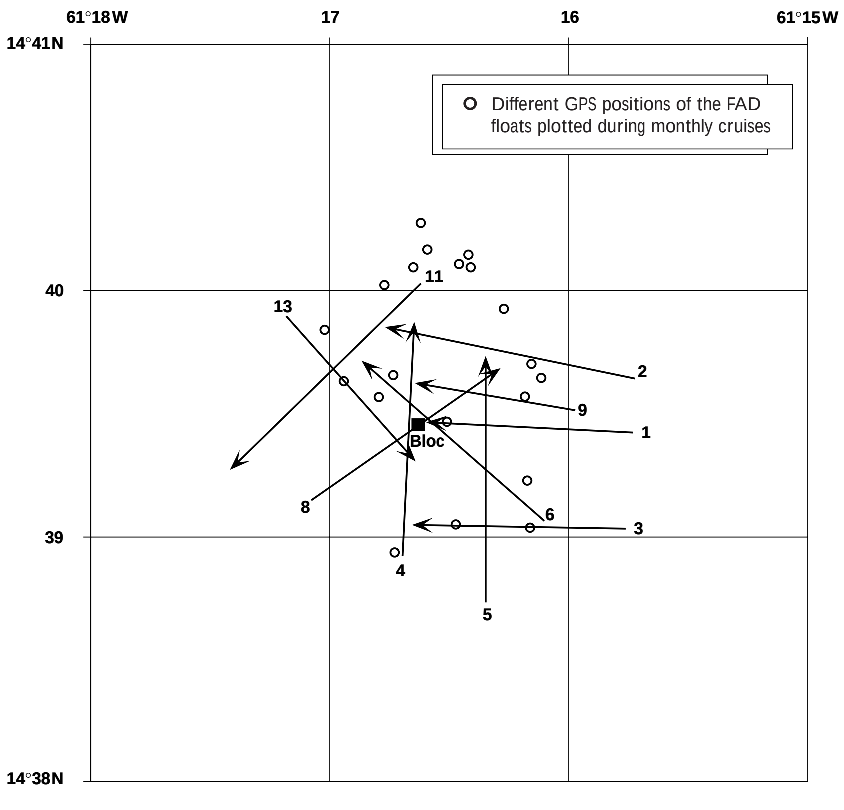

Figure 3

Directions of the grappling-hook line settings on the main site

resulted in the causes of failure being identified. One FAD had been torn away from its mooring by a boat as the stretching of its rope was characteristic of very strong traction (Photo 1). The stainless steel wire leaders from fishing lines tangled at the exact location of the breakage point of the other two devices, leave no doubt about the reason for their loss (Photo 2).

This confirms the theory based on observations of FAD rafts recovered while adrift. In addition, many devices were lost between December and February when weather conditions were good. This period corresponds to the time of the year when maritime traffic is at its heaviest (cruise ships) as well as the fishing season for pelagic species, when FADs are more heavily used. The use of steel wire leaders is considered in French Polynesia to be one of the main causes for the loss of FADs.

On one of the FADs recovered (deployed in 1995 and lost in 1996), we were able to examine in detail the deep-water components. The ropes had not been subjected to any damage (Photo 3). Below the first 200 metres (from the surface), no sign of aging, fouling or kinking was observed. The splices were in perfect condition and the whippings were in place. The shackles and swivels located on the deep part showed little corrosion and were in very good condition. The anchor was in its original condition (Photo 4). The thimbles which had not been secured by whipping were, however, badly damaged, but part of the damage was due to the strain exercised during recovery because of the weight of the anchor. Galvanised thimbles, nevertheless, constitute the weak point of every connection, and a simple alternative must be implemented without delay.

For the deep-water section, the materials used to construct FADs in Martinique are therefore of sufficient quality to ensure a lifespan over two years as long as care is taken with rigging (e.g. splices, whipping). Care must be taken to protect and strengthen the first 200 metres of mooring line. The use, for the upper part of the device, of protective tubing and materials resistant to damage caused by fishing lines should restrict losses. However, the lifespan of FADs can be improved significantly through better visibility of the devices (radar reflectors and more efficient lighting) to limit damage due to boats. Information campaigns directed towards seafarers, shipping companies and fishing groups can also reduce accidental losses.

Photo 1

Photo 2

Photo 3

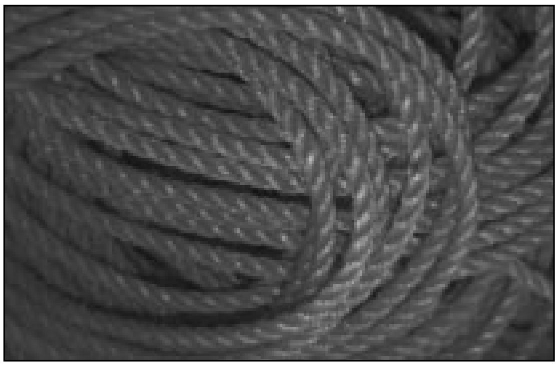

Photo 4

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Safety system developed for light FADs[1]

by Max Palladin[2]

Between 1994 and 1996, the French Co-operation Fund (FAC) supported a light FAD development project as part of an artisanal fishery development programme in Sao Tome and Principe, started by FIDA in 1995.

This programme was managed by the French company SEPIA (fisheries and aquaculture consultants) and supervised by Master Fisherman Joël Diquelou. With the benefit of experience from 26 coastal and deep-water FAD deployments, this programme made it possible to design a type of FAD suitable for local conditions, which was economical to make and set and could be managed and maintained by the fishers themselves.

In addition to the usual problems encountered in programmes of this kind, the use by the fishers of very long drift gillnets added a further constraint by causing the loss of many devices. These nets, 1000 to 2000 m in length and with a 2 m drop, are widely used to catch flying fish from October to May. When the nets drift and become entangled around a FAD, the fishers often have no alternative but to cut the mooring, leading to the irretrievable loss of the FAD.

In order to solve this problem, the project developed an original safety system which makes it possible to recover severed moorings and replace the upper part.

The FADs concerned consist of the following components: an anchor consisting of a lorry tyre filled with concrete from which extend straps similar to car safety belts, to which the mooring line is fixed. This line consists entirely of 10 mm diameter polypropylene rope (length equal to 1.5 times depth). At the surface, a set of 10 buoys each of 4 l of buoyancy, plus a 60 l plastic float fitted with a wooden mast, form the visible part of the FAD.

At approximately 20 m below the surface, three 4 l buoys have been attached to the line followed by a weight of approximately 14 kg which can slide along the mooring line. This weight consist of a cement block with a centre hole made by inserting a PVC tube to protect the rope from chafing

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