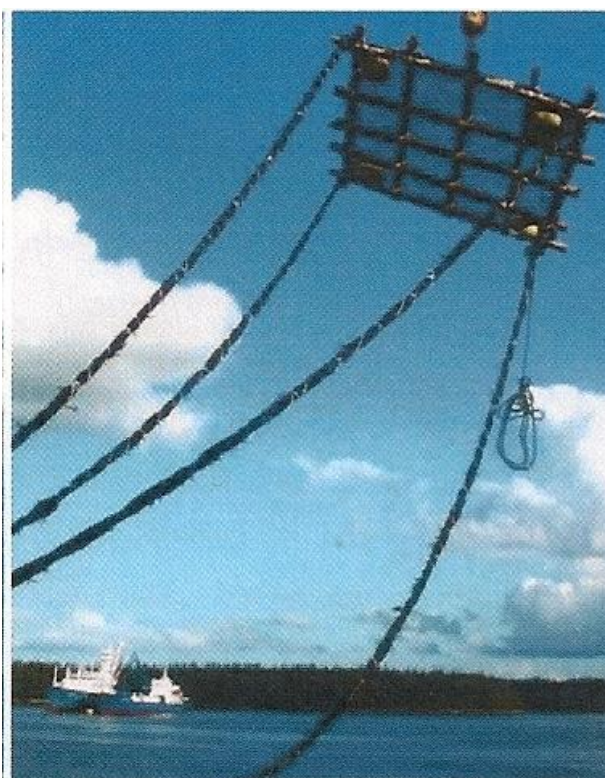


1st Joint Tuna-RFMO FAD Working Group Meeting

19-21 April 2017

Madrid, Spain

An Overview of the Use of FADs by
Mauritian Purse Seiners



By

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Acknowledgement

I am grateful to Messrs D. Norungee, Assistant Director of Fisheries and L. Mootoosamy, Divisional Scientific Officer for their valuable guidance in preparing this paper. Moreover, I would like to thanks Mr. A. Sheik Mamode (Scientific Officer), Mr. D. Bolaky (Senior Technical Officer), Mrs. T. Sooklall (Technical Officer), Mrs. M. Curpen Mahadoo (Technical Officer) and Mr. H. Lutchanna (Fisheries Protection Officer) for compiling and processing of useful data presented in this paper. All officers are part of the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping.

Last but not least, I would like to thanks Mr. Anthony Signour and Mr. Martin Denniel of SAPMER/IOSMS (Indian Ocean Ship Management Services) to provide me with an overview of the operations of the Mauritian purse seiners.

Use of FADs by the Mauritian Purse Seiners

1. Executive Summary

Fish aggregating under floating objects has been observed since the prehistoric time. Fish aggregate in considerable numbers around objects such as drifting flotsam, rafts, and floating seaweed. In the evolution of time, fish aggregating devices (FADs) became a man-made object used to attract ocean going pelagic fish such as tuna and associated species. Commercial tuna fishing by purse seiners use drifting FADs to target surface aggregations of tuna fish.

A first Mauritian purse seiner, 'Lady Sushil' was launched in 1979 and was joined by a second vessel, 'Lady Sushil II' eight years later. A third purse seiner, 'Cirn e', started operations in 1991. However, due to financial problems the vessels were sold off in 2000.

In 2013, the Mauritian purse seiner, Belle Rive entered into operation followed by 6 additional vessels in 2014. A total of 7 Mauritian purse seiners operated till 2015 and 5 of them left leaving 2 purse seiners which are presently in operation.

In the 80s, the Mauritian purse seiners were fishing on free school, log school and payao drifting FADs (DFADs). The present Mauritian purse seiners fish on free school, log school and around drifting FADs. The DFADs used by the purse seiners are of biodegradable and non-entangling types (eco-FADs). The vessels strictly abide to the IOTC resolution. In 2016, less than 550 active beacons were used at one time for a vessel and less than 1100 buoys were purchased per vessel. In 2017, less than 425 buoys were active and 850 buoys purchased per vessel.

A FAD management plan has been prepared with objective to monitor the deployment, use and management of DFADs to maintain tuna stocks at sustainable levels. The management plan has been prepared in line with the IOTC resolution 15/08 which serves as a useful tool to gather pertinent data on DFAD, its use and deployment.

The catches around DFADs by the Mauritian purse seiners vary from 43% to 64% for the period 2014-2016.

An observer programme on board the Mauritian purse seiners was started in 2015 to comply with the IOTC requirements of 5% coverage. During the observer programme, data were recorded on catches from the DFAD, free school and natural logs.

2. Fish Aggregating Devices (FADs)

Fish aggregating under floating objects has been observed since the prehistoric time. Fish are attracted by floating objects. They use them to mark locations for mating activities. They

aggregate in considerable numbers around objects such as drifting flotsam, rafts, and floating seaweed. The objects appear to provide a "visual stimulus in an optical void" and offer some protection for juvenile fish from predators. The gathering of juvenile fish, in turn, attracts larger fish.

A fish aggregating device (FAD) is a man-made object used to attract ocean going pelagic fish such as tuna and associated species. They usually consist of buoys or floats tethered to the ocean floor with concrete blocks. This is called an anchored FAD. Over 300 species of fish gather around FADs. FADs attract fish for numerous reasons that vary by species.

Fish tend to move around FADs in varying orbits, rather than remaining stationary below the buoys. Both recreational and commercial fisheries use FADs.

Presently, commercial tuna fishing by purse seiners use drifting FADs to target surface aggregations of tuna fish. Drifting FADs are not tethered to the bottom and can be man-made or natural objects such as logs.

Drifting FADs are widespread in the Atlantic, Pacific and Indian Ocean purse seine fisheries. They catch over 1 million tons of tuna (nearly one-third of the global tuna total) and over 100,000 tons of by-catch in the vicinity of FADs as estimated in 2005. Skipjack *Katsuwonus pelamis*, Bigeye tuna *Thunnus obesus* and yellowfin *Thunnus albacares* tuna are the three primary tropical tuna species that FADs target. Other fish include albacore, dolphin fish, wahoo, blue marlin, striped marlin, mako shark, silky shark, whitetip shark, galapagos shark, mackerel, and bonito.

Before FADs, pelagic purse seiners targeted free-swimming schools of tuna. Increasing FAD use over the past 30 years has increased the productivity of the fishing fleet, but has significant side-effects. The average FAD-caught fish is smaller and comes with relatively large by-catch raising concern about declining populations of several species of pelagic sharks.

3. The Mauritian Purse Seiners

A first Mauritian purse seiner, ðLady Sushilö was launched in 1979 and was joined by a second vessel, ðLady Sushil IIö eight years later. A third purse seiner, ðCirnëö, started operations in 1991. Until 1997, the three vessels were operating for the local canning factory. However, due to financial problems and change in the administration of the factory, the vessels were sold off in 2000 and the factory has now to rely on imports of raw materials to meet its requirements.

In 2013, the Mauritian purse seiner, Belle Rive entered into operation followed by 6 additional vessels in 2014. A total of 7 Mauritian purse seiners operated till 2015 and 5 of them left leaving 2 purse seiners in operation. The remaining 2 purse seiners, Belle Rive and

Belle Iles are at present still in operation. Both the Mauritian seiners are of LOA 79.7m and GT 2677t. The 5 purse seiners which left by the end of 2015 were of LOA 49.56m and GT 651t. The details of the purse seine fleet for the period 2013-2016 are given in table 1.

Table 1: Details of the purse seine fleet for the period 2013-2016

Year	Gear	Number of vessels	GT	LOA (m)
2013	Purse seine	1	2660	79.7
2014	Purse seine	7	678-2660	49.56-79.7
2015	Purse seine	7	678-2667	49.56-79.7
2016	Purse seine	2	2667	79.7

4. Use of FADs by the Mauritian purse seiners

In the 80s, the Mauritian purse seiners were fishing on free school, log school and payao drifting FADs.



Figure 1: FAD used by the purse seiners in the 80s

The present remaining two purse seiners, Belle Iles and Belle Rive fish on free school, log school and around drifting FADs. The FADs used by the purse seiners are biodegradable and non-entangling types (eco-FADs) as shown in the figure 2. The operators strictly abide to the IOTC resolution. In 2016, less than 550 active beacons were used at one time for a vessel and less than 1100 buoys were purchased per vessel. In 2017, less than 425 buoys were active and 850 buoys purchased per vessel.



Figure 2: Types of materials and FADs used by the Mauritius Purse Seiners

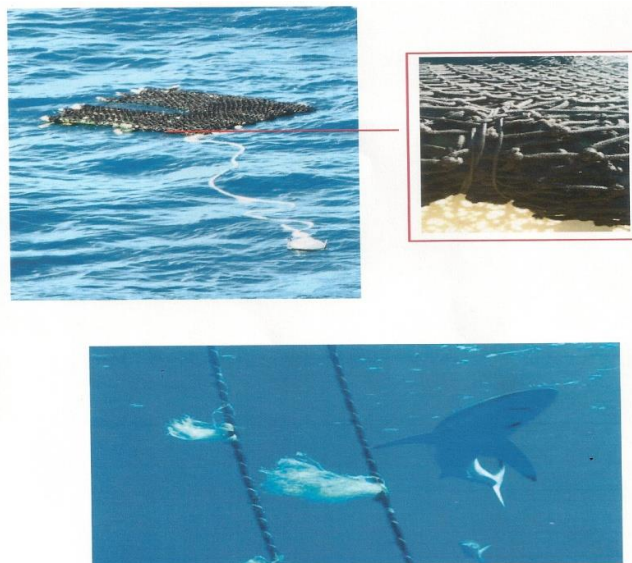


Figure 3: Non-entangling FADs used by the Mauritius Purse Seiners

4.1. FAD deployment by the two Mauritian purse seiners

The number of FADs deployed by the Mauritian purse seiners is given in table 2 by quarters for the period 2014-2016. The authorized number of FADs per vessel was 550 and it is observed that the Mauritian purse seiners have used below 50% of the number of FADs authorized as shown in table 3.

Table 2: Number of FADs deployed during 2014 to 2016

Quarters/year	Belle Rive			Belle Iles		
	2014	2015	2016	2014	2015	2016
Q1	147	163	172	89	177	183
Q2	191	158	174	112	235	129
Q3	193	246	165	114	205	179
Q4	117	139	203	93	173	194

Table 3: Percentage of FADs deployed during 2014 to 2016 in relation to the authorized number (550)

Quarters/year	Belle Rive			Belle Iles		
	2014	2015	2016	2014	2015	2016
Q1	26%	30%	31%	16%	32%	33%
Q2	35%	29%	32%	20%	43%	23%
Q3	35%	45%	30%	21%	37%	33%
Q4	21%	25%	37%	17%	31%	35%

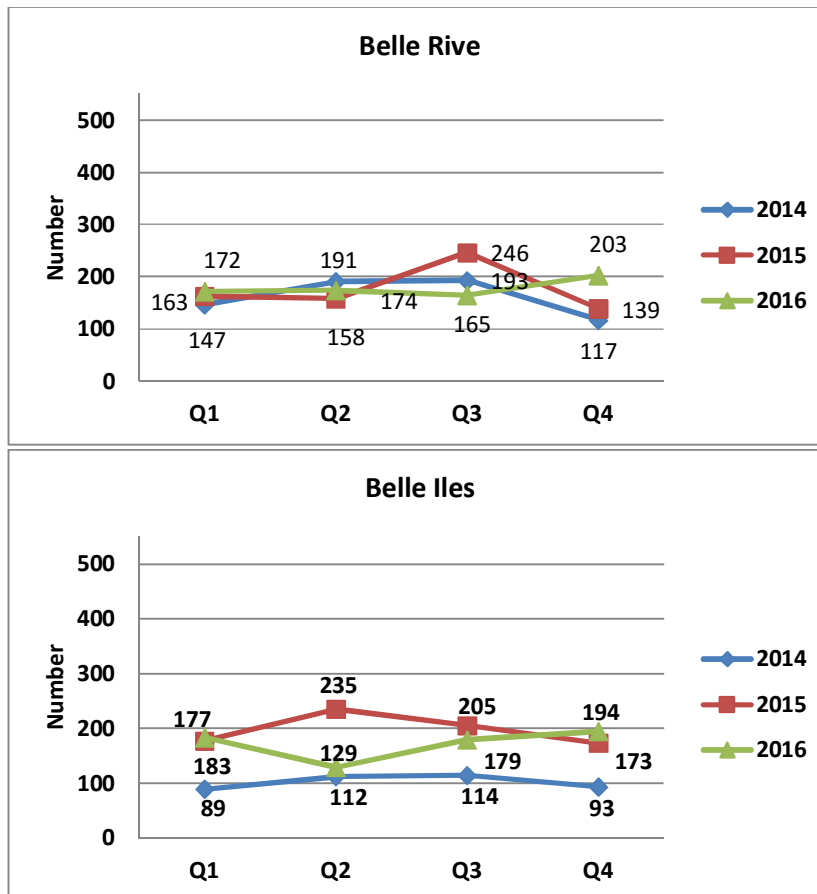


Figure 4: Graphics representation of FADs used by Belle Rive and Belle Iles

4.2. Catch around FADs

The catches around DFADs by the Mauritian purse seiners vary from 43% to 64%. The table 4 shows the annual total catch with percentage fished around FADs and free school.

Table 4: Catch around FADs and free school

Details/year	Belle Rive			Belle Iles		
	2014	2015	2016	2014	2015	2016
Total catch	5570	5195	6902	3178	4854	4623
% Catch on FADs	64	57	45	43	52	60
% Catch on free school	36	43	55	57	48	40

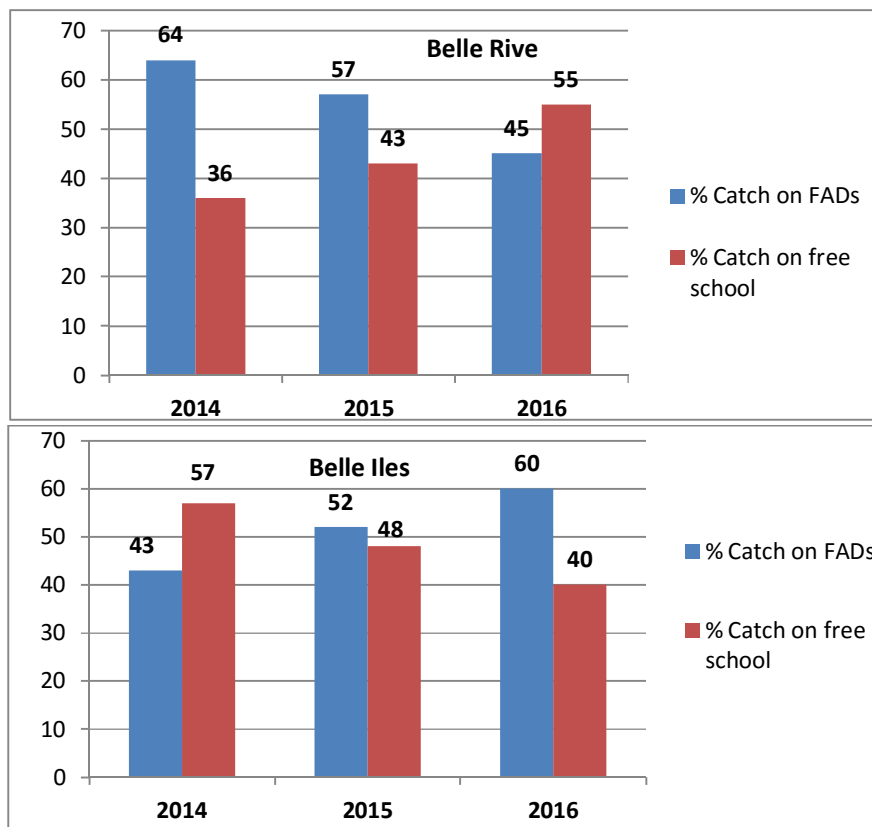


Figure 5: Graphics representation of catch % on FADs and free school

4.3. FAD management plan

A FAD management plan has been prepared with objective to monitor the deployment, use and management of DFADs to maintain tuna stocks at sustainable levels. The management plan has been prepared in line with the IOTC resolution 15/08. The management plan would serve as a useful tool to gather pertinent data on DFAD, its use and deployment.

Operators are required to control number of FADs deployed and abide to the limit set in the resolutions of IOTC. Reporting and minimizing loss of FADs will become pertinent as well as use of satellite buoys. Use of non-entangling FADs is also encouraged in the management plan. The management plan is at annex 1.

5. Observer programme

An observer programme on board the Mauritian purse seiners was started in 2015 to comply with the IOTC requirements of 5% coverage. During the observer programme, data were recorded on catches from the DFAD, free school and natural logs. Data for the years 2015 and 2016 have been processed and presented in tables 5, 6 and 7. Graphic representations of the processed are given in figures 6 and 7.

Table 5: Observer programme in 2015

Fishing vessel	Number of days	Period
Belle Isle	69	From 26/02/2015 to 03/05/2015
Belle Rive	71	From 06/04/2015 to 17/06/2015
Belle Isle	70	From 06/05/2015 to 15/07/2015
Total	210	

Table 6: Observer programme in 2016

Fishing vessel	Number of days	Period
Belle Rive	72	From 23/03/2016 to 01/06/2016
Belle Rive	71	From 01/06/2016 to 10/08/2016
Belle Isle	71	From 08/09/2016 to 17/11/2016
Total	214	

Table 7: Catch in tonnes recorded during the observer programme

Area	2015	2016
Own DFAD	538	836
Foreign DFAD	287	575
Free School	1727	1876
Natural Logs	210	228
Total	2762	3515

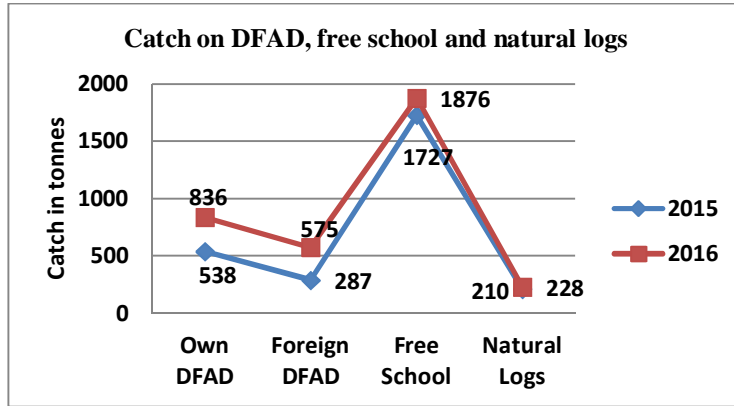


Figure 6: Catch on DFAD, free school and Natural logs

Table 7: Catch in tonnes recorded on DFAD and free school

Area	2015	2016
DFAD	825	1411
Free School	1939	2104
Total	2762	3515

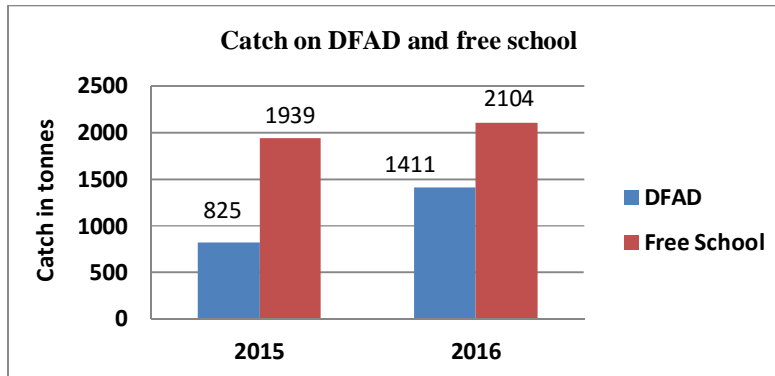


Figure 7: Catch on DFAD and free school plus natural logs

6. Conclusion

The Mauritian purse seiners are fully abiding to the IOTC resolutions relating to the use, deployment and managements of FADs. The purse seiners are using bio-degradable and non-entangling FADs (eco-FADs). A FAD management plan has been prepared and will be submitted to the IOTC soon. However, the Mauritian purse seiners have already adopted the FAD management plan and are deploying fewer FADs compared to the authorized quantity. An observer programme has been put in place since 2015 to follow on the activities of the Mauritian purse seiners.

ANNEX 1

Resolution 15/08 Guidelines for preparation of Drifting Fish Aggregating Device (DFAD) Management Plans

Prepared by: Mauritius

Operator: SAPMER/IOSMS (Indian Ocean Ship Management Services)

Purse Seiners: Belle Isle and Belle Rive

1. **Objective:** To monitor the deployment, use and management of DFADs to maintain tuna stocks at sustainable levels.
2. **Scope:**
 - a. **Vessel type:** *purse seiner*
 - b. **DFAD numbers or number of beacons to be deployed:** Vessel owners and operators are allowed to deploy a maximum of 425 instrumental buoys per vessel at any one time and each vessel is not allowed to exceed 850 instrumental buoys in a year.
 - c. **Reporting procedures:** *Through Logbooks (refer to Appendix 1)*
 - d. **Incidental by catch reduction and utilization policy:** *Use of Non-entangling FADs (refer to Appendix 2)*
 - e. **Consideration of interaction with other gears type:** The tuna longline fleet of Mauritius operates exclusively in the EEZ and hence has no interaction with the purse seine operations which occur mostly outside the EEZ. Moreover licensed foreign longliners operate mostly in the EEZ of Mauritius thereby eliminating the risk of conflict between purse seine fishing and tuna longlining arising from the use of DFADs. The DFAD MP shall be reviewed in case of any adverse impacts reported as a result of DFADs or part of DFADs having interfered with longline fishing operation.
 - f. **Monitoring and retrieval of lost DFADs:** All DFADs that are deployed are equipped with satellite buoys that allow identifying the location and enable movement monitoring. Vessel masters are encouraged to prevent, as far as possible, loss of FAD sets at sea. In the event of a loss or of the impossibility of hauling a FAD, operators must record in the logbook (Appendix 1) its last known date and position.
 - g. **Improvement in information dissemination of deployment and lost DFADs.** Vessel owners have agreed to disseminate to the Ministry and other concerned institutions the positions of instrumental buoys which have drifted in zones where the risk of damage is high.
 - h. **Statement or policy on DFAD:** *use of a limited number of non-entangling FADs*

3. **Institutional arrangement for management of the DFAD Management Plan:**
 - a. **Institutional responsibilities:** Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping.
 - b. **Application processes for DFAD and/or DFAD beacons deployment approval:** Presently, no approval is required for the deployment of DFAD and DFAD beacons. However, the Ministry ensures that the deployment of DFAD is being properly done by the vessels owners and operators according to the DFAD-MP. Moreover, all information pertaining to deployment of DFAD and or DFAD beacons is recorded in logbooks that are inspected for compliance by the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping. The purchase order of the vessel owners and operators is also verified to ensure that their annual purchase of beacons is within an average of 425 DFAD beacons per vessel.
 - c. DFAD and/or DFADs beacons replacement policy: *maintain 425 buoys per vessel per year*
 - d. Reporting obligations: All information pertaining to DFAD/DFAD beacons deployment is recorded in logbooks (*refer to Appendix 1*). This include:
 - *The date of deployment*
 - *The position (latitude and longitude) of DFAD/DFAD beacon deployment.*
 - *Identification number of the beacon*
 - *The total number of DFAD/DFAD beacons deployed per trip.*

4. DFAD construction specifications and requirements
 - a. DFAD design characteristics (a description): *As per annexed plan (refer to Appendix 2)*
 - b. DFAD markings and identifiers, including DFAD beacons: *DFAD identified by serial number*
 - c. Lighting requirements: *flash command*
 - d. Radar reflectors: *visible without radar reflectors*
 - e. Visible distance: *1 NM*
 - f. Radio buoys (requirement for serial numbers): *marine instruments*
MSI XXXXX
M3I XXXXX
M4I XXXXX

 - g. Satellite transceivers (requirement for serial numbers): *All DFADs are equipped with satellite transceivers to allow the monitoring of FADs trajectory.*

5. Applicable areas: *on high seas and EEZ Indian Ocean Coastal State through licenses, excluding closed area as stipulated by IOTC, shipping lanes, away from fishing grounds of the artisanal fishery.*

6. Applicable period for the DFAD-MP: The current Management Plan is valid for a period of 3 years as from 1st January 2016.

7. Means for monitoring and reviewing implementation of the DFAD-MP: The implementation of the DFAD-MP will be monitored and reviewed by the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping on a yearly basis. The monitoring will be done jointly with the ship owners and operators and the tuna export industry. The DFAD-MP will be reviewed on a yearly basis to accommodate new management measures accepted at the Commission meeting. Submission of logbook with complete information on DFAD related activities have been made compulsory. All the information with regard to DFAD is recorded in the Ministry's database that allows easy access for verification and monitoring. For instance, the number of DFADs deployed at sea is recorded based on the logbooks and verified if they are within the set limits of the Resolution 15/08. The catch composition will be monitored through the observer program and port sampling program. The scientific data collected from these programs will be compared to those of the previous years to analyse any progress made during the implementation phase of the DFAD MP. Moreover, a progress report on the implementation of the DFAD-MP will be prepared and submitted to the IOTC on a yearly basis.

8. DFAD Logbook: Presently there is no specific logbook to record all activities related to DFAD. However, the fishing logbook (*Appendix 1*) has been designed to accommodate all information concerning activities on DFAD such as:
 - Deployment/launch of FADs
 - Removal of FADs
 - Visiting of FADs with or without handling (maintenance/exchange)

For each of the above activities, the following information is also recorded in the logbook:

- Date and time;
- Position (latitude & longitude);
- Type of FAD (natural, artificial, "classic" or "non-entangling" draft) along with a short description (tree trunk, pile of straw, container, rope, í)
- Number of associated beacon in case of a TFAD;
- Number of removed beacon in case of a TFAD if the beacon belonged to the vessel, if not write "beacon of a third vessel";
- Any observation with regard to entangled sharks or turtles if ever the FAD has net counterparts;
- Quantity caught per species;
- Any discard quantities

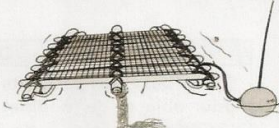
The Tuna for Tomorrow Program « ecoFAD »

Objectives and means


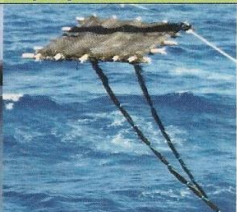
Based on the results of the MADE program, this program intended to modify the Fishing Aggregating Devices (FADs) of the whole French tuna purse-seiners in order to eradicate the entangling of turtles and sharks.

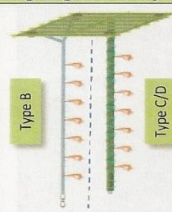
This program has received public funding from DPMA and EU in the context of EFF collective actions and was carried out in close cooperation with IRD.





Duration : July 2010 to June 2012



Deployment of non-entangling FADs by the crews



Program protocol

- Presentation to the crews of the objectives and of initial designs conceived by IRD.
- Provision to the vessels of materials to build non-entangling FADs.
- Documentation by captains of the deployments and sets on non-entangling FADs.
- Debriefing the end of the cruise with the person in charge of the program.
- Redefinition of the characteristics of non-entangling FADs & writing of design sheets for the crews.

Program results

- 3 designs retained.
- 1100 non-entangling FAD deployments documented in the Indian Ocean, 130 in the Atlantic Ocean (where the French tuna purse-seiners use few FADs).
- Comparative analysis of fishing data on non-entangling and traditional FADs showing that the FAD maturation time and the average tonnage caught per set are identical and that there is therefore no significant difference in terms of yield fishing on non-entangling FADs rather than on traditional FADs.

Program implications in terms of management

Since 2012, the fleet of Orthongel therefore does deploy only non-entangling FADs (Decision n° 11) and Orthongel has widely disseminated these results which were used as bases for advice by the scientific committees of RFMOs and ISSF on FAD design.

Orthongel Decision n° 11 <http://www.orthongel.fr/contenu/docs/decisions/Dec11-DCPeco.pdf>
 Program description <http://www.orthongel.fr/index.php?content=cat&page=dcpeco>
 Goujon, M., Vernet, A.L., Dagorn, L., 2012. Preliminary results of the Orthongel program « eco-FAD » as June 30th 2012. IOTC-2012-WPEB08-INF21