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Preliminary results of the Orthongel program "eco-FAD" as June 30th 2012

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Summary

Since August 2010, the French tuna purse seiners operating in the Indian Ocean have deployed more than 1000 modified FADs to be non-entangling. The work done by the crews with the help of IRD scientists also involved in the MADE program, resulted in the identification of three designs of FADs, which present characteristics that allow to reduce or even eliminate the risk of entanglement of turtles and sharks and are widely accepted by the crews without significantly increasing the manufacturing cost of these FADs.

The catch data collected on these non-entangling FADs have shown that the yields do not appear to be altered by the changes of the FAD design.

A small number of incidental entanglements observed in these first generation "non-entangling FADs" suggests, however, that the efforts made by the ship-owners should be continued. The discussion of these results therefore also relates to the responses proposed by the sector in order to achieve the goal of zero entanglement in a sustainable and economically viable manner.

Introduction

Starting from the results of the EU MADE project (#210496), this Tuna Contract for the Future (TCF, so named because belonging to a series of programs aiming at improving the sustainability of the fishery) conducted by Orthongel and IRD has been launched with the help of the European Fisheries Fund (project id 33245) in order to modify the FADs of the French fleet in a way that would eradicate the entanglement of turtles and sharks (although the incidental mortality linked with this entanglement is estimated to be quite low. The modified FADs was to be called "eco-FAD" meaning "turtle & shark friendly" or "non-entangling FAD".

Definitions and methodology

In this paper, the term FAD (Fish Aggregating Device) is used to describe only the drifting-raft-type FAD that fishermen seed at sea in order to increase the number of total tracked drifting objects at sea that can aggregate tuna and therefore increase their efficiency to track and fish skipjack tuna. The French fleet considers that any drifting object at sea (natural, from human origin or fishermen released) is potentially a FAD and that it becomes a tool for the captain to increase his vessel efficiency as soon as a beacon is attached (we then talk of TFAD for tracked FAD). Therefore, what will be referred as FAD in this paper for simplification, should really be called "raft-type TFAD".

French FADs are composed of 3 units: a raft, a underwater hanging structure (UHS) and a beacon (which is not a source of entanglement). The raft is made of bamboo canes and designed to maintain the FAD at the surface and is always covered. The function of this cover is to maintain together the bamboo canes and to make the FAD less visible for other purse seiners). The UHS extends the discontinuity (in the open sea pelagic environment) of the raft in depth (at least down to the thermocline) and serves as a drifting anchor (allowing the FAD to drift in a chosen water mass using underwater currents and to be less affected by wind effects). Its presence is used essential by the fishermen which consider that it needs several weeks to “mature” before tunas start to aggregate.

Lifetime (time between seeding and loss or replacement) of these FADs is estimated by the ship-owners to be at an average maximum of 8 months. Therefore, purse seiners crew regularly prepare new rafts that they seed with a beacon or use to replace a too-old raft (after a while, the rafts start to break up and sink). Often, the replacement consist in associating the new raft to the old one, so that the overall device keeps its aggregating quality during the time the new one is “maturing”.

The first step consisted in identifying the possible technical solutions through a working group and discussions with captains. It was based on the results of previous analyses (Delgado de Molina, Ariz, Pallarès *et al.*, 2005 ; Delgado de Molina, Ariz, Santana and Deniz, 2007 ; ISSF, 2010) and of the MADE program (Moreno, Sancristobal, Franco and Dagorn, 2009) and ended with the elaboration of a document describing the different designs of eco-FAD. This document was distributed to all the captains of the fleet.

During the second step (completed in the Indian Ocean and still in progress in the Atlantic Ocean), the vessels have been testing different types of “eco-FAD” first built following instructions given by an project manager recruited by Orthongel. Liberty was given to the crews to modify the proposed designs as long as the result was non-entangling (the basic term of reference, table 1). Different materials identified by the working group for the construction of non-entangling FADs (rope, small-mesh net, black cotton cloth) were distributed to the vessels, first systematically and then on demand.

Table 1. terms of reference for the conception of non-entangling FADs

Environmental constraints
Non-entangling (no net with large open mesh)
Biodegradable if possible (this constraint was not prioritized at this stage, considering the lack of proper material available nowadays)
Sufficient solidity to resist bad weather conditions and rough sea conditions
Similar drift than traditional FADs (surface and depth of the immerse structure)
Economical constraints
At least, similar yield than traditional FADs
At least, not reducing the furtiveness of the FAD
Reduced additional cost (use of cheap or second-life materials)
Easy and quick design

Tests have been conducted with a raft-cover made of a black cotton cloth.

Each time a non-entangling FAD was seeded (released in the open sea), the captain had to fill a form where information was collected on the FAD (design, number of hanging structures, presence or absence of drifting devices attached to the hanging structures, time spent for its construction, in replacement of an old one, …), the time and position of the release and the id of the attached beacon. This form was also filled when a non-entangling FAD was recovered.

For each set on a non-entangling FAD, the captain had to fill a form where information was collected on the FAD (design, id of the attached beacon), the time and position of the set, the catch of target and bycatch species and the eventual observation of entangled animals.

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At the end of each cruise, the project manager had a debriefing meeting with the captain and the second in order to check and eventually complete the forms filled during the cruises and collect the opinion and ideas developed by the crew on the new non-entangling FAD design and efficiency.

Results

Deployment of non-entangling FADs

Since the beginning of the TCF in August 2010 up to June 30th, 2012, the 12 French purse seiners operating in the Indian Ocean, more than 1103 non-entangling FADs have been seeded by the crews with information provided each time. 67 additional non-entangling FADs were also released in the beginning of the program but without information collected.

306 non-entangling FADs were withdrawn. These withdrawals appeared to have the same causes than the regular withdrawals of the traditional FADs (*i.e.* mainly to recover a FAD that has drifted away from the fishing ground, to prevent it from drifting in areas where fishing is not possible or to recover a FAD which lifetime is close to its end).

Designs

3 designs (fulfilling the given terms of reference) were developed, tested and adopted by the fishermen. For all designs, the raft is similar and made of 8 to 10 2 meters-long bamboo canes attached with cork floats. The raft is covered by 2-4 layers of thick black small-mesh (50 mm) netting tightly sewn together and heavily strained to prevent animals from getting between the netting.

Black cotton clothes were largely tested (each vessel received 10 of these to test). The crews reported that these cotton clothes increased the furtiveness of the raft because of the stagnant water remaining on the top of the waterproof cloth. However, the material was abandoned because it was not strong enough and would tore too easily (increasing entanglement and decreasing furtiveness).

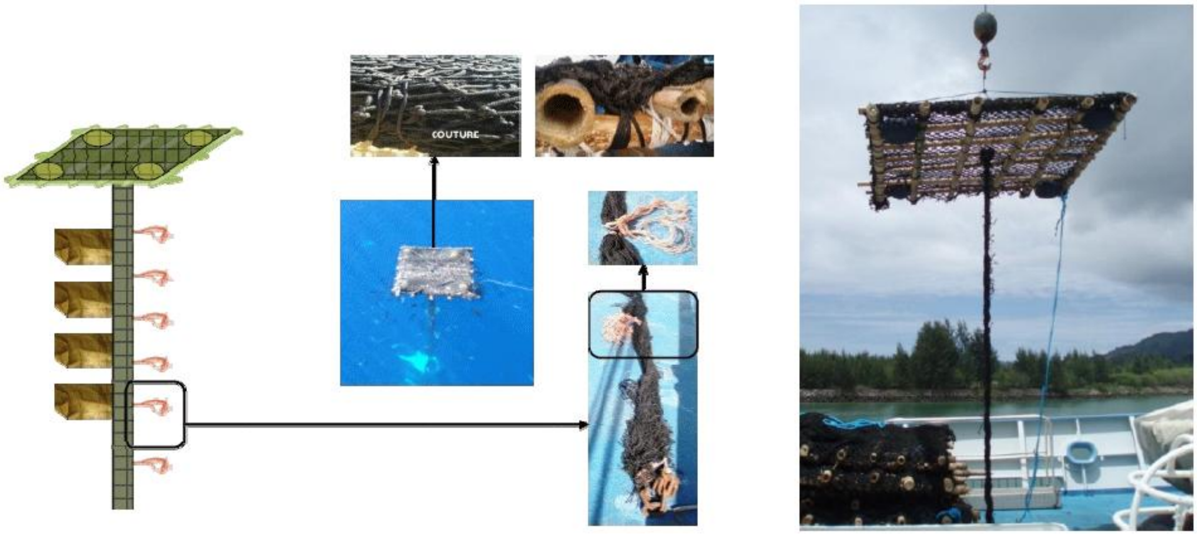
What differentiate the design between themselves is the UHS. The 3 designs are described hereafter:

Type B: the ropes design

The UHS of this FAD is composed of 1 to 4 recycled ropes weighted by a piece of chain or cable at their bottom end and attached to each corner of the raft. To increase the drift of the submerged structure (which serves as a sea anchor), salt bags and/or small unbraided sections of recycled ropes are attached to the ropes.

The advantage of this design is that there is no more immersed meshed material which guarantees the absence of entanglement even when the FAD has sojourned several months in the water. It can also evaluate more easily to a full ecological FAD using (long-term) biodegradable ropes. However, the cost of the FAD is however significantly increased (multiplied by a factor 10 and up to 20 when considering biodegradable ropes).

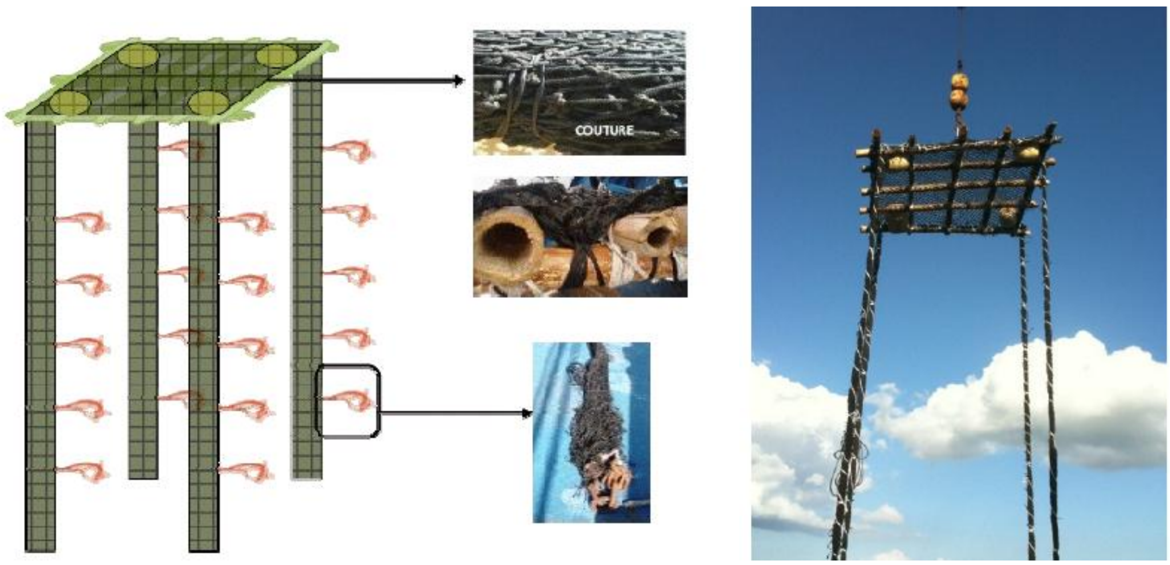
Type C: the twisted net design



The UHS of this FAD is composed of a single (sometime double) twisted net hanging from under the middle of the raft and weighted by a piece of chain or cable at its bottom end. The net is twisted and braided into a sausage shape, sewn or tied every meter to reduce the likelihood of entanglement. To increase the drift of the submerged structure (which serves as a sea anchor), salt bags and/or small unbraided sections of recycled ropes are attached to the net.

The advantage of this design is that it can be realized with the FADs already in use. The transformation of the FAD takes less than one hour and increases only slightly the cost of the FAD.

Type D: the 2 to 4-net strips design



The UHS of this FAD is composed of 2 to 4 strips of net weighted by a piece of chain or cable at their bottom end and attached to each corner of the raft. Each strip is twisted and braided into a sausage shape and sewn or tied every meter to reduce the likelihood of entanglement. To increase the drift of the submerged structure (which serves as a sea anchor), salt bags and/or small unbraided sections of recycled ropes are attached to the ropes.

As for the second design, the advantage of this design is that it can be realized with the FADs already in use and increases only slightly the cost of the FAD. The transformation of the FAD takes however a little bit longer time.

The designs using the nets were clearly preferred by the crews. 53% of the non-entangling FADs seeded during the analyzed period were of type C and 45% of type D, although the type B (16 non-entangling FADs seeded only) was the type preferred by the scientific team. Indeed, most of the crews considered that it would not offer enough surface to drift.

Entanglements

Only a few entanglements have been observed with the new FADs. They have concerned 2 sharks and one barracuda. In this cases, it was noticed that the twisting of the net was insufficiently braided and sewn, therefore leaving some netting with open mesh.

There is however no report of entanglements of sharks and turtles in regular FADs so that no comparison is possible.

Efficiency of the non-entangling FADs

Between the end of December 2010 and June 2012, 124 sets were made on non-entangling FADs (some of them having been revisited). 67 sets (54%) were made on single non-entangling FADs, 57 sets (46%) on non-entangling FADs associated with a disaggregating regular FAD.

92% of the sets made on non-entangling FADs have been made on non-entangling FADs belonging to the fishing vessel.

The average time between the seeding of the non-entangling FAD and the first set made is around 10 weeks for the non-entangling FADs alone instead of less than 4 weeks for a non-entangling FADs associated with an old regular FAD.

In 77% (96) of the sets on non-entangling FADs, the catch was higher than 10 t (which is considered as a profitability threshold by the crew). 78 sets resulted in catch between 10 and 50 t and 18 in catch greater than 50 t. This distribution is very similar to distribution of catch per set of the French fleet over the recent history of the fishery (table 1). The average catch on a non-entangling FAD was of 25.5 t (± 21.9 t) per set. If only the sets made on single non-entangling FAD are considered (37 sets on type D non-entangling FADs and 25 on type C non-entangling FAD), 81% of them resulted in catch greater than 10 t and the average catch per set is 26.5 t (± 22,4 t).

According to the observations, small unbraided sections of recycled ropes attached to the ropes does not appear to affect the “yield” of the FAD (its capacity to aggregate tunas measured by the average catch per set as a proxy) but certainly improve its grip on the currents.

The yield of non-entangling FADs appears very similar to that of regular FADs estimated to 25.2 t/set during the same period (table 1) and the overall average catch rate on log school of 25.0 t/set over the period 2005-2010 (Chassot *et al.*, 2011).

Table 2. Indicators of fishing efficiency of non-entangling and regular FADs

Parameters and indicators	***Non-entangling FADs sets***	***2010-2011 log sets***	***2005-2010 log sets****
Number of observations	124	-	11 832
Average catch per set	25.5 t	-	25.0 t
Number of observations used for Shapiro-Wilk test	67	1349	-
Average catch per set	25.0 t	25.2 t	
%age of sets of <10 t	22.6%	29,8%	25.2%
%age of sets of 10-50 t	62.9%	57,6%	60.6%
%age of sets of >50 t	14.5%	12,6%	14.2%

* including null sets.

Discussion

This program was not a regular scientific program since its purpose was to generalize the use of non-entangling FADs in the French fleet. It was therefore necessary to distribute, discuss and adapt the non-entangling FAD designs proposed by the scientists. This process has allowed the appropriation by fishermen of the objective to develop new FADs and therefore a large cooperation of the crews and the ship-owners. It should be noticed that, as a result of this program, the members of Orthongel have taken the decision that from January 1st, only non-entangling FADs could be seeded by the vessels of the Indian Ocean. In the same spirit, ship-owners continue to request their captains to collect information when seeding or fishing on a non-entangling FAD (forms described in the Methodology chapter).

The effort is now focusing on the constant attention that has to be given to the manufacturing of the non-entangling FADs onboard the vessels. The few entanglements showing that even a small piece of net with open mesh can entangle animals. Orthongel has recently decided to launch a new TCF in continuity of this one, where the manufacturing of (100%) non-entangling FADs in land workshop will be tested and generalized to the fleets in both oceans. The terms of reference of the non-entangling FADs will be reinforced to guarantee the total absence of entanglement risks and the ship-owners (with the agreement of crews already granted) expect to release the crews from having to build the non-entangling FADs at the end of this new phase (end of 2013).

The analyses of the progress realized with this TCF in terms of incidental entanglement of turtles (a source of a small additional mortality due to the purse-seine activity for these fragile populations already heavily impacted by pollution and other gears) was however pondered by the lack of data for the traditional FADs. Therefore, we suggest that observers embarked onboard purse seiners are demanded extra attention to the collect of information concerning these (rare) events whenever a vessel encounters a traditional FAD.

As far as the efficiency of non-entangling FADs, data show that it does not differ from that of regular FADs. Moreover the TCF has convinced the fishermen of that fact which is very important since the appreciation of the efficiency of new FAD designs can be largely subjective.

Acknowledgments

This TCF has benefited from a public financial assistance for collective actions under the FEP program. At its end, the financial involvement of the sector will therefore be of no less than 35%. This program was realized in close cooperation with IRD. Special thank is expressed to the captains and the crews of the French purse seiners who have played fully their role in adapting, innovating and adopting the non-entangling FADs and in collecting data and discussing it during the debriefings at the end of the cruises.

The progress of the program was however unfortunately disturbed by the persistence of piracy in the Indian Ocean and the initial period of one year for the program was extended to two years.

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