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Initiatives to reduce tropical tuna FAD fishery ecological impacts: from traditional to non-entangling and biodegradable FADs

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Initiatives to reduce tropical tuna FAD fishery ecological impacts: from traditional to non-entangling and biodegradable FADs.

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Abstract

Two ecological impacts historically linked with traditional FADs are ghost fishing of sensitive species and marine pollution. Both issues directly relate to FAD design and construction materials, in which in general wide mesh size nylon netting is the principal component. Modifying FAD designs to avoid open large mesh and using non-synthetic degradable materials can help solving these problems. In the early 2010's the Spanish purse seine fleet began to replace entangling FADs by non-entangling FADs. This process has occurred within the frame of the Code of Good Practices, a self-imposed voluntary agreement to adopt best available sustainable fishing practices by the Spanish fleet covering over 65 super-seiners operating in the Indian, Atlantic, Western and Central Pacific and Eastern Pacific Oceans. Compliance has been monitored since late 2014 by interviews first and by observers and data revised by an independent scientific body, AZTI. In the first two years of the program, over 600 fishing trips and 37879 FADs have been examined showing that the majority of FADs are completely non-entangling (NEFADs). This document also updates on the use of NEFADs by other fleets across the world. The next step is to find suitable biodegradable FAD materials to prevent marine pollution caused by lost FADs. For this purpose, the EU funded BIOFAD project soon will embark in an Indian Ocean trial where 1000 biodegradable FADs will be deployed and monitored over the next two-years by the Spanish and French fleet.

Introduction

Tropical tuna purse seine fishing is one of the most important fisheries in the world, reaching 3 million tons in recent years. Because pelagic species aggregate around floating objects in the tropical oceans, about half of these catches rely on fish aggregating device (FAD) sets. Despite being very effective fishing tools, FADs also have potential impacts on the ecosystem, including, but not limited to, ghost fishing of sensitive species (e.g. sharks, turtles) and marine debris. Both issues directly relate to FAD design and construction materials, in which wide mesh size nylon netting has been using as the principal component. Modifying FAD designs to avoid open large mesh and using non-synthetic degradable materials can help solving these problems. In order to decrease impacts and improve the long-term sustainability of the fishery, the two Spanish tuna purse seiner associations, ANABAC and OPAGAC, established in 2012 a voluntary agreement for the application of good practices for responsible tuna fishing activities. The aim of this agreement is to use best fishing practices by reducing mortality of incidental catch of sensitive species and the use of non-entangling FADs (NEFADs; FADs with lower entangling potential, as constructed with no netting, or using tied up or small mesh netting).The Spanish purse seine fleet voluntary started to progressively replace conventional higher potential risk entangling FADs by NEFADs since 2012 and compliance has been monitored since late 2014 by interviews first and by observers and data revised by the independent scientific organization AZTI. However, the implementation and use of NEFADs by the different fleets worldwide show significant differences (see section “NEFAD adoption by other fleets” for details).

On the other side, using NEFADs constructed with biodegradable natural materials (BIOFAD) would help reducing the marine debris when FADs are lost, sink or some components are discarded. Despite several small-scale initiatives being conducted by EU fishing companies in this field (Franco et al., 2009; Franco et al., 2012; Goujon et al., 2012; Lopez et al., 2016; Moreno et al., 2016), no large-scale experiment has been conducted up to date, which prevents reaching significant conclusions on their efficiency and long-term material degradation in real conditions. In this context, the EU commission, with the participation of the EU fleet, research organizations, and International Seafood Sustainability Foundation (ISSF) will launch a two-year project to test and assess BIOFAD designs and materials at large-scale, starting in July 2017.

This document updates on the use of NEFADs by fleets across the world and provides guidelines and information on the new EU BIOFAD initiative investigating and promoting the use of biodegradable NEFADs.

NEFAD verification for the Code of Good Practices

The Code of Good Practices, a voluntary agreement between the Spanish purse seine associations OPAGAC and ANABAC, established in 2012, among other requirements (see Lopez et al. (2017b) for details), that all associated companies should progressively change from traditional higher risk entangling FADs (i.e., conventional FADs) to NEFADs. The Spanish fleet operates globally in 4 tuna convention areas (ICCAT, IOTC, WCPFC, and IATTC) and covers about 65 large-scale purse seiners. To monitor and evaluate compliance levels with this and other conservation measures, a verification system has been implemented since late 2014 by AZTI that monitors and assess purse seine and supply vessels activity using either trained scientific observers or, more recently, electronic monitoring systems (Goñi et al., 2015; Ruiz et al., 2015). Specific data-collection forms recording details of design and construction materials for the raft and the underwater part of each FAD used during the fishing trips have been developed and used since 2015 by the program. In the first two years monitored by the program (2015-2016) data for more than 600 fishing trips in the Atlantic, Indian and Pacific Oceans was analyzed. Although trials were conducted to include specific observer forms in the Pacific Ocean, their use was not finally established in the region. However, the successful collaboration with IATTC and WCFPC permitted to obtain data of vessels operating under its observer programs, which included certain relevant information on FAD structure and materials.

A total of 37879 FADs have been analyzed for FAD structure and components (e.g. mesh size, construction materials, etc.) (Table 1). FADs are ranked in 6 categories according to their entangling potential, being index 1 completely non-entangling (both raft and underwater part with no entangling components or structures) and index 6 FADs with higher risk of entangling potential (FADs with potential entangling components or structure in both the raft and the underwater part).

Table 1. Summary of the number FADs evaluated in the 2015-2016 period.

	FADs
Atlantic Ocean	22532
Indian Ocean	6475
Pacific Ocean	8872
Total	37879

The number of FADs for which information was collected in the Atlantic Ocean and their entangling degree are shown in Table 1 and Figure 1. Vessels used about 50-200 FADs in each fishing trip in this area, only considering FADs left at sea. As it can be seen in Fig. 1, the degree of entanglement has been decreasing with time and today most FADs are totally non-entangling (Fig. 3; index 1). The major non-conformity in the construction is the use of non-permitted material in the upper part of the raft. Currently, there are very few FADs that present both raft and underwater part with non-conformity components (Index 6, Fig. 1). It is worth noting that the number of FADs for which total conformity cannot be evaluated appears to be important (~35%), as fishers not always lift FADs out of the water to check all the structures of the FADs encountered at sea. However, the analysis in the verification system can reflect vessel-specific behaviors and suggest changes where necessary.

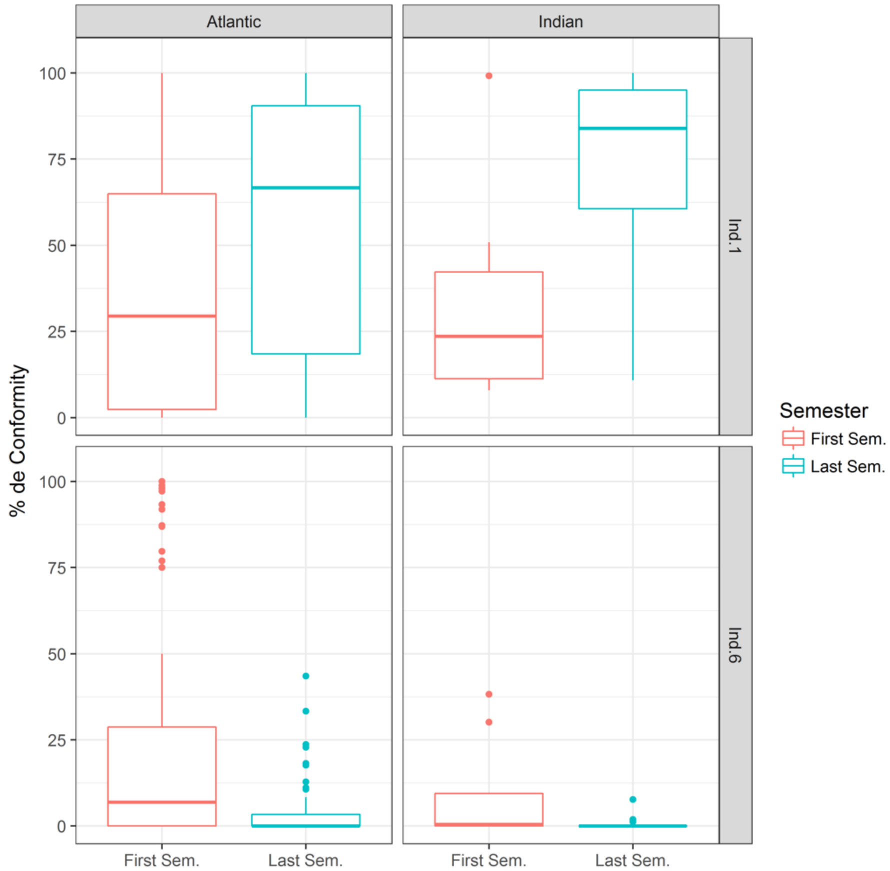

Figure 1. Evolution of the Index 1 (totally conform) and Index 6 (raft and underwater part non-conform) FAD categories in the Atlantic and Indian Oceans during the first years of the program (re-scaled with no consideration of unknowns [~35% of observations]). “First Sem.” corresponds to the first semester of 2015 whereas “Last Sem.” corresponds to the last semester of 2016.

In the Indian Ocean, the number of FADs used and analyzed for each fishing trip and vessel ranged between ~50 and 300 units. Similarly to the Atlantic Ocean, FADs that are completely in non-conformity have almost disappeared (Fig. 3; Index 6), and the main issue is again related to the material used to cover the upper part of the raft (i.e. netting wrapping the raft). It is also interesting to note that the percentage of totally NEFADs used has increased considerably through time (Fig. 3; index 1). As in the Atlantic, there is a significant part of the FADs that cannot be completely evaluated, as certain parts of the FADs were not observed or recorded by the observer (~30%). As such, future efforts may be conducted to try to lift all FADs that are encountered at sea. This improvement would assist to better understand the deterioration of the underwater part of the FADs through time as well as assess their progressive entangling potential.

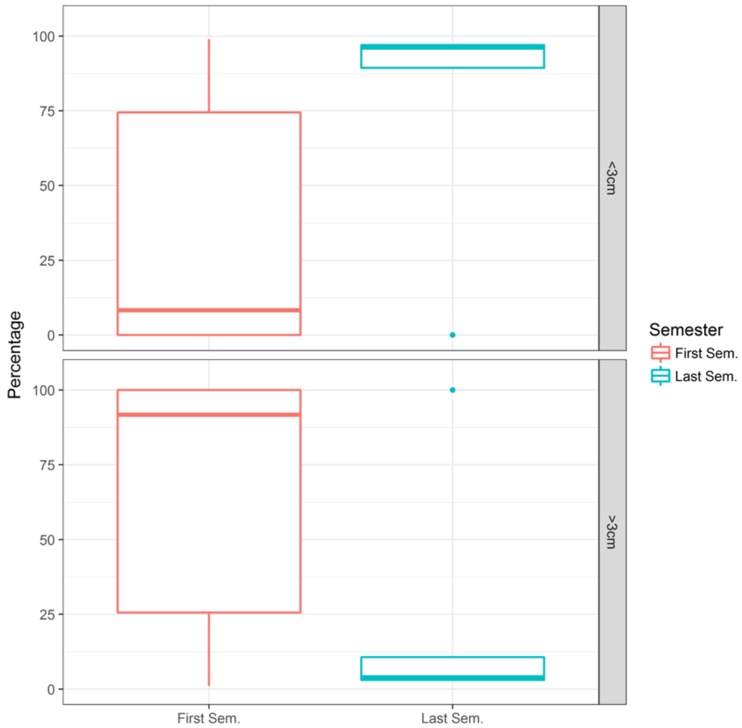

Figure 2. Evolution of the FAD underwater part mesh size categories (<3cm or >3cm) in the Pacific Ocean during the first years of the program (re-scaled with no consideration of unknowns [6.9% of the observations]). "First Sem." corresponds to the first semester of 2015 whereas "Last Sem." corresponds to the last semester of 2016.

In the Pacific Ocean, the number of FADs observed and analyzed for each fishing trip was 25-250. The data collected by observers in this region has no information on the mesh size used to construct the FAD's raft. However, the data does contain information on the mesh size used in the underwater part of the floating object but not on its structure (i.e., if the net is tied in coils or "sausages"). Because of this, the analysis conducted for this region was not identical to that applied in the Indian and Atlantic Oceans. Figure 2 shows the evolution and use of the different mesh size nets (< 3 cm; > 3 cm) to construct the underwater part of FADs by the Spanish fleet. However, the ways nets are structured to construct the underwater parts are unknown, so the entangling potential cannot be accurately assessed for all FADs and thus, results are just descriptive. However, it can be clearly noted that the use of nets with mesh size > 3 cm is currently very rare (Fig. 2).

In general, there are currently very few FADs with high-risk entanglement traits in both raft and tail (Index 6). The principal reason for a portion of FADs not falling within the NEFAD category is because Spanish fishers often wrap around the bamboo raft with > 3 cm mesh purse seine netting to improve structural integrity. A canvas cover usually is laid on top of the raft to prevent exposure of this net, but not on the underside of the raft. It is worth noting that reported turtle and shark entanglement rates have been extremely low (<0.1%; Lopez et al. (2017a)). The progress in the implementation of NEFADs by the Spanish fleet since 2012 to now has been rapid and sustained. A very important aspect of this change to NEFADs is that the Spanish fleet, with a high component of their annual catches coming from FAD sets, has not observed since switching from conventional to NEFADs any decrease in their average catch in any of the oceanic regions, whereas first estimates of entanglement rates observed for sharks and turtles have been extremely low.

NEFAD adoption by other fleets

Since 2009 the International Seafood Sustainability Foundation (ISSF) has been organizing bycatch reduction workshops with tuna purse seine fleets (referred to as "Skippers' Workshops"). Over 2000 fishers and key stakeholders from more than 25 flags from the four tropical tuna regions have participated. In these workshops discussions on NEFADs and biodegradable FADs is an important element of the agenda. Since 2015, 308 anonymous questionnaires with specific questions on FAD entanglement characteristics and materials have been completed by captains from 8 fleets at workshops (Table 2). In other Skippers' Workshops no questionnaires were collected (e.g. China, Taiwan, Indonesia, South Korea) but open discussion with fleet managers and captains clearly indicated what kind of FADs they are using. This information has also been corroborated by numerous visits to key ports of the Indian, Atlantic and Pacific Oceans (e.g., Seychelles, Tema, Jakarta, Bitung, Majuro, Pohnpei, Manta, etc.).

Thanks to information provided by captains from consulted fleets it can be gathered that the use of NEFADs is almost total in the Atlantic and Indian Ocean, where purse seiners belong majorly to the EU fleets (i.e., Spanish and French) (Table 3). Meanwhile, in the Eastern Pacific the use of NEFADs is almost complete in some fleets like the Mexican and Peruvian because they construct FADs with very small mesh netting from reused Medina panel and anchoveta seine net, respectively. In Ecuador, which is the principal fleet in the Eastern Pacific, use of NEFAD has rapidly increased in recent times, with over half of consulted captains answering they use this kind of FAD. Note many OPAGAC vessels, which are members of the Code of Good Practices operate in IATTC waters.

Table 2. Number of ISSF Skippers Workshops questionnaires on types of FADs completed by fleet between 2015 and 2017.

Fleet	No. Questionnaires
Spain	122
Ecuador	164
Ghana	30
French	20
South Korea	10
Peru	7
USA	5
Mexico	4

Table 3. Use of DFAD type by fleet according to entanglement characteristics. Source: ISSF Skippers' Workshop fishing master and captain questionnaires. Highest Entanglement Risk FAD (HERFAD); Non-entanglement FAD (NEFAD). Oceanic regions: Eastern Pacific Ocean (EPO), Western and Central Pacific Ocean (WCPO), Indian Ocean (IND) and Atlantic Ocean (ATL). *The Indonesian fleet uses anchored FADs, the rest of fleets drifting FADs.

Fleet	Ocean Presence	HERFAD (%)	NEFAD (%)
Ecuador	EPO	39	61
Peru	EPO	0	100
Mexico	EPO	0	100
Spain	EPO, IO, AO	3	97
USA	EPO, WCPO	100	0
Korea	WCPO	100	0
Taiwan	WCPO	100	0
China	WCPO	100	0
Indonesia*	WCPO, IO	0	100
France	IO, AO	0	100
Ghana	AO	0	100

In the Western and Central Pacific Ocean fleets fishing on anchored FADs use no netting in their construction, thus are considered totally NEFADs. Many of these fleets like Indonesia and Philippines operate with mostly small and medium scale vessels (< 100 GT). Although some super-seiners from the Philippines and Papua New Guinea fish on non-meshing anchored FADs as well.

Note however, that the number of drifting FADs in the Western and Central Pacific is much higher, four to five times, that of anchored FADs (Scott and Lopez, 2014). Based on feedback from captains from key fleets in this region such as China, Taiwan, South Korea, USA, there is no use of drifting NEFADs at present. In fact, most fleets utilize a similar drifting FAD design, with 4-5-inch mesh netting wrapping the corks of the float and open netting with colored streamers hanging down to 40-70 meters in the underwater appendage. This kind of FAD was recently observed on numerous boats from various flags while conducting port visits at Majuro and Pohnpei.

The ICCAT, IOTC and IATTC have approved resolutions encouraging or requiring the use of NEFADs, this has provided an incentive for fishing companies to try and implement their use. The WCPFC remains the only tropical tuna RFMO which has not officially endorsed NEFADs yet. Many Western and Central Pacific consulted captains in workshops would be willing to try NEFADs if these aggregated tunas in a similar way to traditional higher entanglement risk drifting FADs. As NEFADs have worked in the Eastern Pacific, Indian and Atlantic Oceans it is reasonable to think they would also be efficient in other regions, such as the WCPO. In fact, some OPAGAC boats have successfully worked in the WCPO region using NEFADs.

Going further: the BIOFAD project

There is growing concern about marine debris generated by lost FADs constructed with long lasting synthetic materials such as plastic, nylon, metals or PVC. Some FADs can end up stranded in ecologically sensitive zones such as coral reefs, beaches and mangroves (Balderson and Martin, 2015; Maufroy et al., 2015). To prevent this impact the use of FADs constructed with natural biodegradable materials such as bamboo, balsa wood, cotton or jute has been proposed by the scientific community. The idea is to have functional biodegradable NEFADs that effectively serves for fishing purposes for about a year (depending on the ocean) and after this time breakdown and decompose without generating pollutants or negative impacts on coastal sensitive habitats.

Small scale trials with BIOFAD prototypes and materials by some companies and boats have shown promising results on the capability of these FADs to aggregate tuna (Franco et al., 2009; Franco et al., 2012; Goujon et al., 2012; Lopez et al., 2016; Moreno et al., 2016), but larger scale testing in natural environmental conditions is required to achieve significant results and advance faster and in a more effective way towards suitable materials and designs. A new EU project called BIOFAD, with aid from ISSF for supply of biodegradable construction materials, will test for 21 months biodegradable NEFADs in the Western Indian Ocean. Around 1000 BIOFADs (and paired 1000 conventional NEFADs for comparison) will be deployed and monitored by the entire Spanish (OPAGAC and ANABAC) and French (ORTHONGEL) fleets, which make up the majority of tuna purse seiners operating in this region (i.e, 39 EU purse seine vessel are operating in the area, assisted by 19 supply vessels). The project will test 3-4 different biodegradable FAD designs, which are mostly constructed out of biodegradable materials (except for flotation devices like corks and weight like metallic ring, for which a specific task is also being considered to develop them with biodegradable materials). Information on biodegradable NEFAD trajectory values (e.g., speed, direction), tuna aggregation capability, or rate of decomposition of materials will be monitored throughout the experiment using a specific form and logbook and information of echo-sounder buoys. The data collection and analysis protocols have been designed by EU research organizations AZTI, IEO, IRD and with the help of ISSF expertise in the field, following the specific requirements and needs of EU Commission. First results of the project are expected to be available by late 2018, as the first biodegradable NEFAD deployments are planned for late 2017 or early 2018, as soon as selected biodegradable materials are available for the fleet.

REFERENCES

Balderson, S., Martin, L., 2015. Environmental impacts and causation of 'beached'Drifting Fish Aggregating Devices around Seychelles Islands: a preliminary report on data collected by Island Conservation Society. IOTC–2015–WPEB11–39.

Franco, J., Dagorn, L., Sancristobal, I., Moreno, G., 2009. Design of ecological FADs. IOTC-2009-WPEB-16.

Franco, J., Moreno, G., Lopez, J., Sancristobal, I., 2012. TESTING NEW DESIGNS OF DRIFTING FISH AGGREGATING DEVICE (DFAD) IN THE EASTERN ATLANTIC TO REDUCE TURTLE AND SHARK MORTALITY. Collect. Vol. Sci. Pap. ICCAT 68, 1754-1762.

Goñi, N., Ruiz, J., Murua, H., Santiago, J., Krug, I., Sotillo de Olano, B., Gonzalez de Zarate, A., Moreno, G., Murua, J., 2015. System of verification of the code of good practices on board ANABAC and OPAGAC tuna purse seiners and preliminary results for the Atlantic Ocean. IOTC–2015–WPEB11–INF09.

Goujon, M., Vernet, A.L., Dagorn, L., 2012. Preliminary results of the Orthongel program "eco-FAD" as June 30th 2012 IOTC–2012–WPEB08–INF21

Lopez, J., Ferarios, J., Santiago, J., Alvarez, O., Moreno, G., Murua, H., 2016. Evaluating potential biodegradable twines for use in the tropical tuna fishery. SAC-07-INF-C(h)-BIOFAD.

Lopez, J., Goñi, N., Arregi, I., Ruiz, J., Krug, I., Murua, H., Murua, J., Santiago, J., 2017a. Main results of the Spanish Best Practices program: evolution of the use of Non-entangling FADs, interaction with entangled animals, and fauna release operations. IOTC–2017–WGFAD01–11.

Lopez, J., Goñi, N., Arregi, I., Ruiz, J., Krug, I., Murua, H., Murua, J., Santiago, J., 2017b. Taking another step forward: system of verification of the code of good practices in the Spanish tropical tuna purse seiner fleet operating in the Atlantic, Indian and Pacific Oceans. IOTC–2017–WGFAD01–12.

Maufroy, A., Chassot, E., Joo, R., Kaplan, D.M., 2015. Large-Scale Examination of Spatio-Temporal Patterns of Drifting Fish Aggregating Devices (dFADs) from Tropical Tuna Fisheries of the Indian and Atlantic Oceans. PLoS ONE 10, e0128023.

Moreno, G., Restrepo, V., Dagorn, L., Hall, M., Murua, J., Sancristobal, I., Grande, M., Le Couls, S., Santiago, J., 2016. Workshop on the Use of Biodegradable Fish Aggregating Devices (FADs). ISSF 2016-18A.

Ruiz, J., Batty, A., Chavance, P., McElderry, H., Restrepo, V., Sharples, P., Santos, J., Urtizberea, A., 2015. Electronic monitoring trials on in the tropical tuna purse-seine fishery. ICES Journal of Marine Science 72, 1201-1213.

Scott, G.P., Lopez, J., 2014. The use of FADs in tuna fisheries. European Parliament. Policy Department B: Structural and Cohesion Policies: Fisheries IP/B/PECH/IC/2013-123, 70p.