Preliminary results of the BIOFAD project: testing designs and identify options to mitigate impacts of drifting Fish Aggregating Devices on the ecosystem

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Summary

The EU project BIOFAD was launched in August 2017. This 28-months EU project is coordinated by a Consortium comprising three European research centers: AZTI, IRD (Institut de recherche pour le développement) and IEO (Instituto Español de Oceanografía). The International Seafood Sustainability Foundation (ISSF) is also actively collaborating by providing the biodegradable materials needed to test biodegradable dFADs (drifting FADs). Following IOTC, along with other tuna RFMOs, recommendations and resolutions to promote the use of natural or biodegradable materials for dFADs, this project is seeking to develop and implement the use of dFADs with both characteristics, non-entangling and biodegradable, in the IOTC Convention Area. However, there are no technical guidelines on the type of materials and FAD designs to be used. The main objectives of the project are: (1) to test the use of specific biodegradable materials and designs for the construction of dFADs in real fishing conditions; (2) to identify options to mitigate dFADs impacts on the ecosystem; and (3) to assess the socio-economic viability of the use of biodegradable dFADs in the purse seine tropical tuna fishery. This document shows the preliminary results regarding the effectiveness of around 560 BIOFADs deployed, in terms of tuna aggregation, drift, materials' durability, etc. in comparison to currently deployed NEFADs (non-entangling dFADs). The project BIOFAD has counted since its inception with the support of the whole EU purse seine tuna fishery and, more recently, with the collaboration of the Korean purse seine fleet.

Introduction

In the last decade, efforts have been focused to eliminate the entangling characteristics of drifting Fish Aggregating Devices (dFADs), to minimize their negative impacts on sensitive and other associated non-target species (Murua et al. 2016). However, most of those non-entangling dFADs are made of non-biodegradable materials which result in an increase of marine litter (Dagorn et al., 2013) and other potential negative impacts for the ecosystem (Maufroy et al., 2015). The European agencies have promoted Policies and Directives seeking environmentally friendly fishing methods to minimize the habitat destruction and the introduction of any litter into the marine environment. Similarly, several recommendations and resolutions have been adopted by tRFMOs (tuna-Regional Fisheries Management Organizations) to replace existing dFADs with NEFADs and to undertake research on biodegradable dFADs (IATTC 2016; ICCAT, 2016; IOTC, 2018). Yet, the implementation of BIOFADs (i.e. non-entangling and biodegradable) requires further investigation to solve technical aspects for their operationalization in real conditions. The Consortium, formed by AZTI, IRD and IEO, launched the European project BIOFAD (SC07 EASME/EMFF/2016/008) in August 2017, addressing the problematic associated to the current materials used for dFADs construction. This 28-month project aims to provide solutions that shall support the implementation of BIOFADs by testing specific biodegradable materials and designs in real environmental conditions. The study will provide criteria and guidelines to identify options to mitigate dFADs impacts on the ecosystem, assessing their feasibility in terms of performance (e.g., lifetime, durability) and efficiency (e.g., aggregation of tuna and non-tuna species) in comparison with current NEFADs. It will also appraise the socio-economic viability of BIOFADs in the purse seine tropical tuna fishery in the Indian Ocean. The Consortium counts with the active collaboration of the International Seafood Sustainability Foundation (ISSF), the EU purse seine tropical tuna fishery, Korean fleet, Seychelles Fishing Authority (SFA) and IOTC.

Material and Methods

A large-scale experiment with the deployment of approximately 1000 BIOFADs has been planned. BIOFADs are deployed in pairs along with 1000 currently used NEFADs for comparison purposes. The deployment will last 15 months (up to June 2019) to cover possible seasonality effects. In total, 44 purse seine vessels are participating with the deployment of 24 BIOFADs each (6 BIOFADs by trimester). The methodology used for BIOFAD construction, selected biodegradable materials, prototypes, BIOFAD deployment strategy, comparison with NEFADs, as well as BIOFAD monitoring, data collection and reporting were defined by the Consortium and the collaborators (Zudaire et al., 2017). Prototypes were designed based on previously identified designs in the Indian Ocean (Moreno et al., 2016) and covering fishermen's requirements for dFADs construction (Fig.1). Details regarding materials, dimensions and construction of these prototypes are provided in Zudaire et al. (2017). Traceability of BIOFADs is ensured during their entire life-cycle through a dFAD identification system. Besides, all activity information (e.g., new deployment, visit, buoy exchange, set, etc.) related to these dFADs is reported by the fleet and collected by observers onboard. Information regarding BIOFAD and NEFAD's components degradation status is also being gathered (Zudaire et al., 2017).

Results and Discussion

To date, **560 BIOFADs have been deployed**, representing 56% of the final deployment goal. By prototypes, 81% of deployments corresponded to A1, 12% to A2, 5% to B1 and 3% to C1 (Fig.1). Different patterns of **drifts** were observed by FAD pairs (i.e., pairs following totally different drifts, pairs following partly similar drifts and pairs following same patterns). The assessment of the **quality status of each biodegradable component** (i.e., cotton canvas, and two type of cotton ropes) showed significant degradation of the cotton canvas during the first month at sea which kept large in the second and third months at sea, when more than 50% of the observations classified the cotton canvas as "bad", "very bad" or "absent". In contrast, the degradation of the two cotton ropes was less pronounced. Both ropes types were classified as "good" or "very good" until the fourth month at sea. The efficiency of BIOFADs in terms of aggregating tuna was compared with NEFADs through **catch and echo-sounder buoy data**. In total, 40 sets were identified (20 to BIOFADs and 20 to pairing NEFADs) with mean catch values of 40.7t and 46.8t for BIOFADs and NEFADs, respectively. No significant differences in catch values between FAD types were found. **Tuna colonization time and lifetime of the aggregation** was assessed by FAD pairs deployed together (BIOFAD and NEFAD). The preliminary results showed that NEFADs were colonized faster (in days) (Fig.2). Considering FADs with at least 30 days after deployment and a maximum distance of 500 km between pairs, we also observed that in 15% of cases both FAD types did not show any presence of tuna, in 61% of cases both FAD types had presence of tuna, in 20% only NEFADs had presence of tuna and in 3.3% of the cases only BIOFAD were colonized. In terms of proportion of time the FADs stay colonized in relation to the duration of its trajectory, higher proportions were observed in NEFADs when the distance between pairs was lower. This proportion tended to be equal when the distance between pairs was higher than 250 Km. In terms of **tuna biomass** estimated from the acoustic energy obtained from the echosounders, NEFADs were found to have higher biomass than BIOFADs, however the estimated values were relatively low for both FAD types (Fig.3). A peak in the biomass was observed for both types around the week 22 after deployment. In the future, life-cycle analysis and socio-economic analysis will be conducted to provide data on BIOFAD impacts and feasibility.

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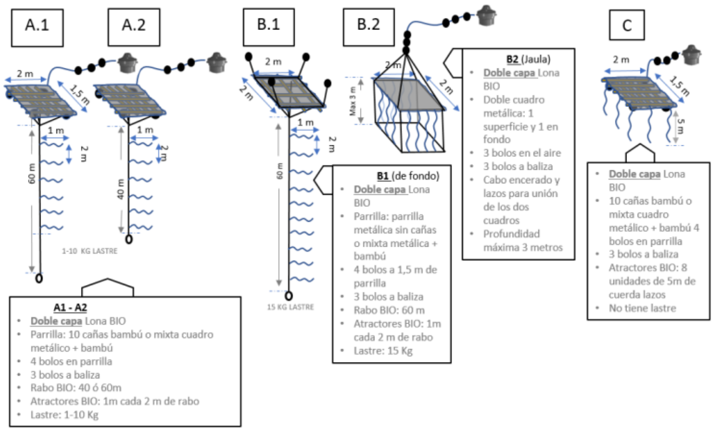

FIGURE 1. Prototypes designed during the workshop. Details of materials and dimensions are given for each prototype.

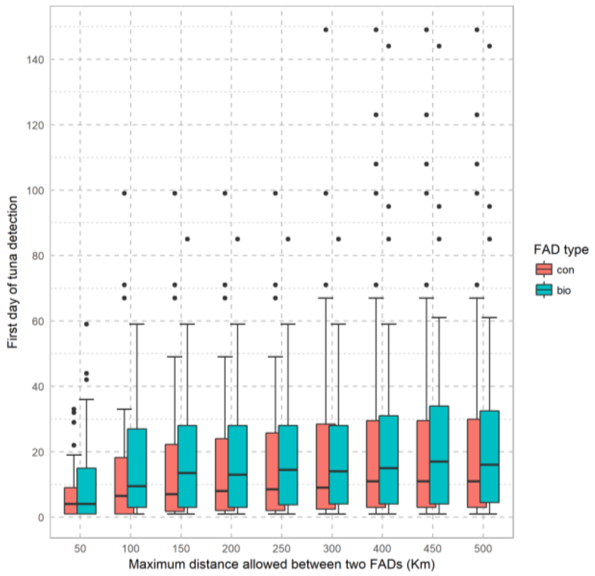

FIGURE 2. First day of tuna detection by type of FADs and by range of distance between pairs.

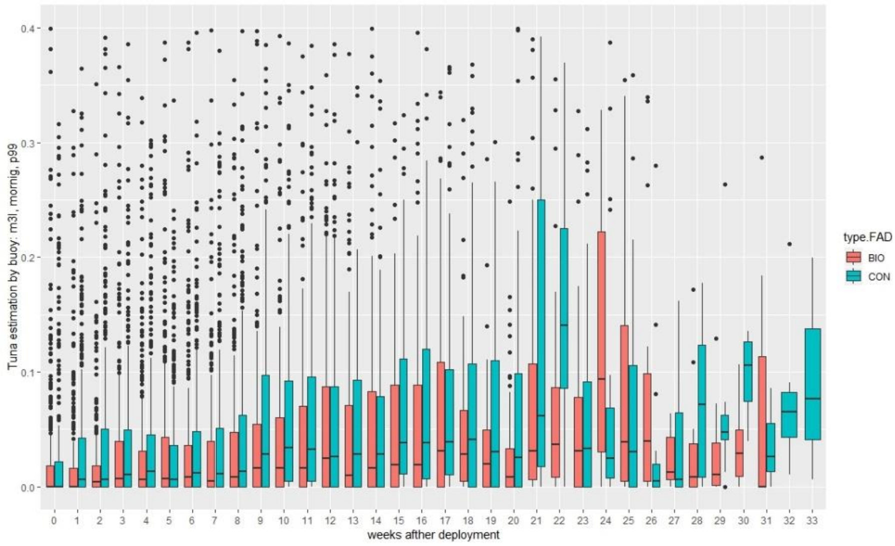

FIGURE 3. Tuna estimation by FAD type and by group of weeks since first deployment.