The Use of Instrumented Buoys to Monitor the Activity of the Purse Seine Fleet on FADs

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SUMMARY

In response to the increasing use of FADs in the purse seiner tropical tuna fishing, legal binding measures have been implemented by RFMOs to limit the number of FADs used by vessel. Broad terminology referred to buoys and FADs use is included in different management measures which should be standardized among RFMOs and precisely defined to avoid subjectivity on the interpretation and harmonize the verification system. To provide detailed definitions and consistent with the buoy use and dynamics, and to clarify and facilitate the monitoring of the number of FADs used by a vessel or a fleet among RFMOs, the buoy dynamic is described and detailed definition for terms used by RFMOs are proposed.

KEYWORDS: FADs, instrumented buoys, purse seiner, tropical tuna

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1. Introduction

Since the introduction of man-made fish aggregating devices (FADs) in the purse seiner tuna fishery and the development of the technology attached (i.e. echosounder buoys with GPS) (Lopez et al., 2014), the fishery has evolved increasing the effort on FAD fishing, which has contributed to the total catch increase (Fonteneau et al., 2013). Currently purse seiners account for the 75% of the total tuna catches. The use of FADs has increased over the last years (Fonteneau et al., 2013; Scott and Lopez, 2014; Maufroy et al., 2017) and nowadays FAD fishing overall has surpassed free-swimming school fishing worldwide (Scott and Lopez, 2014; Fonteneau et al., 2013).

This evolution has raised concerns about potential impacts of the increasing use of FADs on target species, non-target and vulnerable species and the marine ecosystem (i.e. pelagic and vulnerable coastal areas) (Dagorn et al. 2012, Maufroy et al., 2015; Davies et al., 2017). Also, the increasing fishing efficiency has altered the relationship between catch per unit effort (CPUE) and abundance, breaking the link between searching time and effective fishing effort for FAD sets (Fonteneau et al., 2013; Torres-Irineo et al., 2014), and potentially impacting the diagnostics of abundance and associated management advice (Gaertner et al., 2016).

FADs are nowadays deployed with GPS geolocated buoys which make possible the continuous tracking of the FAD. The transmission rate and type of information received by skippers depends on the buoy brand, model and user. The skippers or fleet owners choose the best fishing option, and so, during the last decades geolocated echosounder buoys have replaced gradually the radio and non-echosounder devices (Lopez et al., 2014). Thus, information of the biomass aggregated underneath the FADs is generally available for skippers. These devices represent one of the mayor technological improvements for this fishery and have become essential for determining the fishing strategy (Baske et al. 2012; Lopez et al., 2014), but also are valuable tools for management bodies which have integrated them in the FAD use control and management systems.

Despite increasing FAD use and concerns, little information is available regarding FAD[9] use worldwide, which is necessary for appropriate impact monitoring and management. As such, Tuna Regional Fisheries Management Organizations (RFMOs) have called for FAD management plans, including data collection on deployment and use of FADs by purse seiners and supply vessels; have strengthened the data reporting requirements on FAD to CPCs and have attempted to limit the use of FADs by regulating the number of active buoys at sea (IOTC: Res. 17-08, Res 15/02; ICCAT: Rec 16-01, Rec 13-01; IATTC: C-16-01, C-17-02 ; WCPFC: CMM-17-01). In these binding measures, terms referred to buoy and FAD use are included but are not precisely defined which can lead to ambiguity and subjectivity in interpretation. While these terms are used worldwide the meaning could differ among actors (i.e. buoy providers, users, researchers or managements bodies) and context. During the last years a glossary of terms has been proposed regarding to FAD and buoy use (Gaertner et al., 2016; Hampton et al., 2017). Following that approach, this work aims to describe the buoy dynamics and uses and provide detailed terminology to contribute to develop standardized language and definitions in line with buoy life cycle and uses, to improve and harmonize data collection and support consistent interpretation of what conservation and management measures intend to achieve across ocean basins.

2. The life cycle of the instrumented buoys on drifting FADs

Figures 1 and 2 illustrate the life cycle of a buoy during FAD fishing. Buoys in stock are registered with a unique identifier printed on a visible place, which is composed by an alphanumeric code given by the model and a serial number (Gillman, 2018; He and Suuronen, 2018). Buoys are provided deactivated to vessels (i.e. purse seiner or supply vessel). Once the buoys are received the user requests the activation to the buoy provider company. From then on, the vessel starts paying communication services. Once the buoy is activated, to switch it on and allow satellite connection, a magnet must be added by the user and so a physical contact with the buoy is required. This action generally occurs onboard the vessel or on land. However, in some cases, the buoy supplier has also the option of activating the satellite connection when required (e.g. deactivated drifting buoys

[9] The term FAD refers more properly to FOB (floating object) that can be either a FAD or a log.

at sea). To avoid activation of drifting buoys (i.e. switching on deactivated or “sleeping” buoys) the IOTC, IATTC and WCPFC included a specific clause in Res 17/08, C-17-02 and CMM-17-01 respectively, requiring that the buoy activation must occur on board.

Usually the buoys are switched on onboard to be tested before the sea deployment (Fig. 2). As such, when the buoy is turned on by means of a magnet it transmits at short intervals for a limited time. This test can be followed by a buoy deployment (on a deployed FAD or a floating object (FOB) in the water), or the user can turn it off again with the magnet for a later deployment. Once the buoys are activated and switched on, they start transmitting positions to the users, who should have access to internet connection via ADSL or data connection through a satellite type terminal for GPS echosounder buoys. The transmission intervals depend on the brand and model but can be adjusted by the user, who can set them depending on the interest in a particular buoy (e.g. given the proximity to the buoy or aggregation size underneath the FAD). Generally, the owner is the one receiving the information, but it could be shared with as many users as wanted.

Once at sea, the buoy starts computing as an active buoy for the owner as indicated in Res. 17-08 (IOTC); Rec 16-01 (ICCAT); C-17-02 (IATTC); CMM-01 (WCPFC). The buoy and the FAD to which it is attached are tracked by the user, who can follow the global positioning devices on the buoys via satellite as they drift across the ocean surface. If the buoy is equipped with an echosounder, the user also receives biomass estimations underneath the FAD which are displayed as images to the vessel. The frequency and reliability of the records depend on the brand and model (Lopez et al., 2014). The technology is quickly developing, for example, buoys have moved from operating with one frequency and restricted number of soundings per day (e.g. before dawn, at dawn, after dawn), to work with a second frequency for species and size-class discrimination and improved sampling by a higher frequency sounding. This provides the skipper with more and better-quality information on the aggregation. During the FAD’s life at sea, the user can operate with the FAD and buoy as described in CECOFAD (Gaertner et al., 2016) and Figures 1 and 2. When referring to buoys, the following activities were described: (i) Tagging (deployment of a buoy on a FOB, including deploying a buoy on a foreign FOB, transferring a buoy changing the FOB owner, and changing the buoy on the same FOB without changing the FOB owner); (ii) Remove buoy (retrieval of the buoy equipping the FOB) (Gaertner et al., 2016). Those are illustrated in the Figure 1 and 2. If a buoy is retrieved onboard, an at-vessel period is registered where the buoy could continue transmitting, unless it is switched off with a magnet or by a deactivation request, usually occurring when the buoy is stolen by another user (Fig 1 and Fig 2). The deactivation can also be the result of accidental loss of transmission (e.g. after sinking or a technological error) or due to drifting of the buoy outside the fishing area or unintended beaching episodes in coastal areas. When deactivated, the owner stops paying transmission fees and those buoys exit the buoy control mechanism. Some deactivated buoys can reenter again in the system as they could be recovered at port, as in some cases recovered buoys at sea are exchanged by the users, or at water.

3. RFMOs statements for the regulation on the use of FADs

RFMOs have established different limitations on the use of FADs and/or attached instrumented buoys. The IOTC in Res. 17/08 (which superseded Res. 15/08 and Res. 16/01), set the number of active instrumented buoys followed or operated by any purse seine vessel at any one time. The IATTC, in C-17-02 refers to active FADs tracked by the vessel, its owner or operator, while the WCPFC in CMM.17-01 refers to FADs with activated instrumented buoys deployed at any one time (CMM.17-01). In this line, ICCAT refers to the number of FADs (with or without instrumented buoys) in relation to each owner vessel. The IOTC defined the calculation method as the number of active buoys operated by a purse seine vessel, proposing the telecommunication bills as a verification tool.

These limits refer to active FADs tracked or active instrumented buoys, which implies that the number of FADs should be evaluated through the number of active instrumented buoys attached to FADs. This is how the verification is being conducted in the case of the EU and other fleets (Santiago et al., 2017) and in the IATTC (https://www.iattc.org/Downloads/Documents/FAD-WG-Guidance-on-FAD-reporting.pdf). However, the requirement of deploying a FAD with a buoy is not explicit in the legal binding documents and, thus, FADs without buoys would be beyond the scope of this rule and remain out of the verification system. In addition, the terminology used to establish obligations is ambiguous and specific definitions are not always provided, leaving space for a wide range of, and in some cases not very clear, interpretations (Table 1). Table 1 gathers terms that are used to regulate FAD and buoy use and includes for each case the definitions extracted from the management measures currently in place in the different RFMOs. For example, in the case of the IOTC the distinction between activated and active buoy is ambiguous; while activation should be the action and active or activated, the state, following the buoy mechanism. In terms of established control mechanism, those terms do not refer to the same, as the activated buoy is not active until it has not been deployed. In addition, for compliance verification IOTC refers to buoys followed or operated, proposing the telecommunications bills as the verification tool, which are generally issued on behalf of the owner of the buoy by the buoy supplier.

4. Definition of terms for a harmonization among RFMOs

To provide detailed definitions and consistent with the buoy mechanism, use and dynamics, and to clarify and facilitate the monitoring of the number of FADs used by a vessel or a fleet among RFMOs, in the following section definitions for terms used by RFMOs are proposed. Definitions were elaborated by the authors following those proposed by Grande et al. (2018) in the context of a small working group that met during the ICCAT SCRS 2018 meeting. These definitions were finally adopted by the ICCAT SCRS.

- **Buoy (also GPS Buoy or instrumented buoy)**: A buoy is a signal device used to indicate a geographical position. Drifting FADs can be equipped with transmitter buoys so that they can be located. Buoys have a clearly marked reference number that allows their identification.
- **Buoy in stock**: It is a buoy acquired by the owner, that has been recorded by the owner and has the capacity to transmit.
- **Activation**: Action of registering a buoy which implies that the satellite communication service is initialized. It is done by the buoy supplier company upon request of the vessel owner. From then on, the vessel owner starts paying the communication service. The buoy can be transmitting or not depending if the magnet has been applied for switching it on.
- **Switching on**: action of applying a magnet on the activated buoy to allow satellite connection. From then on, the buoy transmits, and the user receives buoy position.
- **Deactivation**: Action of de-registering a buoy. It is done by the buoy supplier company after the request by the vessel owner. From then on, the communication service is no longer billed, and the buoy stops transmitting.
- **Reactivation**: Action of registering a deactivated buoy that was previously activated.
- **Active or activated buoy**: It is a buoy subjected to the action of activation and, therefore, it is capable of transmitting. However, the magnet still needs to be applied to start the transmission of a signal.
- **Operational buoy**: Active buoy that is transmitting a signal and is drifting in the sea. The number of operational buoys should be used for the verification of the fulfillment of the limitations in force.
- **Buoy Owner**: The unique purse seiner vessel to which the buoy is assigned when activated and receives the telecommunication bills. Buoys can be owned only by a purse seiner operating in the corresponding ocean.
- **Tracked / Followed Buoys**: Buoys owned by a purse seiner that are in operational condition.
- **Acquired buoy:** Buoy purchased and assigned to a purse seine vessel to whom the purchase invoice is issued.
- **Loss of FAD:** FAD that can no longer be tracked by a vessel because the information of the buoy attached is no longer received due to several reasons (robbery, beaching, sinking, …)
- **Abandoned FADs:** FAD from which the communication has been intentionally stopped by deactivating the buoy attached or has been left at sea without a buoy.

5. Concluding remarks

The RFMOs aiming to limit the number of FADs at sea have adopted legal binding measures. However, some gaps have been identified for the different RFMOs, which give ambiguous and too broad definitions that should be further specified in line with FAD and buoy use dynamics. To harmonize the legal requirements and verification mechanisms the life cycle of the buoy and its use onboard are described, and detailed definitions are provided. These terms should be considered by RFMOs not only for compliance but also to adapt data reporting requirements for good-quality data collection. In order to properly monitor all FADs at sea, (i) the prohibition of FAD deployments without active satellite buoys should be considered; (ii) The activation of the buoys should be done always onboard in order to avoid remote activation/reactivations of deactivated drifting buoys; (iii) for the verification of the FAD limitation clear definitions and guidelines should be established.

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Tables

Table 1. Terms used in the legal binding documents in RFMOs

RFMO	Resolution or Recommendations	Terminology used	Definitions
IATTC	C-17-02	Active FAD	Deployed at sea and starts transmitting its location and is being tracked by the vessel owner, or operator. FADs are activated exclusively onboard
		Owner	Not provided
		Operator	Not provided
IOTC	Res. 17-08	Instrumented buoy	As a buoy with a clearly marked reference number allowing its identification and equipped with a satellite tracking system to monitor its position.
		Active buoy	Buoy is considered active when it has been switched on and then deployed. An instrumented buoy may be activated only when physically present on board the purse-seine vessel to which it belongs or its supply vessel.
		Activated	Not provided
		Active number	Active number being calculated as the number of active buoys operated by a purse seine vessel
		Switch on	Not provided
		Followed buoy	Not provided
		Operated buoy	Not provided
		Acquired buoys	Not provided
		Deactivated	Not provided
		Loss of FADs	not provided
		Abandoned FADs	Not provided
ICCAT	Rec. 16-01	Instrumental buoy	Not provided
		Active FAD	Not provided
WCPFC	CMM-17-01	Instrumented buoy	Buoy with a clearly marked reference number allowing its identification and equipped with a satellite tracking system to monitor its position. Buoy shall be activated exclusively on board the vessel

Figures

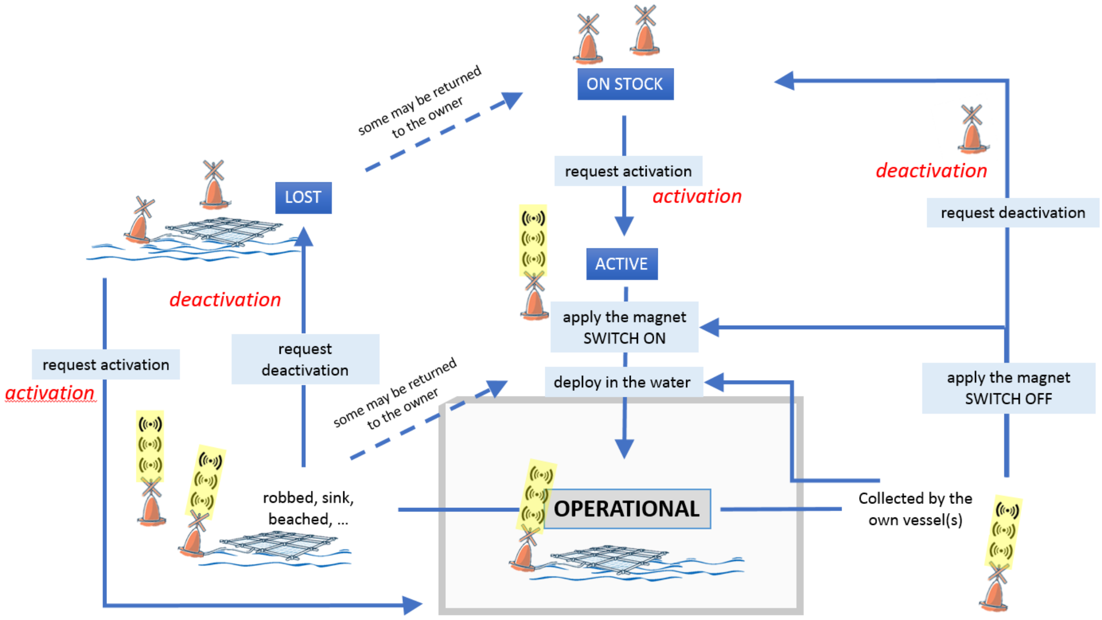

Figure 1. Life cycle of an instrumented buoy

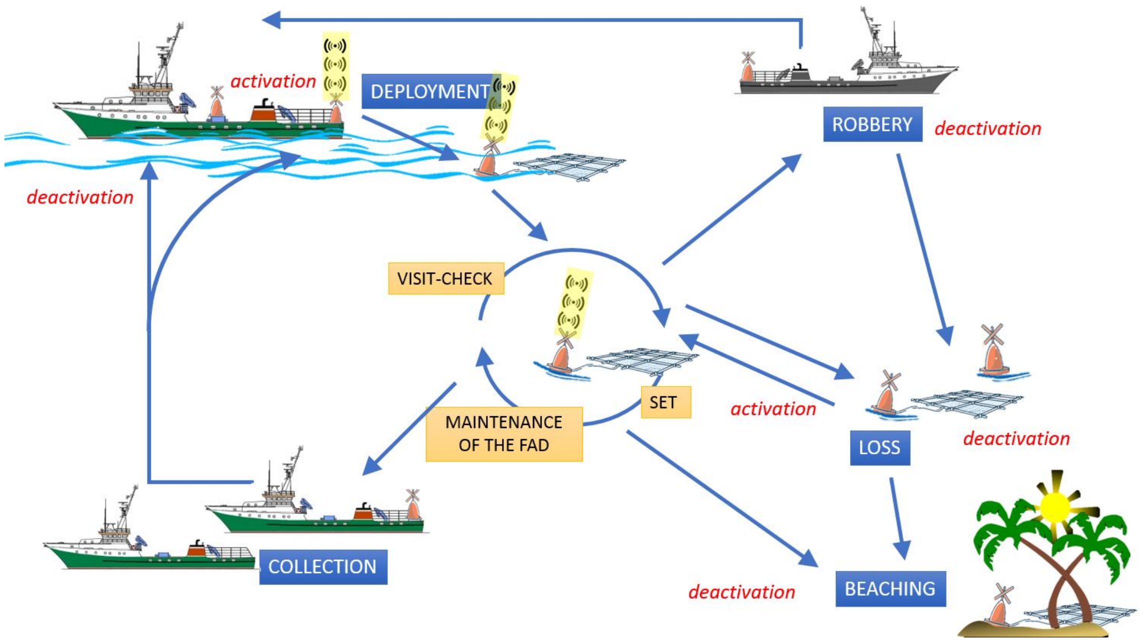

Figure 2. Life cycle of a buoy in connection with FAD activities