Review of current FAD design, data collection and plans to move to fully non-entangling and biodegradable FADs for the French Atlantic Ocean tuna purse seine fishery

Confidential Report

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1. Introduction

The Eastern Atlantic tropical tuna French purse seine fishery targets Atlantic Ocean bigeye (*Thunnus obesus),* eastern Atlantic Ocean skipjack (*Katsuwonus pelamis*) and Atlantic Ocean yellowfin tuna (*Thunnus albacares*) stocks on the Atlantic Ocean high seas and the Exclusive Economic Zones (EEZs) of Mauritania, Cape Verde, Senegal, Gambia, Guinea Bissau, Republic of Guinea, Sierra Leone, Ivory Coast, Ghana, Sao Tome, Gabon, and Angola. All vessels in the fishery are flagged to the European Union (EU) and France and are owned by the French fishing companies Compagnie Française du Thon Oceanique (CFTO) and Via Océan. The fishery is managed regionally by the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the EU's Common Fisheries Policy. The fishery achieved Marine Stewardship Council (MSC) certification in March 2024 for yellowfin and skipjack tuna.

The fishery operates in two ways. Either setting the net on free-swimming schools of fish not associated with any floating object, or around floating objects. Floating objects (FOBs) can be natural objects such as logs or man-made objects such as fish aggregating devices (FADs).

The main objectives of the FIP are:

- To form a collaboration between governments, industry, and fleets to bring about improvements in the fishery.
- To address the shortfalls in the stock health, ecosystem health and management of the fishery by meeting actions described by the Improvement Performance Goals (IPGs).
- To improve the fishery to unconditionally meet the MSC fishery standard.

This report is specifically being created to address four actions within the FIP action plan, as described below:

5.a Review of the information reported by vessels and/or observers on FADs design + solutions to make this information available to scientists and managers.

5.b Provide designs of current FADs deployed in the fishery and quantify current deployments of fully non-entangling FADs compared to lower risk non-entangling FADs to present a baseline for the fishery.

6a. Review of FAD use, monitoring and management options to improve knowledge of impacts of FADs in the fishery for habitats.

6b. Develop and implement a plan to demonstrate the fishery is moving to biodegradable FADs.

Note that this report will also be used to partially address MSC condition 10.

With the above description of the task, this report will review the current FAD designs deployed by the fishery, the data collection made by the fleet and the actions implemented for the transition to biodegradable FADs (bioFADs) and fully non-entangling FADs (NEFADs).

2. Overview

In 2018, global catches of commercial tuna stocks had reached 5.2 million metric tonnes, more than doubling in the last 30 years (Banks & Zaharia, 2020). Much of this growth can be attributed to the introduction of fish aggregating devices (FADs), which have allowed tuna purse seine fleets to more efficiently locate and catch schools of tuna throughout the world's oceans. While this has been positive for tuna suppliers there have been negative consequences associated with the use of FADs.

Floating objects (FOBs) tend to aggregate species of fish underneath the object due to the natural behaviour of the fish. This can include natural objects such as tree logs or whale sharks, or artificial objects such as debris from terrestrial activities on land or debris of fishing activities floating at the surface of the ocean. Fishing aggregating devices (FADs) were built to mimic the natural behaviour of fish with logs. Drifting FADs (dFADs) are man-made objects consisting of a floating raft supporting submerged hanging nets and ropes, usually with an attached echosounder-equipped satellite buoy to allow tracking of its location and to provide estimates of the biomass of tuna aggregating beneath.

Whilst FADs have proven to be a considerably advantageous tool to the fishing industry, the increase in the deployment of FADs over the last three decades has also come with a reported high ecological cost. These negative impacts are outlined below, and concerns have been raised by scientists since the 1990s, and widely relayed by NGOs, environmental activists, and investigative journalists in recent years:

1) Increased bycatch of non-targeted marine species and juveniles of tuna in FAD fishing sets compared to fishing on free swimming school (FSC).
2) Ghost fishing by entanglements with the physical FAD components (sharks, turtles, cetaceans) when meshing elements are used for the construction of FADs. Though high-risk entangling FADs (HERFADs) have been replaced by low-risk entanglement FADs (LERFADs), entanglements have been reported on abandoned, lost, or discarded FADs that may become entangling again at the end of their lifecycle.
3) Degradation of sensitive coral reefs and other sensitive habitats when FADs drifting outside fishing grounds are lost and are brought onshore or snagged on shallow habitats.
4) Marine pollution from FADs that have been lost outside fishing grounds, stranded, or sunk.

The impacts of the structure of FADs have received special attention from scientists, fishers, RFMOs and non-governmental organisations resulting in efforts being made to replace FADs built with meshing elements with NEFADs (non-entangling and non-biodegradable) and bioFADs (non-entangling and biodegradable) through research, regulation, and advocacy.

Efforts are also being made to improve the tracking and recovery of FADs by:

1) Reporting of all activities with FADs (deployment, tracking, fishing, end of use) into logbooks.
2) Closely working with satellite companies to monitor FAD locations and lost FADs. FAD trajectory and echosounder data have been provided to national scientists for scientific purposes since the 2010s and are also used to test FAD recovery solutions.

Though management measures have been adopted in the frame of RFMOs and data collection has improved in recent years, there is still room for improvement in the monitoring and management of FOB fisheries. Various recommendations have been drawn by a variety of stakeholders (scientists, fisheries managements, fishers, NGOs):

1) Collection and reporting of data on fishery statistics by set type (including FAD sets), through FAD logbooks and observers, and reporting by fleets to appropriate RFMOs and science bodies.
2) Enhancement of monitoring of FAD use and associated bycatch, including the provision of FAD tracking and echosounder data.
3) Adoption of science-based FAD management measures, such as limits on the overall number of FADs used/made.

3. FAD management plan

The Orthongel FAD management plan was drafted in accordance with the French FAD management plan submitted to ICCAT under Recommendation 21-01 and affirms the fishery's commitment to the International Seafood Sustainability Foundation (ISSF).

The FAD management plan has three objectives:

1. Improve knowledge on FAD fishing activities.
2. Limit FAD deployment; and
3. Reduce potential ecosystem impacts of FADs.

Deployments, losses, and transfers of FADs are monitored annually, and the information collected in the logbook is transmitted to national scientists at the end of each trip and submitted to the Standing Committee Research and Statistics (SCRS). Information collected includes the vessel name, date, position, type of floating object, material of the FAD if applicable, size and presence of mesh on the surface and submerged part, type of activity conducted, type of buoy, and the set catches by species.

The FAD management plan includes measures to minimise the impacts of drifting FADs on vulnerable marine habitats (VMEs) and endangered, threatened and protected (ETP) species. These include the prohibition of abandonment of FADs, the requirement for buoys to be equipped with GPS, a limitation on the number of operational buoys, the prohibition of deactivation of buoys and the requirement of onboard or electronic observation. The current FAD management states that no FAD built or deployed by the fishery is permitted to contain materials with mesh sizes exceeding 6.5cm.

4. Current design of dFADs deployed by the fishery

Currently, the French purse seine fleet deploys lower entangling FADs, with trials currently being undertaken to move to fully NEFAD deployments. The fishery has a FAD management plan, which again will be adapted when the transition to NEFADs is complete.

The current dimensions, structure and materials of the FADs used by the fleet are detailed in Figure 1.

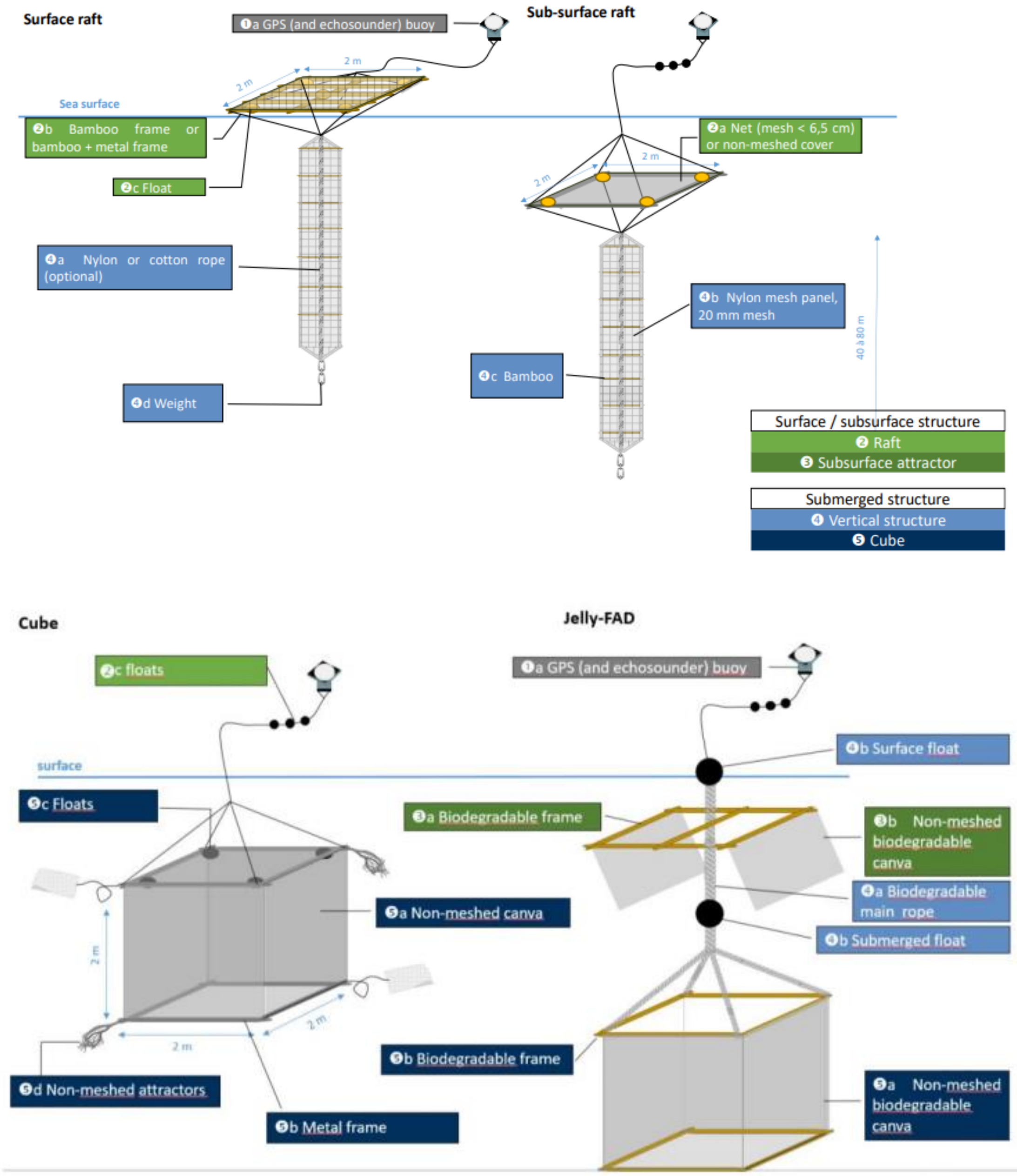

Figure 1: Dimensions and materials used for the construction of Orthongel FADs.

5. Data collection

5.1. By captains in the logbook

From October 2022 to April 2024, an in-depth revision of the Excel logbook used by French purse seiners was completed. This revision was presented by ORTHONGEL during the Indian Ocean Tuna Commission (IOTC) Working Party on Data Collection and Statistics (WPDCS) meeting (Maufroy *et al.*, 2023).

Since January 2024, a more detailed data collection has been carried out by the captains. This detailed data collection is complex due to the constant evolution of dFAD designs. For example, in recent years, dFAD designs have evolved towards subsurface rafts and subsurface *cages* (Maufroy *et al.*, 2022) and hybrids of rafts and cages have been proposed such as the biodegradable jelly-FAD (Moreno *et al.*, 2021). To overcome this issue, in the redesigned logbook of French purse seiners, dFADs will be described as a combination of a surface or subsurface raft, one or several tails, and a cage (Figure 2).

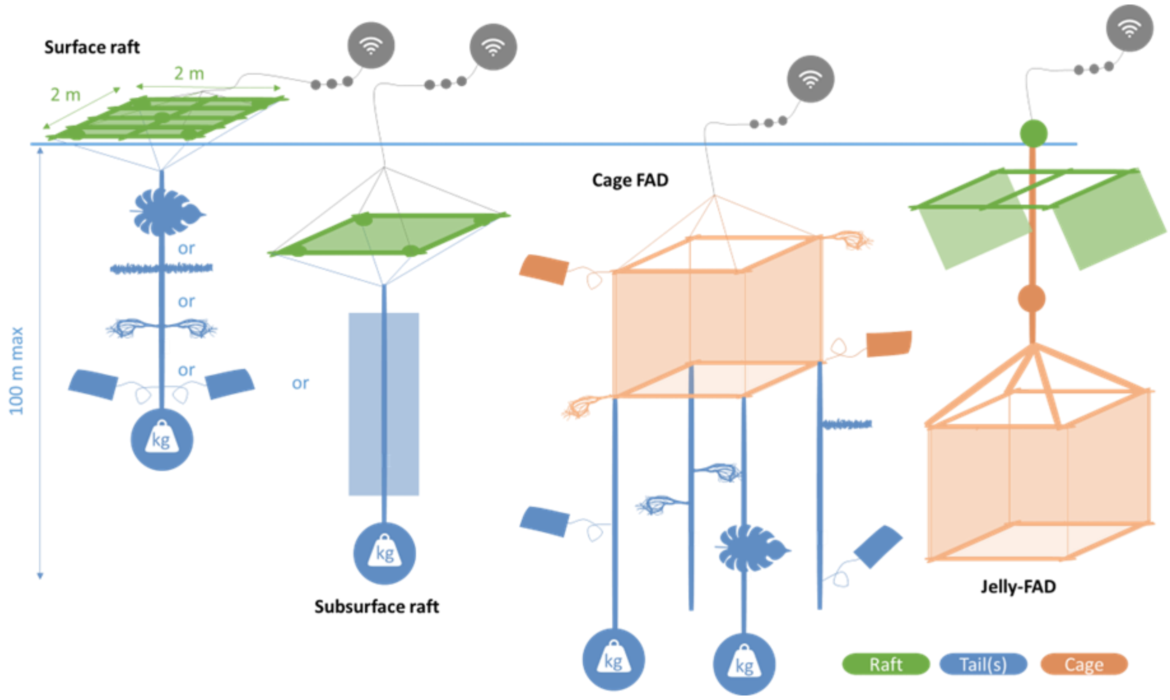

Figure 2: Examples of dFAD designs using the raft, tail, and cage components.

Figure 3 describes the FOB operation menu and associated data entry forms. The first step consists of selecting a FOB operation type (e.g., dFAD deployment, FOB visit followed by a fishing set, see Maufroy *et al.*, 2022 for the full list of possible FOB activities). This first step opens a second data entry form, with various degrees of complexity, depending on the complexity of the FOB (single dFAD vs. combination of FOBs) and of the operation (simple deployment or visit vs. visit with dFAD added on the FOB).

On this second form, it is necessary to select the components of the object and to indicate for each component:

1) Number.
2) Dimensions.
3) Presence / absence and size of mesh.
4) Presence / absence of metal.
5) Presence / absence of plastic.
6) Presence / absence of biodegradable elements.

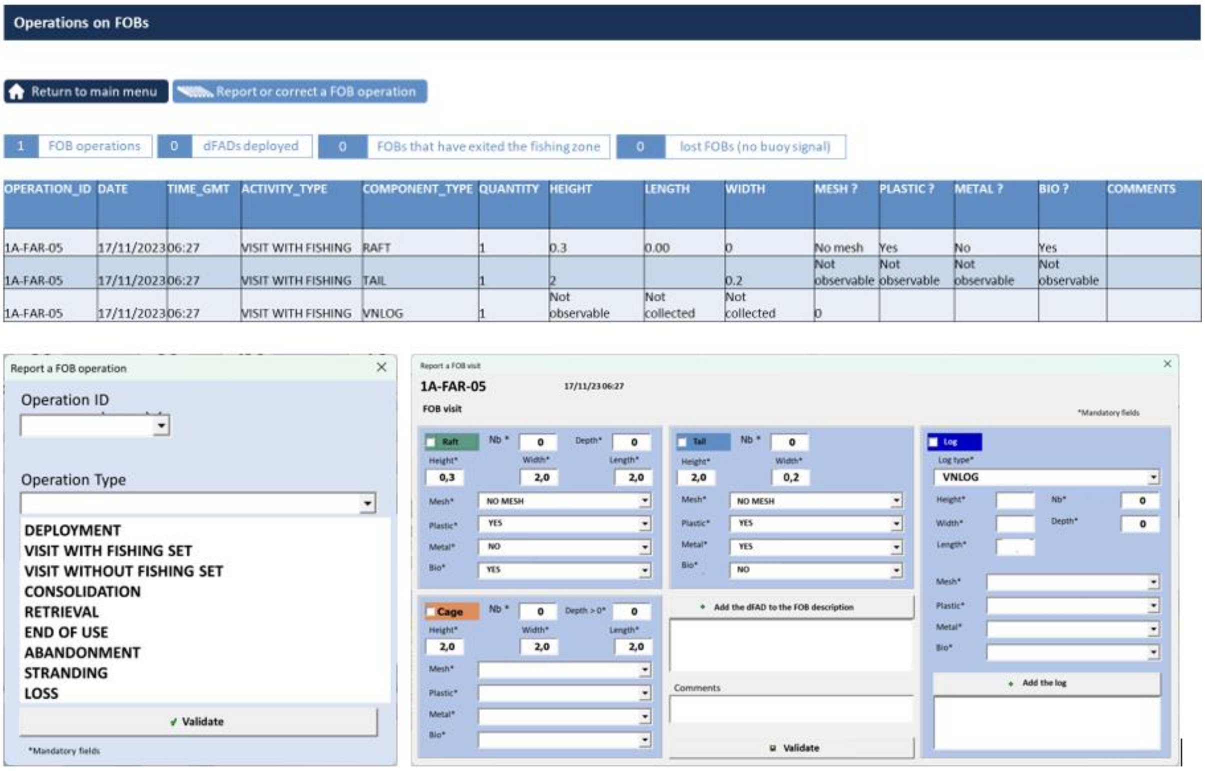

Figure 3: Operations on FOBs menu (top panel), selection of FOB operation (bottom left panel) and data entry form in the example of a FOB visit (bottom right panel).

5.2. By scientific observers

French vessels in the Atlantic Ocean embark scientific observers. Observer coverage is close to 100% of fishing operations thanks to the combination of the EU Data Collection Framework (DCF), ICCAT Moratorium and OCUP programmes.

In addition to data collected on vessel activity and catches, observers collect information on floating objects (FOBs) encountered. This data is collected in "form D" of the Handbook for Observers on Board Tropical Tuna Purse Seiners (Sabarros & Mollier, 2023).

For each FOB encountered, the scientific observer notes:

1) The type of activity (e.g. visiting, fishing, deployment, etc.).
2) The materials present on the emerged and submerged parts.
3) The size of the mesh if present.

In the framework of the MSC certification, the fishery will work with OCUP partners to analyse data collected by observers and identify potential needs for improvement. Depending on the results, the data collection protocol may be strengthened.

6. Non-entangling FADs

6.1. Trials

At present, the fishery uses lower entanglement risk FADs and is aiming towards the use of fully NEFADs in 2024. To facilitate the transition to fully NEFADs the fishery has been undertaking experimental trials to research the potential replacement of any possibly entangling structures on dFADs currently in use.

Through the fisheries' participation in the Eastern Atlantic Ocean tuna purse seine FIP, trials of bioFAD prototypes such as jelly-FADs were undertaken. A two-day workshop was held with attendance from CFTO, Via Océan and Orthongel in Abidjan. During this workshop, a presentation was held detailing the structure of the jelly-FADs and the fully biodegradable materials that are utilised during construction. Jelly-FADs feature non-meshed canvas on both the raft and submerged structure. The dimensions and materials of a jelly-FAD are displayed in Figure *1*. The second part of the workshop involved instruction on the construction and steps required to assemble jelly-FADs (Moreno, et al., 2023).

These jelly-FADs have been implemented by Tri Marine in 2023.

In 2023, CFTO carried out a study on a specific design of fully NEFADs using also biodegradable materials. This internal study aims to compare the lifetime, drifting and fishing capacity and operation of this new design compared to other designs used. This study is still in progress.

6.2. Action plan to move to fully NEFADs

As stated in the Orthongel FAD management plan, the fishery has committed to the ISSF recommendation to use only fully NEFADs to reduce the risk of ghost fishing. Following these trials, the fishery will convert to using fully NEFADs by January 2025. After this transition has been made, the fishery will verify the use of fully NEFADs through the comprehensive data collected by onboard observers and captains in the logbook when the fishery deploys FADs.

7. Biodegradable FADs

7.1 Trials

Due to risks of habitat interactions from lost or discarded FADs, all non-biodegradable materials used to construct FADs must be replaced by fully biodegradable materials as soon as possible. To facilitate this transition, Orthongel, CFTO and Tri Marine have undertaken research projects into suitable biodegradable materials for FAD construction.

The fishery is currently taking part in the Orthongel CAT DCP Bio which continues the research into biodegradable FAD (bioFAD) designs in collaboration with a Breton company, Kairos.

Orthongel in collaboration with Kairos, an environmentally focused ocean construction and innovation company based in Concarneau, tested ropes, canvases and floats constructed by the LCSM laboratory of IFREMER in Brest. This project is being conducted in five stages involving research for suitable biodegradable materials, testing under controlled conditions to verify the potential degradation timeframe and the effects of degraded products, the construction of prototypes and tests in real-time by Orthongel crews and the assessment of costs for production and assembly of bioFADs. This project is currently at stage four, which involves testing biodegradable floats.

As described in section 6.1. Trials, the fishery has been undertaking trials of jelly-FADs which are fully non-entangling and incorporate biodegradable materials into the FAD design. The biodegradable components of the jelly-FAD subsurface attractor and structure are displayed in Figure *1*. These materials include recycled cotton ropes, cotton canvas and bamboo canes (Moreno, et al., 2023).

Tri Marine is trialling the use of biodegradable materials in FADs in the eastern Pacific Ocean, to then implement any successful materials and structures across their purse seine fleet.

In 2023, CFTO carried out a study on a specific design of fully NEFADs using also biodegradable materials. This internal study aims to compare the lifetime, drifting and fishing capacity and operation of this new design compared to other designs used. This study is still in progress.

7.2 Action plan to move to fully bioFADs

The plan to switch to fully biodegradable FADs will depend on the results of the preliminary studies and implementation of additional trials might be required to validate the plan. After this transition has been made, the fishery will verify the use of fully bioFADs through the comprehensive data collected by onboard observers and captains when the fishery deploys FADs.

8. Removal and retrieval improvement measures

The recovery of FADs and buoys is encouraged under the FAD management plan to mitigate the number of lost and discarded FADs causing marine pollution. The positions of all buoys used by the fishery are continuously reported to the IRD. The tracking of FADs can potentially facilitate a system to minimise VME interactions through the notification when FADs are approaching habitats and organising their retrieval before beaching or entanglement can occur.

Additionally, Orthongel are a participant of FAD Watch, a programme in the Indian Ocean developed to prevent FAD beaching in the Islands of the Seychelles. The study by Zudaire et al., (2018) demonstrated that implementing a device to the tracker on a dFAD to alert the FAD-watch project when a structure drifts across a buffer zone of a coastline, will increase the likelihood that the FAD will be retrieved and prevent further damage to the surrounding ecosystem and habitat. However, the practicality and feasibility of a similar recovery programme in the Atlantic Ocean requires further research and testing (Zudaire, et al., 2018).

9. Conclusion

Several trials have been carried out or are underway by the companies or the producer organisation.

CFTO and Via Océan plan to deploy only non-entangling FADs (NEFADs) from January 2025. This date corresponds to the ISSF requirements.

Regarding the use of biodegradable FADs (bioFADs), several trials are underway and it will be necessary to wait for the results of these tests before defining a transition timetable.

At the same time, ORTHONGEL will be working with the partners in the observation programmes and the fishing crews to continue to improve data collection. This will, among other things, make it possible to document more accurately the design of the FADs deployed by CFTO and Via Océan vessels.

A review of this report will be conducted next year when the research trials have been completed and the fishery is implementing 100% NEFADs and bioFADs to monitor this progress.

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