IOTC-2021-WGFAD02-04

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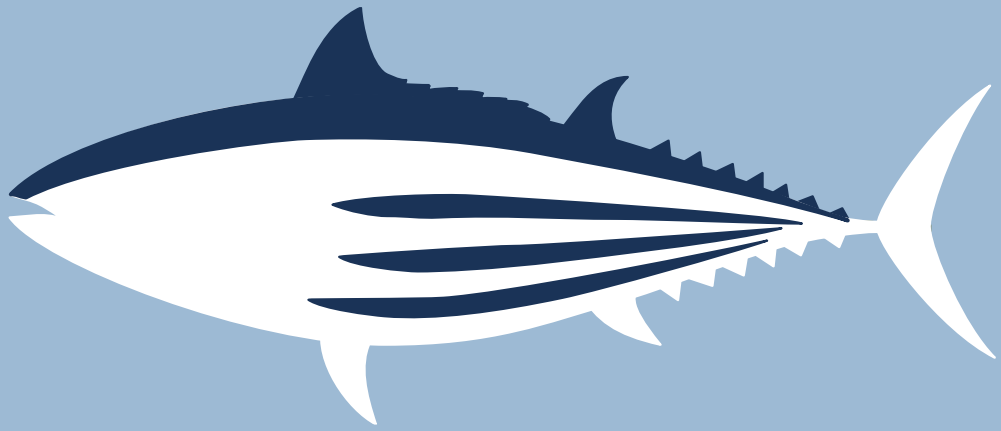
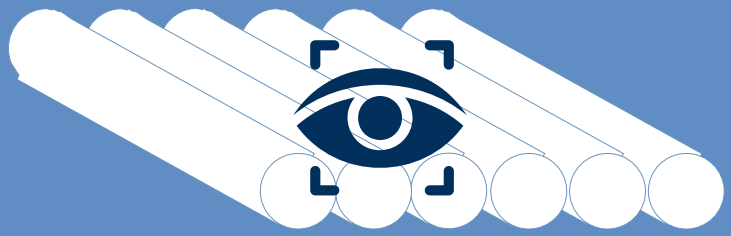
What we think you should know about

Fish Aggregating Devices





What we think you should know about
FISH AGGREGATING DEVICES

It's a fact, the use of Fish Aggregating Devices (FADs), man-made objects designed and deployed by fishers to attract fish, receives much attention. While FADs contributed to the development of tropical tuna fisheries during the 1990s, their too extensive use during the following decades, especially the 2010s, has raised major concerns for tunas, non-targeted species and ecosystems.

On behalf of French and Italian fishers targeting tropical tunas with purse seines in the Atlantic and Indian Oceans, ORTHONGEL has always advocated for a sustainable and rational use of FADs. In 2012, our fleet of French and Italian purse seiners adopted for the first time a self imposed limitation of drifting FAD use, that has become mandatory in all oceans since, along with various data provision to managers and scientists. These management decisions were obviously major steps for the sustainability of our fishery. In 2021 however, we realise that FAD fisheries are still a major concern for many stakeholders. Worse, we realise that despite our efforts to be transparent on our use of drifting FADs, very little seems to be understood on that use.

Here, we offer a detailed overview of drifting FADs in tropical tuna fisheries, their use, and their management with a focus on the Atlantic and Indian Oceans that we know best. We hope that you will find the information you need as a manager, NGO, citizen, scientist or fisher.

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What is a drifting FISH AGGREGATING DEVICE ?

The definitions presented here were proposed in the frame of the European Union funded project CECOFAD

FOB
Floating OBject

Fishers have known for centuries that many species of fish, like tropical tunas, aggregate under virtually anything that can float at the surface of the ocean.

ANLOG
Natural log of animal origin

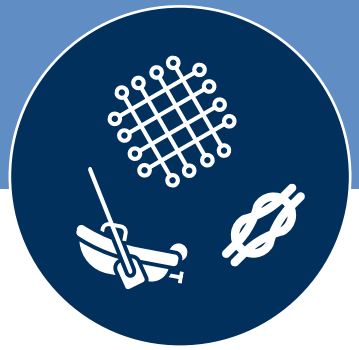
That can be anything natural either of animal origin ...

VNLOG
Natural log of vegetal origin

... or of plant origin that originates from the oceans or have been brought there by rivers.

HALOG
Artificial log from human activities

Fish also aggregate with debris of various human activities ...



FALOG
Artificial log from fishing activities

... or with anything that has been lost or abandoned at sea by fishers.

Fishers can use opportunistically found FOBs, called **LOGs**, to find fish and facilitate their capture.

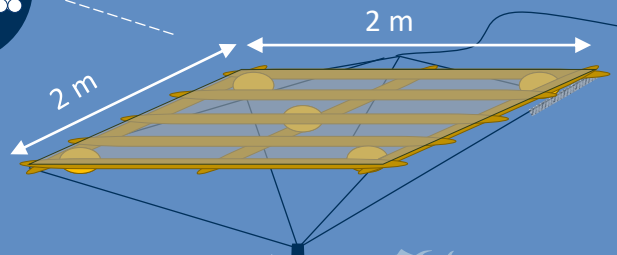
FAD
Fish Aggregating Device

Fishers can also deploy their own objects, called **Fish Aggregating Devices**. FADs can be anchored (aFADs) or drifting (dFADs).

ANATOMY OF A *Fish Aggregating Device*

Raft

Raft made of bamboo and/or metal that can be either floating on surface or submerged. Floats are used to ensure the dFAD is not sinking . A cover is added to render the dFAD invisible to other fishing boats . Fishers also think that the raft and its cover provide shade, which allows attracting fish, though there is no scientific evidence for this. Nowadays, the cover is made of non meshing elements to avoid entanglements of sea turtles.



Tracking buoy

Used to locate the dFAD or any type of FOB while drifting. Some buoy models also provide rough estimates of the amount of fish aggregated with the object.

Tail

Ensures the dFAD is drifting with currents and not with winds. The tail is generally made of a rope. Old fishing nets are not used anymore since the 2010's to avoid shark entanglement.

Attractants

Ropes, palm leaves, ... or any element creating additional volume are added to the dFAD tail. Though this has not been proven scientifically, fishers think that this contributes to attracting fish.

Weight

Ensures the tail of the dFAD is well anchored in currents.

i There are many designs of dFADs. The design presented here is one of the most common.

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How are LOGs and dFADs used ?

The definitions presented here were proposed in the frame of the European Union funded project CECOFAD. Two types of boats are involved in FOB activities : *purse seiners* (fishing boats) and their *support vessels* (boats in charge of assisting purse seiner in their FOB activities but not only, as support vessels can also provide purse seiners maintenance services).

Construction

Some boats build their FADs directly at sea. Other FADs are built on land. By definition, logs are not built by fishers.

Tracking

Newly deployed dFADs are left drifting at sea for a few weeks to a few months. FOBs that were previously drifting at sea are tracked for shorter periods if they have aggregated sufficient amounts of fish.

Fishing

During the visit to the FOB, the boat evaluates the amount of fish that has aggregated with that FOB. If it sufficient, it may decide to set the net around the school.

Deployment

Once ready, the dFAD is deployed with its tracking buoy. Obviously, there is no such thing as a deployment of a log (though tracking buoys can be deployed on logs).

Visit

Boats locate owned FOBs using their tracking buoys. They may also randomly encounter dFADs and logs drifting at sea, equipped or not with a tracking buoy belonging to other fishers.

End of use

dFADs and logs equipped with a tracking buoy can either be retrieved by their owner, found by other fishers, lost outside fishing grounds, lose their buoys or the buoy may stop transmitting.

How are FOB TRACKING BUOYS used ?

The definitions presented here were proposed in the frame of the European Union funded projects CECOFAD and RECOLAPE. Terms related to activities with FOBs should be separated from those related to tracking buoy activities. This allows providing meaningful data to fisheries scientists , fisheries managers and tuna Regional Fisheries Management Organisations (RFMOs).

Activation

The tracking buoy is registered on the satellite system by the boat so that satellite can detect its future transmissions.

Deployment

The buoy can then be attached to a new dFAD that the boat is deploying, any FOB that was drifting at sea without a buoy (tagging) or any FOB that was previously equipped with a buoy of another boat (transfer). At this stage, the buoy is considered **operational**.

Visit

Visits can either occur on owned FOBs, whose location is provided by the owned tracking buoy. Non-owned FOBs may also be detected, especially when there is bird or fish activity that indicates the presence of an aggregated school of fish.

Switch on

The tracking buoy is then turned on onboard the boat and starts transmitting.

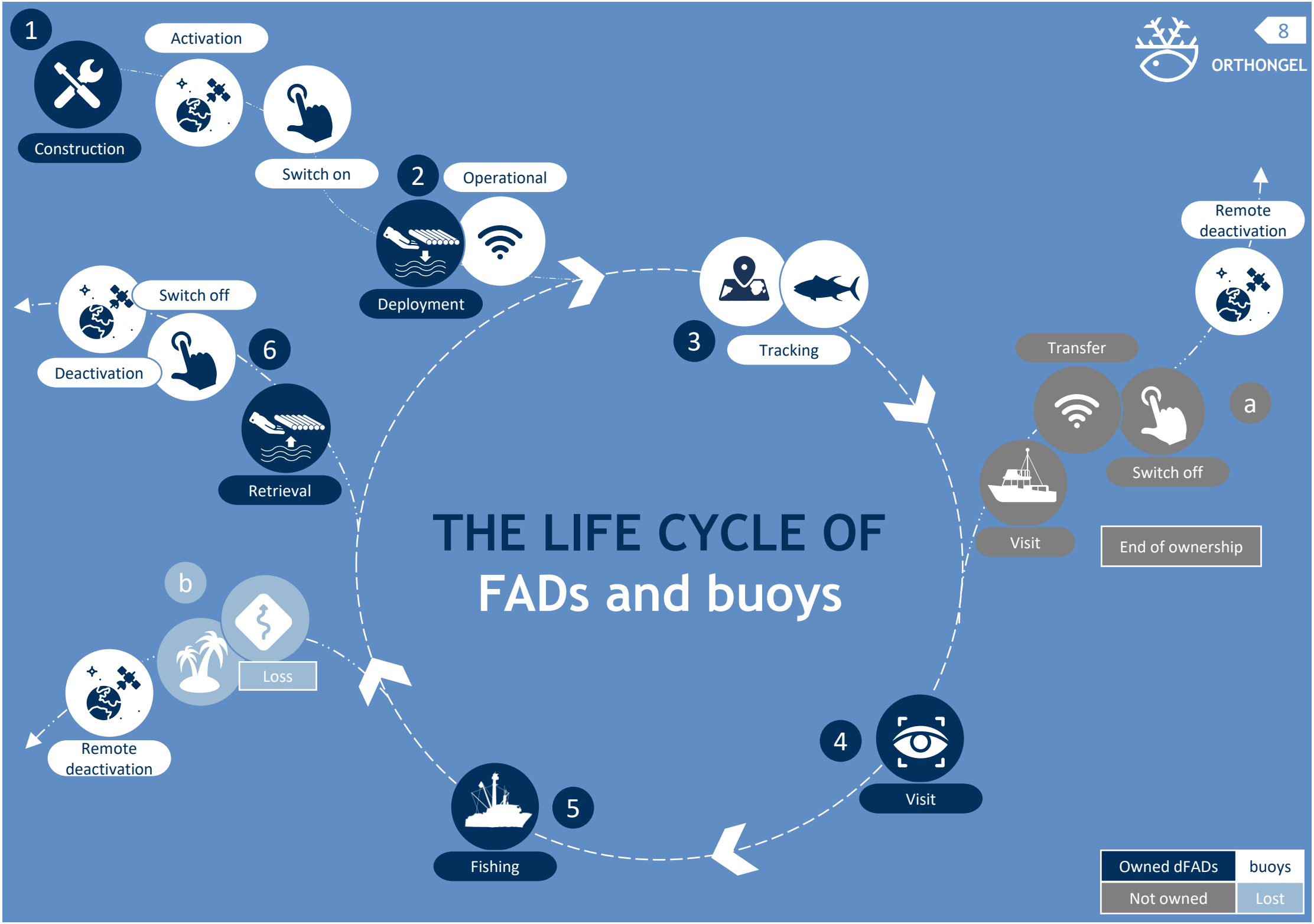
Tracking

Tracking buoys provide the position of the FOB during its drift. In the case of echosounder buoys, it can also provide rough estimates of the amount of fish present around the FOB. These information are used to decide to visit owned FOBs.

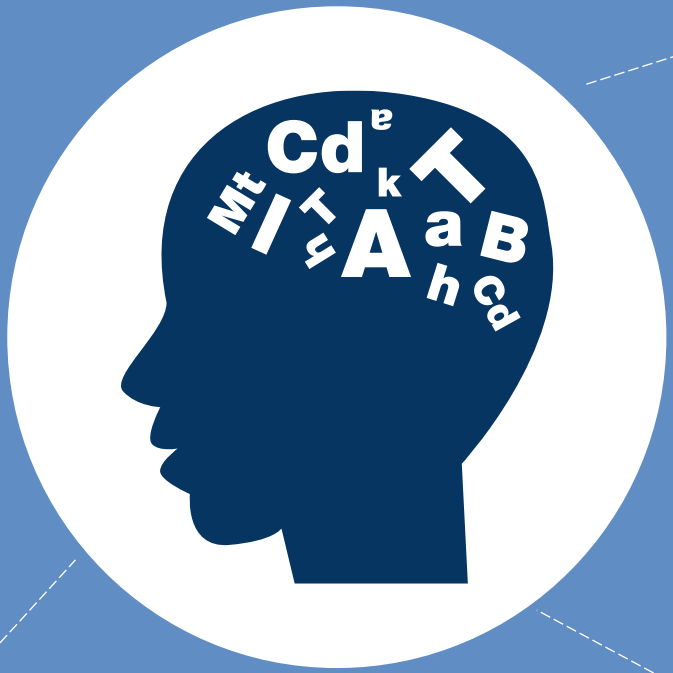
End of use

Tracking buoys can either be retrieved by their owner, found by other fishers or lost outside fishing grounds. After deactivation and / or switch off, the buoy stops transmitting.

THE LIFE CYCLE OF FADs and buoys



USING THE RIGHT *vocabulary*



active FAD

operational buoy

Activation refers to the action registering of a buoy on the satellite system, it is therefore not appropriate to qualify the state of a FAD. Also, when a buoy is active, it does not mean that the buoy is transmitting nor that it has been deployed on a FOB. The proper term for this is ***operational buoy*** (active, switched on and deployed on a FOB that is drifting at sea).

FAD FOB

For the sake of simplicity, many people use the term **FAD** to designate anything that floats at sea. Though simplicity is often a good option, being slightly more precise is important to accurately assess the impacts of dFADs. The proper term that should be used is ***FOB (Floating OBject)***.

deployed FAD

owned FAD

Deploying a FAD does not mean that you will remain its owner until its end of use. Other boats may find that FAD at sea and decide to replace the buoy by one of their own. They will then become the new FAD owner after this **buoy transfer**. It is therefore important to monitor separately the number of FADs that a vessel has ***deployed at sea*** (contribution of that vessel to ecosystem modification) and is ***owning at any given time*** (contribution to fishing pressure, and if the FAD and its buoy are lost outside fishing grounds, contribution to marine litter and damages to fragile ecosystems).

FAD deployment

FOB deployment

Tracking buoy deployment

By definition, any **FOB** that has not been built and deployed by fishers is a **log**. So obviously, only FADs are deployed by fishers and we cannot talk about FOB deployments. The only possibilities are ***FAD deployments*** and ***tracking buoy deployments***.

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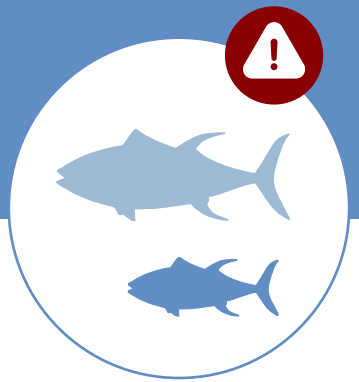
What are the CONSEQUENCES of relying too heavily on dFADs ?

Tuna behaviour

Adding dFADs to FOBs naturally present at sea may modify the behaviour of tunas. If too many dFADs are present at sea, this may affect the feeding behaviour of tunas, their reproduction and natural migrations. dFAD use is limited in all oceans since the 2010's.

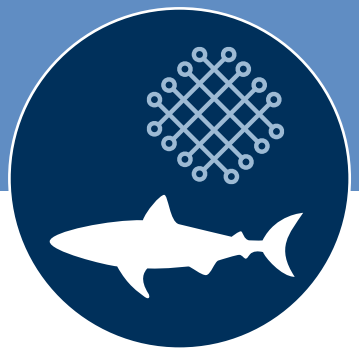


Juvenile tuna catch

Fishing on FOBs contributes to more catches of young yellowfin and bigeye tunas. Ultimately, relying too heavily on FOB fishing may lead to overfishing.

Non-target catch

Fishing on FOBs contributes to higher levels of catch of non-target species. For many species, this is not an issue as long as this does not contribute to wasting fish through discards. This is not the case for sensitive species such as sharks, for which fishing mortality should be reduced as much as possible.



Ghost fishing

In the past, fishers reused their old fishing nets to cover the raft of dFADs and build their tail. This used to cause entanglement of sea turtles and sharks, that are now avoided with dFADs built without meshing elements (non-entangling dFADs).

Marine litter

Several components of dFADs are built with materials that have a long lifespan at sea. When dFADs are lost outside fishing grounds, they can therefore add to marine pollution.

Stranding

dFADs that were lost outside fishing grounds or left at sea can be brought onshore by currents. They may strand in fragile ecosystems such as coral reefs.

Which MANAGEMENT OPTIONS for which impacts ?

There is no such thing as a perfect management solution. In general, to manage dFADs and their impacts it is better to combine several solutions and to choose those that cover the full dFAD lifecycle, address more types of negative impacts and do not have unwanted consequences on fish stocks and ecosystems. Here is a list of the measures discussed in tuna RFMOs and other forums. Potential socio-economic consequences are not addressed here but should be taken into account as well.

When ?	How ?	What for ?						Potential unwanted consequences ? and other useful information	Implemented in	
		Tuna behaviour	Tuna juveniles	Non-target	Ghost fishing	Marine litter	Stranding		ICCAT	IOTC
Construction	Non entangling FADs							Used by most purse seine fleets since the 2010's.	✓	✓
	Biodegradable FADs							Tests are currently being undertaken for a transition to bioFADs.	🕐	🕐
	FOB buoy purchase limits							FOB buoys can be reused several times. Limiting the purchase is therefore less efficient than directly limiting use.	✓	✓
Deployment	FAD deployment limits							A long FAD deployment moratorium, as already in place in ICCAT (3 months) may have similar effects.		
	FAD deployment zones									
	Support vessel limits							Support vessels may contribute to the recovery of derelict dFADs.		✓
Tracking	Operational FOB buoy limits							There are less dFADs at sea and therefore all FOB impacts are addressed. But FOB buoys are deactivated earlier to comply with limits.	✓	✓
	Support vessel limits							Support vessels may contribute to the recovery of derelict dFADs.		✓
Visit and fishing	FOB fishing sets limits							If the measure is not combined with FOB buoy limits, more dFADs are deployed to ensure finding FOBs with fish.		
	FOB fishing moratorium							dFADs that are not visited during the closure are more easily lost outside fishing grounds.	✓	
End of use	Derelict dFAD recovery							Tests are currently being undertaken in Seychelles (Indian Ocean).		

no effect | efficient impact mitigation | moderate impact mitigation | potential unwanted consequences on stocks and ecosystems

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How can we efficiently MONITOR AND CONTROL dFAD / FOB use ?

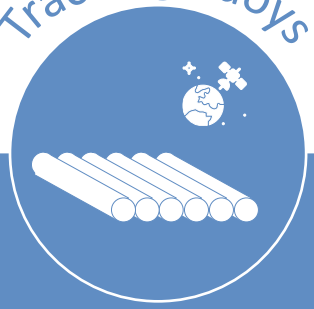
Logbooks

Fishers report information on FOB types, designs of dFADs and activities with FOBs and tracking buoys in logbooks or FOB registries. When a fishing set occurs, fishers also report catches. dFAD and tracking buoy loss should also be reported to allow their recovery.

Observers

When present onboard, scientific observers also report this type of information. Electronic observation (EMS) is currently being tested but does not provide the same detailed information so far.

Tracking buoys



dFADs and other FOBs found at sea are equipped with satellite tracking buoys that provide the position during the drift. Some buoy models provide rough estimates of the amount of aggregated fish.

National scientists

Through agreements with fishing fleets using dFADs and other FOBs, national scientists can access detailed data that are not necessary publicly available in RFMOs. It is the case for example for detailed position and echosounder data from tracking buoys.

MAKE BUOY LIMITS WORK

1 Use the right vocabulary

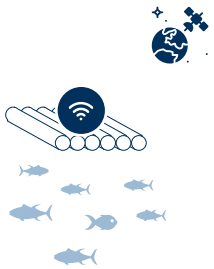
Operational buoys are those buoys that are registered on the satellite system (active), switched on and deployed on a drifting FOB. The number of operational buoys is limited in all ocean since the mid 2010's to control the number of dFADs present at sea at any time.

Remember that **words matter** to ensure that the data provided to RFMOs and fisheries managers is appropriate.

~~active FAD~~

~~active buoy~~

2 Get the data directly from buoy providers

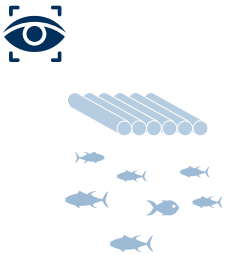


Buoy providers transmit detailed information (position, estimated amount of aggregated fish) to the vessels sharing the tracking buoy / FOB. The same information can be transmitted to national scientists, national fisheries managers and RFMOs to verify compliance with buoy limits. This can be done independently from fishers, which makes it suitable for control purposes.

3 Make sure all tracking buoys are counted

To make the measure efficient, one must ensure that the information is available for all buoys used by purse seiners and their support vessels. The easiest solution is to **ensure that all vessels receiving the information from the buoy declare its use**. It makes it also far more difficult to selectively report some buoys and not the others.

Since it can be tempting to temporarily deactivate buoys remotely, so as to avoid them being counted as operational, one must also verify that there is no **ghost buoy** at sea. One can verify that buoys are activated onboard purse seiners and support vessel by cross checking the position of the buoy and sharing vessels for example.



4 Avoid unwanted consequences

One potential unwanted consequence of buoy limits is that buoys of FOBs drifting too far from fishing grounds are deactivated earlier, so as to avoid exceeding limits for FOBs that cannot be used for fishing. A potential solution for this would be to **declare FOB end of use**. Buoys would then be counted as **retrievable instead of operational** and we would keep track of derelict dFADs for recovery purposes.

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Learn more with SCIENTISTS

about FOB use and FOB technology

Learn more about the contribution of FOB technology to fishing efficiency

The technology used by purse seiners to fish on FOBs has evolved a lot since the beginning of the tropical tuna purse seine fishery. Major changes include the use of GPS and echosounder tracking buoys, support vessels (vessels in charge of supporting purse seiners in their FOB activities but not only, support vessels may also provide purse seiners maintenance services). The following scientific publications will tell you more on these evolutions :

[1] Lopez et al (2014). Evolution and current state of the technology of echosounder buoys used by Spanish tropical tuna purse seiners in the Atlantic, Indian and Pacific Oceans. *Fisheries Research*, 155:127-137.

[2] Torres-Irineo et al. (2014). Changes in fishing power and fishing strategies driven by new technologies: the case of tropical tuna purse seiners in the eastern Atlantic Ocean. F*isheries Research,* 155: 10-19.

[3] Gaertner et al (2016). Results achieved within the framework of the EU research project : Catch, Effort and eCOsystem impacts of FAD-fishing (CECOFAD). IOTC-2016-WPTT18-35

[4] Tidd et al (2016). Estimating productivity, technical and efficiency changes in the Western Pacific purse seine fleets. *ICES Journal of Marine Science*. 73: 1226-1234.

[5] Maufroy et al (2017). dFADs used by EU tropical tuna purse seiners in the Atlantic and Indian Oceans : increasing use, contribution to fishing efficiency and potential management. Joint t-RFMO FAD Working Group meeting. J-FAD_17/2017.

[6] Wain et al (2021). Quantifying the increase in fishing efficiency due to the use of drifting FADs equipped with echosounders in tropical tuna purse seine fisheries. *ICES Journal of Marine Science,* 78:235-245.

Learn more about the number of dFADs and FOB tracking buoys

The number of dFADs has massively increased during the 2010's, leading to major concerns. Several authors have made attempts to estimate the magnitude of dFAD use, until this use was monitored and limited in the frame of tuna RFMOs.

[7] Fonteneau et al (2013). Global spatio-temporal patterns in tropical tuna purse seine fisheries on drifting fish aggregating devices (DFADs): Taking a historical perspective to inform current challenges. *Aquatic Living Resources,* 26, 37-48.

[8] Maufroy et al. (2016). Massive increase in the use of drifting Fish Aggregating Devices (dFADs) by tropical tuna fisheries in the Atlantic and Indian Oceans. *ICES Journal of Marine Science*., 74:215-225.

[9] Chassot et al (2019). Major reduction in the number of FADs used in the Seychelles purse seine fishery following IOTC limitations. IOTC-2019-WPDCS15-21_Rev1

[10] Maufroy and Goujon. (2019). Methodology for the monitoring of FOB and buoy use by French and Italian purse seiners in the Indian Ocean. IOTC-WPTT21-53

[11] Escalle et al. (2021). Quantifying drifting Fish Aggregating Device use by the world's largest tuna fishery. *ICES Journal of Marine Science*, fsab116

Learn more with SCIENTISTS

about FOB impacts and management

Learn more about the effects of using too many dFADs

Using too many dFADs can affect targeted tropical tunas, non-target species and ecosystems. Scientists have raised awareness on these issues since the 1990s and evaluated the magnitude of such impacts.

[12] Bromhead et al (2003). A review of the impact of fish aggregating devices (FADs) on tuna fisheries. Final report to the Fisheries Resources Research Fund. Bureau of Rural Sciences, Canberra, Australia. 122 p

[13] Hallier and Gaertner (2008). Drifting fish aggregation devices could act as an ecological trap for tropical tuna species. *Marine Ecology Progress Series*, 353:255-264.

[14] Dagorn et al (2013). Is it good or bad to fish with FADs ? What are the real impacts of drifting FADs on pelagic marine ecosystems ? *Fish and Fisheries*, 14:391-415

[15] Filmalter et al (2013). Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices. *Frontiers in Ecology and the Environment*, 11:291-296.

[16] Leroy et al (2013). A critique of the ecosystem impacts of drifting and anchored FADs use by purse-seine tuna fisheries in the Western and Central Pacific Ocean, *Aquatic Living Resources*, 26:49-61.

[17] Sempo et al (2013). Impact of increasing deployment of artificial floating objects on the spatial distribution of social fish species. *Journal of applied Ecology*, 50: 1081-1092.

[18] Maufroy et al (2015). Large scale examination of spatio-temporal patterns of drifting Fish Aggregating Devices from tropical tuna fisheries of the Indian and Atlantic Oceans. *PLoS One*, 10:1-21.

Learn more about management options for FOB fisheries

The optimal management of FOB fisheries and their impacts has long been discussed among fishers, fisheries scientists and fisheries managers. Fisheries scientists have made various recommendations on potential management tools, though the efficacy and the feasibility of such management options needs more thought.

[19] Davies et al. (2014). The past, present and future use of drifting fish aggregating devices (FADs) in the Indian Ocean. *Marine Policy* 45, 163-170

[20] Fonteneau et al (2014). Managing tropical tuna fisheries through limiting the number of fish aggregating devices in the Indian Ocean : food for thought. IOTC-2014-WPPTT16-22.

[21] ISSF (2015). ISSF guide for non-entangling FADs. 7p. http://iss-foundation.org/download-monitor-demo/download-info/issf-guide-for-non-entangling-fads

[22] Escalle et al (2017). Forecasted consequences of simulated FAD moratoria in the Atlantic and Indian Oceans on catches and bycatches. *ICES Journal of Marine Science*. 74: 780-792

[23] Lennert-Cody et al (2018). Recent purse-seine FAD fishing strategies in the eastern Pacific Ocean: what is the appropriate number of FADs at sea ? *ICES Journal of Marine Science*, 75:1748-1757.

[24] Zudaire et al (2018). FAD Watch: a collaborative initiative to minimize the impact of FADs in coastal ecosystems. IOTC-2018-WPEB14-2.

[25] Zudaire et al (2019). Results of BIOFAD project: testing designs and identify options to mitigate impacts of drifting fish aggregating devices on the ecosystem. IOTC-2019-WPTT21-52.

[26] Imzilen et al (2021). Spatial management can significantly reduce dFAD beachings in Indian and Atlantic Ocean tropical tuna purse seine fisheries. *Biological Conservation*, 254:18239

What we have shared about
FISH AGGREGATING DEVICES

Here, we have shared our experience as a purse seine fleet using FOBs in the Atlantic and Indian oceans. We have reviewed the best knowledge we have on dFADs in tropical tuna purse seine fisheries, their use and their management. Among others, we have touched upon longstanding discussions in tuna RFMOs such as the appropriate terminology that should be used, the availability of FOB data and the options for an efficient management and control of FOB fisheries.

We believe that a responsible and transparent use, monitoring and control can ensure sustainable FOB fisheries. This document is our contribution to more transparent FOB purse seine fisheries. We hope that this dictionary of FOB fisheries will help stakeholders speaking the same language when discussing dFADs in tuna RFMOs.

We would like to thank scientists of the Institute of Research for sustainable Development (IRD) and fisheries managers of the Direction des Pêches Maritimes et de l'Aquaculture (DPMA) for their useful comments on this document and more generally all people who have contributed to our own understanding of dFADs.

Any question or suggestion ?
Visit our website : www.orthongel.fr
Contact us by email : orthongel@orthongel.fr

4 WRONG ASSERTIONS ABOUT *Fish Aggregating Devices*

1 We know very few things about dFAD use

incorrect

It was certainly the case until very recently but the amount of information available to scientists and Regional Fisheries Management Organizations (RFMOs) has increased at lot.

Mandatory or voluntary data provision to national scientists, such as FOB trajectory and echosounder data has already contributed to improving the knowledge of FOB fisheries and dFAD / FOB use impacts.

RFMOs also request more and more detailed information on FOB and tracking buoy use, for scientific and compliance purposes. It is however critical that the information required is harmonized among RFMOs and follows scientific recommendations, especially when it comes to using the proper vocabulary. Otherwise, data provided to RFMOs will remain too imprecise to draw reliable conclusions.

2 There is no dFAD management

incorrect

Though this was still mostly the case during the 2010s, things have changed very fast and various FAD/FOB management measures have been adopted by Regional Fisheries Management Organizations (RFMOs).

Among the measures that have been adopted, we may find (depending on the ocean) : limitations of the number of operational buoys, limitations of the number of support vessels, FOB closures, non-entangling dFADs, biodegradable material for the construction of dFADs, …

However, it is true to consider that FOB data, that were only requested in recent years, are still too recent and sometimes too imprecise to correctly assess the effects of all these measures.

3 dFAD fisheries are not sustainable

nuance needed

Yes, using dFADs has consequences and some of these consequences have been addressed only in recent years with management measures whose efficacy still needs to be fully assessed.

Yet, things are never black or white. This is not really the use of dFADs that cannot be sustainable, but the excess use of any fishing equipment. Management measures have been adopted in recent years to avoid such excess use of dFADs.

4 Fishers don't care about the fate of their dFADs

incorrect

Until FOB trajectory data was provided to national scientists for the first time during the 2010s, the magnitude of the problem of derelict dFADs remaining at sea had never been assessed. All stakeholders of the fishery are now aware that actions must be taken to address this issue.

Though things may seem to move too slowly, tests have been carried out in Seychelles (Indian Ocean) by the fleets, in collaboration with local NGOs and scientists. Ongoing collaboration with national scientists also provides more and more precise advice to design effective dFAD recovery programs. Finally, biodegradable dFADs are currently being developed.

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Organisation des Producteurs de thon congelé et surgelé

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