

Should we manage drifting FADs with closures in IOTC ? What can we learn from experience in other RFMOs?

Alexandra MAUFROY¹and Michel GOUJON¹

Abstract

In the Indian Ocean, the potential benefits of implementing a “DFAD closure period” has been extensively discussed in recent years, as a mean to reduce catches of juveniles of yellowfin and bigeye tunas, so as to improve stock status for these two species in the Indian Ocean. In this document, we provide an overview of existing closures in IATTC, ICCAT and WCPFC and past closures in IOTC.

Using catch data in the Indian Ocean, Eastern Pacific Ocean, Western and Central Pacific Ocean and Atlantic Ocean and a review of existing Conservation and Management measures, we examine the following questions : (1) how do purse seine FOB fisheries look like in each tuna RFMO ? (2) why have closures been implemented in t-RFMOs and how ? (3) how is the efficiency of closures assessed in t-RFMOs and are they reaching their objectives ? (4) are there alternative options in place in other t-RFMOs that may be useful to consider in IOTC ?

The comparison of closures across t-RFMOs indicate that this management option has been adopted in other oceans with the primary objective of mitigating catches of juvenile bigeye tuna, through a limitation of FOB catches and/or a limitation of PS fishing effort. Experience in other t-RFMO tends to indicate that the sole implementation of closures is not sufficient and complementary measures are explored or implemented in other oceans (other measures on FOBs, limits on fishing effort, catch limits for other gears, etc).

¹ ORTHONGEL, Concarneau, France. amaufroy@orthongel.fr

Introduction

Since the mid-2010s, all tropical tuna Regional Fisheries Management Organizations (t-RFMOs) have gradually implemented Conservation and Management Measures (CMMs) that have either a direct or an indirect impact on purse seine fleets and their use of Floating Objects (FOBs). Despite the implementation of such CMMs, the appropriate management of drifting FOB fisheries remains a central issue in all t-RFMOs.

In the Indian Ocean, several attempts have been made since 2021 to revise IOTC Resolution 19/02 on *Procedures on a Fish Aggregating Devices (FADs) Management Plan*, with no consensus reached between all CPCs in 2021, 2022 and 2023. In 2023 especially, debates have focused on the potential benefits of implementing a “DFAD closure period”, whose primary objective would be to reduce catches of juveniles of yellowfin and bigeye tunas, to improve stock status for these two species in the Indian Ocean. The implementation of such a FAD closure was adopted during the 6th Special Session on FADs in February 2023 (IOTC Resolution 23/02), with the following provisions :

(Para 26) The IOTC Scientific Committee shall provide advice and recommendations no later than 31 December 2023 on appropriate DFAD management options, in particular a DFAD closure [...] with the objective of achieving a high probability of reducing fishing mortality of juvenile [...] bigeye and yellowfin tuna [...]

(Para 27) In producing its advice and recommendations, the IOTC Scientific Committee shall take into account, inter alia:

a) available IOTC fisheries data;

b) experiences of implementing similar management measures with similar objectives, including DFAD closures, from other RFMOs [...]

The WGFAD working group met in May 2023 and agreed on a workplan to address the provisions of Resolution 23/02 on a potential DFAD closure period, including the following action :

(Action 1) Review closures across tuna RFMOs, including options (full closures, spatial, temporal, to DFADs etc) and describe the contribution of purse seine catch in the IOTC and other RFMOs.

Though more than one-third of IOTC members have objected IOTC Resolution 23/02 since the 6th Special Session on FADs in February (IOTC Circular, it is still worth examining if and how a DFAD closure period would be useful in the context of IOTC to assist managers in their future decision making. In the present document, we therefore (i) provide a comparison of FOB fisheries in IOTC, ICCAT, IATTC and WCPFC (ii) describe existing closures in ICCAT, IATTC and WCPFC and (iii) describe FOB management options that are currently in place or in discussion in the four tropical tuna RFMOs.

1. Terminology used in this document

Before examining the potential benefit of a “*FAD closure*” in IOTC, it is useful to make sure that the terminology used in this document will not be subject to interpretation. The terminology developed in the frame of the European Union CECOFAD project (Gaertner *et al.*, 2016), that was developed to meet both science and management objectives will be used.

In this document, we will distinguish the Floating Objects (FOBs, Figure 1) that have been deployed by fishers to aggregate fish (Fish Aggregating Devices, FADs) from those that fishers can find at sea (logs). We will also distinguish the FOB from the instrumented buoy (Figure 1). The presence of a buoy on a log does not transform that log into a dFAD, but rather into a tracked log.



Figure 1 : dFADs, logs, FOBs and instrumented buoys

The objectives of these separate terminologies on FOBs, dFADs and instrumented buoys are :

For management purposes, to be able to set separate rules for dFADs, logs, FOBs and instrumented buoys if needed. For example, during a moratorium, the following rules could be considered :

- (1) dFAD deployment is forbidden
- (2) buoy deployment is allowed on logs that present a risk of pollution or entanglement of sensitive fauna to facilitate their recovery by a vessel with appropriate equipment / storage
- (3) FOB fishing is forbidden
- (4) dFAD and buoy recovery are allowed to avoid stranding

For science purposes, to be able to assess separately the effects of dFAD use in terms of :

- (1) fishing effort (all tracked FOBs)
- (2) habitat modification and marine pollution (all dFADs, tracked or untracked)

2. How do purse seine FOB fisheries look like in each tuna RFMO ?

IATTC, ICCAT and WCPFC all implement closures that apply to industrial purse seiners (all fishing modes combined or FOB fishing only, see section 3). Examining if and how such measures could be transposed to IOTC requires to understand the specific context of other t-RFMOs.

In this section, publicly available datasets of each t-RFMO are used to describe purse seine fisheries on FOBs and their contribution to total catches in the Indian Ocean (IO), Atlantic Ocean (AO), Eastern Pacific Ocean (EPO) and Western and Central Pacific Ocean (WCPO). As information on the type of fishing set (FOB or Free Swimming School, FSC) is only available from 1991 in Task 2 data of ICCAT and the last year of available information in WCPFC data is 2021, the comparison is made for the period 1991 – 2021. In addition, since industrial tropical tuna purse seiners have changed their strategy since the implementation of the YFT catch limits in 2017, with an increased use of FOB fishing to slow the rate of consumption of their YFT quotas (Floch *et al.*, 2020; Maufroy and Goujon, 2021), the period 2017 – 2021 is considered to be representative of the current situation in IOTC.

2.1 What is the composition of FOB catches of tropical tuna purse seiners ?

In all oceans, FOB catches of purse seiners are dominated by SKJ, followed by YFT and BET though differences exist between oceans (Figure 2). For example, the proportion of YFT in catches of purse seiners on FOBs is the highest in the IO with an average of 26.3 % (S.D. 6.3) since 2017 against 15.9 % (S.D. 3.5) in the EPO. The proportion of BET in catches of purse seiners on FOBs in the IO is also among the lowest, with an average of 7.8 % (S.D. 1.3) over 2017 – 2021 against 16.8 % in the AO.

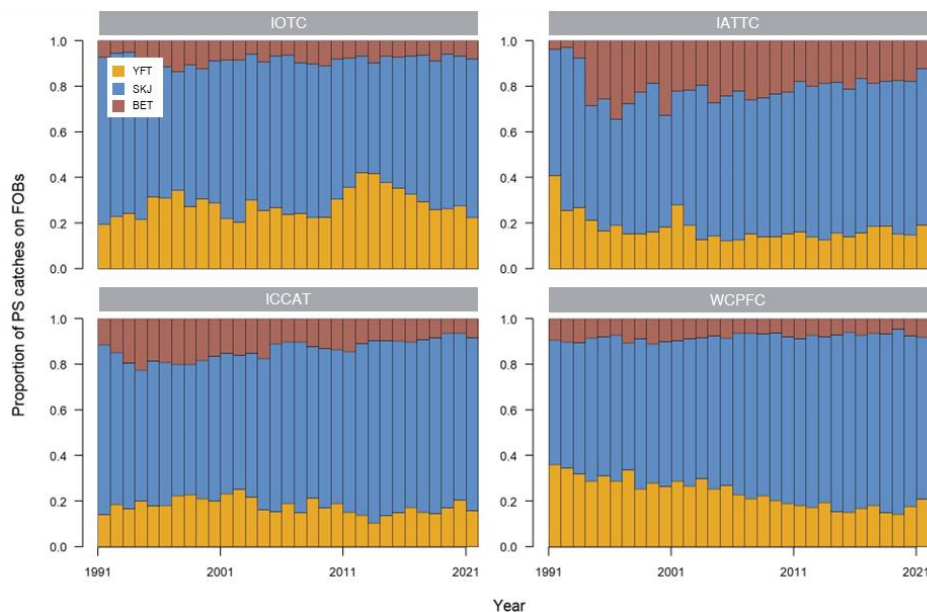


Figure 3 : Relative proportions of YFT, SKJ and BET in purse seine FOB associated catches in each RFMO over 1991 – 2021. PS FOB catches comprise drifting FOBs and aFADs, since only WCPFC makes the distinction between dFADs, logs and aFADs in its publicly available datasets.

2.2 How much do tropical tuna purse seiners rely on FOB fishing ?

Pons *et al.* (2023) recently described the evolution of catches of tropical tuna purse seiners in all oceans, using t-RFMO datasets. Over 2010 – 2020, the proportion of combined catches PS FOB of YFT,

SKJ and BET was of 45% in the WCPO, 52% in the EPO, 75% in the AO and 84% in the IO. This proportion has increased over time in all oceans, except in the WCPO. It is also useful to examine each species separately, especially as the potential implementation of a “*FAD moratorium*” is being discussed for YFT and BET in the IO and the implementation of such a measure should in principle not set an unnecessary reduction of catches of SKJ. The following observations should be made (Fig. 4, Table 2) :

SKJ : In the IO, EPO and AO, SKJ dominates catches of PS with an increase in recent years and an important contribution of FOB fishing. In the WCPO, SKJ largely dominates PS catches, with however a lower contribution of FOBs compared to other oceans.

YFT : In the EPO, PS fish on three types of schools : FOBs and FSC as in other oceans, but also on dolphin-associated schools (DEL) for YFT, with some PS fleets specialized either in FOB or DEL fishing. There is therefore a lower contribution of FOBs to YFT catches.

BET : FOB fishing is the main mode of catch in all areas. A higher contribution of FOB fishing should be noted in the EPO, with almost no contribution of other types of schools.

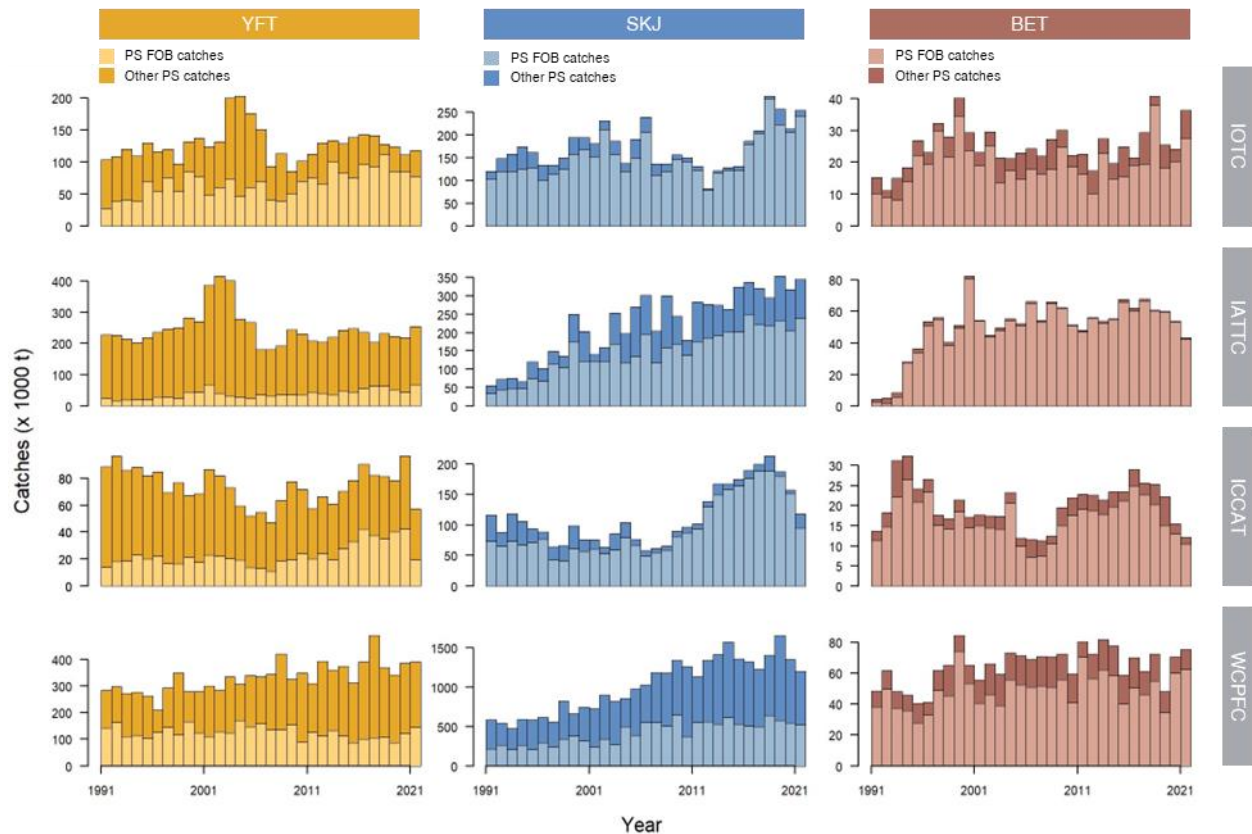


Figure 4 : Yellowfin, skipjack and bigeye tuna catches made by purse seiners on FOBs (light colors) and other types of catches (dark colors) in each RFMO over 1991 – 2021. Other types of FOB catches comprise catches made by purse seiners on Free Swimming Schools (FSC) and dolphins (DEL)

Table 1 : Average contribution of FOBs to PS catches per species over 2017 – 2021.

	YFT	SKJ	BET
IOTC	73.1 % (S.D. 9.2)	94.7 % (S.D. 4.6)	78.2 % (S.D. 10.3)
IATTC	25.9 % (S.D. 4.4)	68.5 % (S.D. 3.8)	98.7 % (S.D. 0.6)
ICCAT	43.7 % (S.D. 6.0)	91.0 % (S.D. 6.6)	81.2 % (S.D. 8.6)
WCPCFC	36.0 % (S.D. 5.8)	48.1 % (S.D. 3.6)	82.0 % (S.D. 6.0)

2.3 How much does FOB fishing by purse seiners contribute to overall catches ?

Though the evolution of the proportion of FOB fishing among PS catches has extensively been described over time, the contribution of PS FOB catches to the total amount caught by all fishing gears with all fishing modes is rarely explored. Such an indicator is useful to assess the efficiency of moratoria that would only target PS FOB fishing.

In the Indian Ocean, PS FOB fishing contributed on average to 38.8% (S.D. 3.8) of yearly catches of YFT (all gears and fishing modes combined) since 2017, 58.4 % (S.D. 3.3) of catches of SKJ and 40.9 % (S.D. 10.4) of catches of BET (Figure 5). Differences exist between oceans, with a lower contribution of FOB fishing to overall catches of YFT in the EPO (24.5 %, due to dolphin-associated fishing sets, S.D. 4.1), a lower contribution of FOB fishing to catches of SKJ in the WPCO (41.9 %, S.D. 2.9) and a higher contribution of FOB fishing to catches of BET in the EPO (66.1 %, S.D. 1.3).

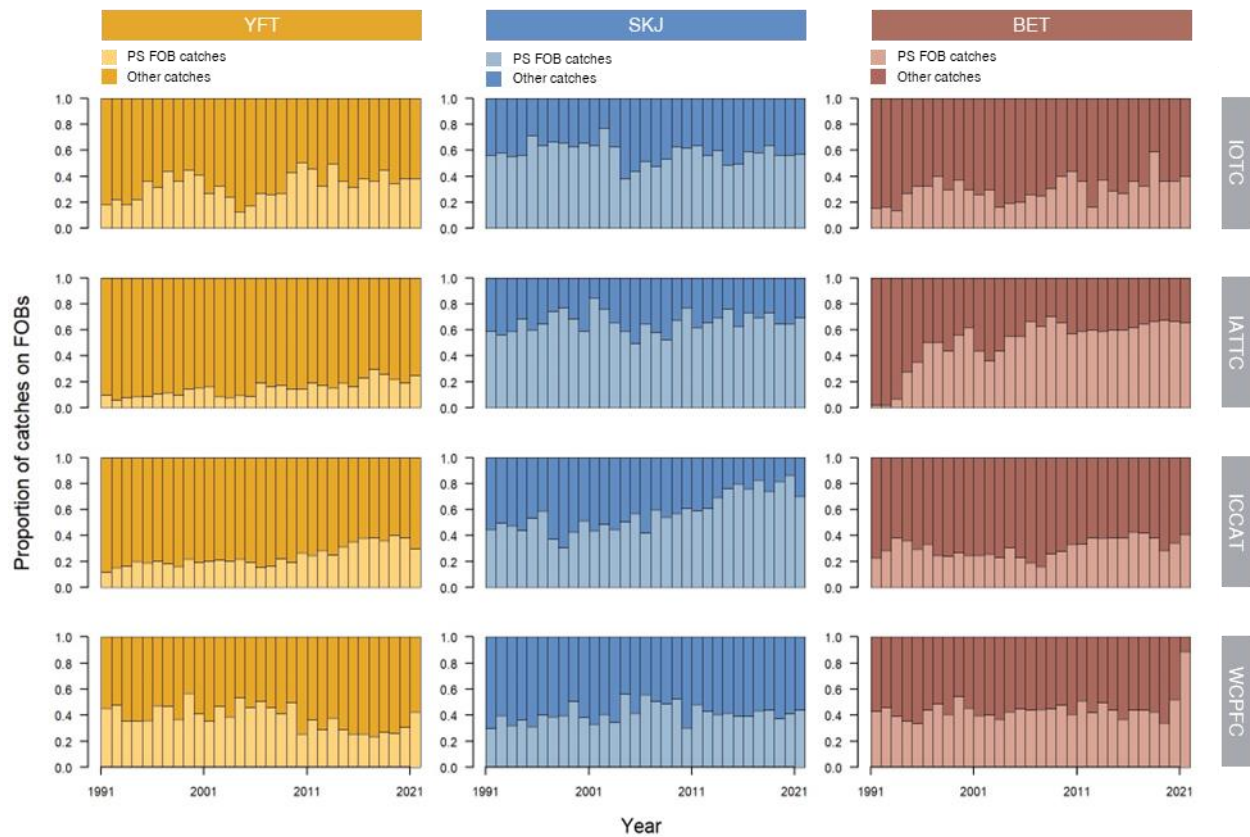


Figure 5 : Relative proportions of PS FOB fishing in the total catch of YFT, SKJ and BET in each RFMO over 1991 – 2021. PS FOB catches (light colors) comprise drifting FOBs and aFADs, since only WCPFC makes the distinction between dFADs, logs and aFADs in its publicly available datasets. Other catches (dark colors) comprise PS FCS catches and catches of other gears.

Differences can also be noted between oceans on the recent evolution of the amount of catches made by purse seiners on FOBs and on all other type of catches (catches of purse seiners on FSC and catches of other gears, Figure 4 and Table 2). In the IO, during the period 2017 – 2021, the average yearly amount of catches of YFT originating from PS fishing increased of 8.3% compared to the period 2012 – 2016 (Figure 6, Table 1). In other oceans, between 2012 – 2016 and 2017 – 2021, despite closures of purse fishing in IATTC and ICCAT (see section), the amount of catches of purse seiners on FOBs increased respectively of 31.4 % and 19.7 %.

In addition, in the case of BET, catches of purse seiners on FOBs have doubled between 2012 – 2016 and 2017 – 2021 in the IO, while it has decreased for other fishing gears and modes of the IO and in all other oceans.

Finally, an important increase of SKJ catches occurred both for PS FOB catches (+ 85.7%) and other types of gears and fishing modes (+ 57.3 %) in the IO though SKJ catches remained stable in the EPO and WCPO and increased for a few years in the AO before decreasing between 2019 and 2021.

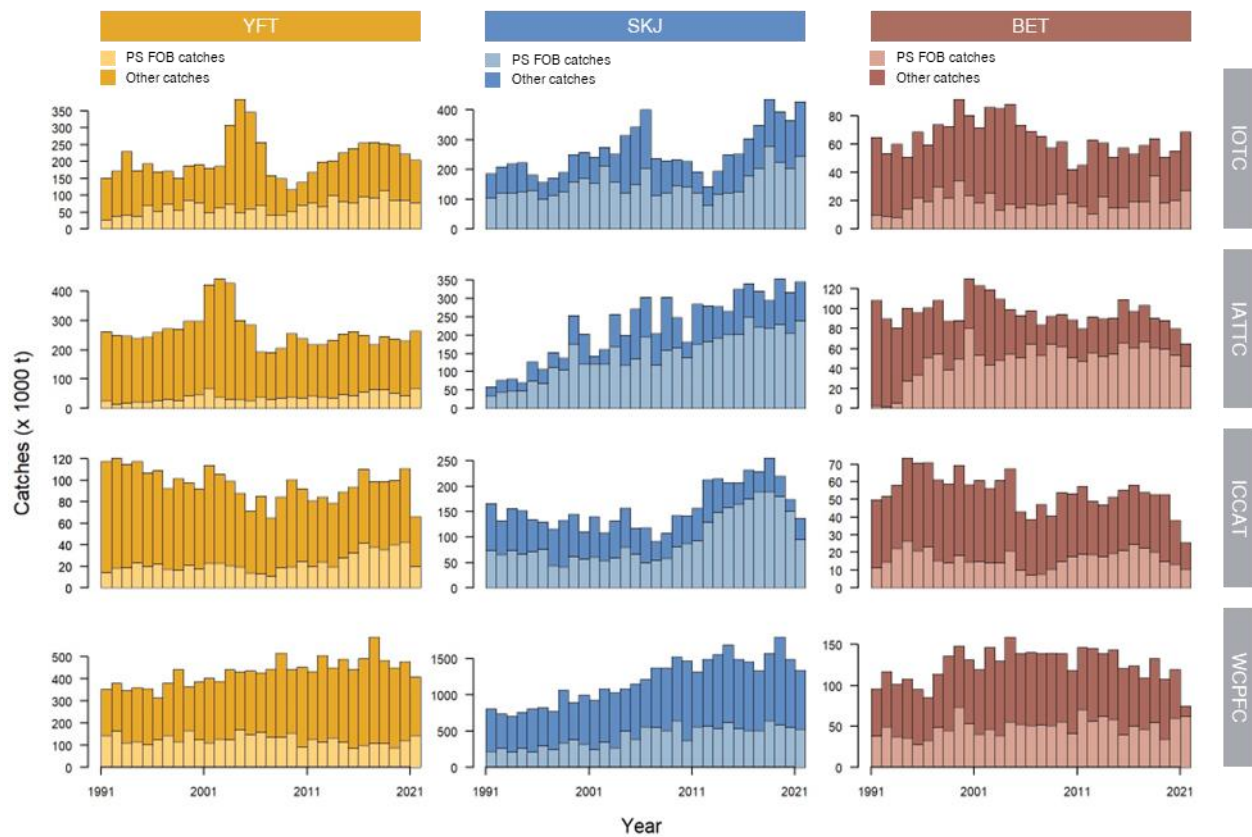


Figure 6 : YFT, SKJ and BET catches made by purse seiners on FOBs (light colors) and other types of catches (dark colors) in each RFMO over 1991 – 2021. Other types of PS catches comprise catches made by purse seiners on FSC, on dolphins (EPO only) or on schools that are “unclassified” in t-RFMO databases.

Table 2 : Percentage of change in the average amount of catches between 2012-2016 and 2017-2021 per species, RFMO and type of catch. Catches made by purse seiners on FOBs are compared to all other type of catches (purse seine catches on FSC and catches of other gears).

	YFT		SKJ		BET	
	PS FOB	Other	PS FOB	OTH	PS FOB	OTH
IOTC	+ 8.3 %	+ 4.4 %	+ 85.7 %	+ 57.3 %	+ 50.3%	- 14.0 %
IATTC	+ 31.4 %	- 9.1 %	+ 8.4 %	+ 12.9 %	- 2.1 %	- 24.3 %
ICCAT	+ 19.7 %	- 3.4 %	+ 3.2 %	- 28.2 %	- 20.3 %	- 10.0 %
WCPFC	+ 1.7 %	+ 1.0 %	+ 0.2 %	- 3.7 %	-7.8 %	- 27.7 %

2.4 What are the key discussions on the impacts of dFADs in each RFMO ?

Relying too heavily on dFADs may impact target tropical tunas through alteration of their natural behaviour (Hallier and Gaertner, 2008; Sempo *et al.*, 2013), contribute to growth overfishing through excess fishing mortality of yellowfin and bigeye tunas (Dagorn *et al.*, 2013; IOTC Secretariat, 2022; Pons *et al.*, 2023), increase levels of non-target catch (Amandè *et al.*, 2008, 2010; Hall and Román, 2013), contribute to ghost fishing of sharks and sea turtles when meshing elements are used for the construction of dFADs (Franco *et al.*, 2012; Filmalter *et al.*, 2013) and contribute to marine litter and deterioration of fragile habitats when dFADs are lost outside fishing grounds (Balderson and Martin, 2015; Maufroy *et al.*, 2015; Escalle *et al.*, 2021; Imzilen *et al.*, 2021).

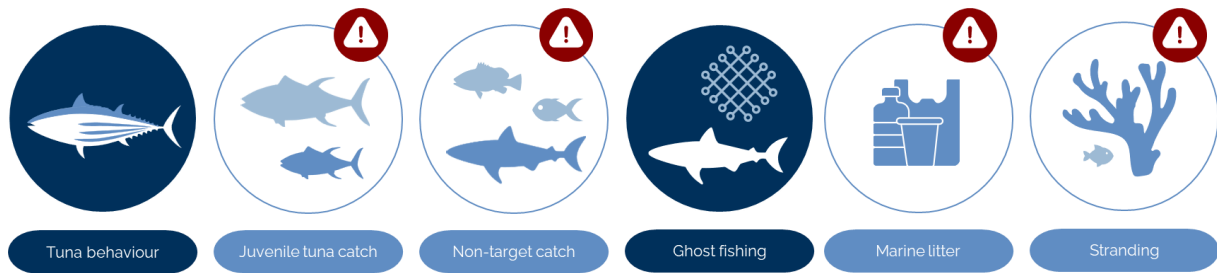


Figure 7 : Main impacts of relying to heavily on FOB fishing. Warning signs indicate those category of impacts that require enhanced assessment and/or management in IOTC (Maufroy and Goujon, 2021).

In the rest of this document, we will primarily focus on the potential impacts of FOB on tropical tuna stock status, these impacts being extensively discussed in IOTC. Other types of impacts will nevertheless be briefly discussed in section 5.

Catches of YFT and BET on FOBs being dominated by juveniles of these two species (Dagorn *et al.*, 2013; Pons *et al.*, 2023), with a decreasing trend in the size of YFT and BET caught by purse seiners (IOTC Secretariat, 2022), the potential benefits of implementing a closure to rebuild YFT and BET stocks of the Indian Ocean has been extensively discussed for several years.

In the other t-RFMOs, where various types of closures are in place, the stock status of BET in the EPO and the AO still require improvement. In the AO and the EPO, the expansion of the FOB fishery made the recent assessment of SKJ and BET more difficult, with issues of convergence of stock assessment models caused by apparent high recruitment (IATTC, 2022).

Table 3 : Status of the YFT, SKJ and BET stocks as assessed in each t-RFMO. For ICCAT SKJ, diagnostics for the eastern and western stocks are combined. Yellow : requires improvement or lack of recent assessment. Red : experiencing overfishing (F) or overfished (SSB). Adapted from ISSF (2023).

	YFT		SKJ		BET	
	SSB	F	SSB	F	SSB	F
IOTC						
IATTC						
ICCAT						
WCPFC						

3. Why have closures been implemented in t-RFMOs and how ?

ICCAT, IATTC and WCPFC implement closures of different nature (FOBs only vs all activities of purse seiners), spatial extent (area closures or whole ocean) and duration, with various objectives (reducing the catch of juvenile tropical tunas and/or managing the capacity of purse seiners) and with different management frameworks. Examining if and how such measures could be transposed to IOTC requires to understand the reasons that motivated the choices made in each t-RFMO. In this section, we describe the FOB or PS closures implemented in other t-RFMOs, the rules that apply during these closures and their objectives. Closures to FOB, PS or LL fishing have also been experimented in IOTC for a few years. They will also be discussed in this section.

3.1 Past FOB closure and PS/LL no-take area in the Indian Ocean

In 1998, as the YFT and BET catches of purse seiners as well as the proportion of their catches on FOBs was increasing, a first voluntary closure was implemented by EU tropical tuna purse seiners in the Indian Ocean from the 15th November 1998 to the 15th January 1999 (Arrizabalaga and Artetxe, 2000; Fonteneau *et al.*, 2000, Figure 8). Though the effects of FOB fishing on BET and YFT were not fully understood, this measure was applied as a precautionary approach to reduce the fishing mortality of juvenile BET (Fonteneau *et al.*, 2000). This voluntary closure was set as an extension of the agreement between Producer Organizations in the ICCAT convention area for the season 1997/1998 and the same rules applied : no dFAD deployment, no FOB fishing, no buoy operation (Morón, 2001; see section 3).

This first moratorium has not been reconducted for the following years, nor since 1998, though options for a dFAD moratorium have been discussed at the Commission and Scientific Committee levels during the late 1990s – early 2000s (Fonteneau *et al.*, 2000; IOTC, 2011). However, a one month no-take area was put in place in 2011 for purse seine (November) and longline (February) as a mean to maintain YFT and BET catches below MSY levels. This solution was adopted as a transitory measure with a view to replace it with catch limits when a TAC allocation scheme would be adopted (IOTC, 2010). It was abandoned in 2015 due to its absence of efficacy, mainly due to the reallocation of effort outside closed months / seasons and lack of clear objectives set by the Commission (IOTC, 2011). Issues with support vessels, that were allowed to visit the area during the closed season, and could therefore transfer buoys of FOBs present in the area were also encountered (Maufroy *et al.*, 2016).

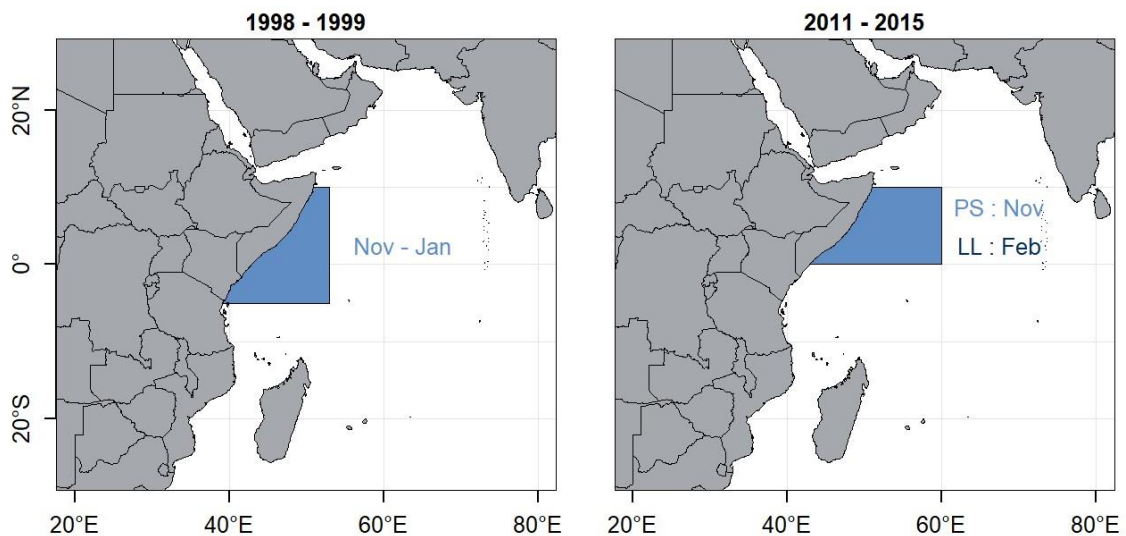


Figure 8 : Successive voluntary FOB and mandatory PS/LL closures in IOTC since 1998. No closure to PS FOB fishing has been implemented in IOTC since 2015.

3.2 The IATTC closures to purse seine

In the EPO, the first measures to be adopted were catch limits from 1966 to 1980. These catch limits were not in place during 1980 – 1997 as fishing effort had decreased (Bayliff, 2016) and their implementation resumed in 1998 (IATTC Resolution C-98-04, IATTC Resolution C-98-05). The catch limits, that were not allocated between IATTC members and therefore created a race to fish, did not managed to stop the capacity of purse seiners from increasing, while at the same time, the capacity of longliners was increasing as well. By the beginning of the 2000s, fishing mortality exceeded F_{MSY} for both BET and YFT and the decision was therefore made to replace catch limits with seasonal closures (Torres-Irineo *et al.*, 2017). Figure 9 presents the evolution of the seasons and zones of closures in the EPO since 2000.

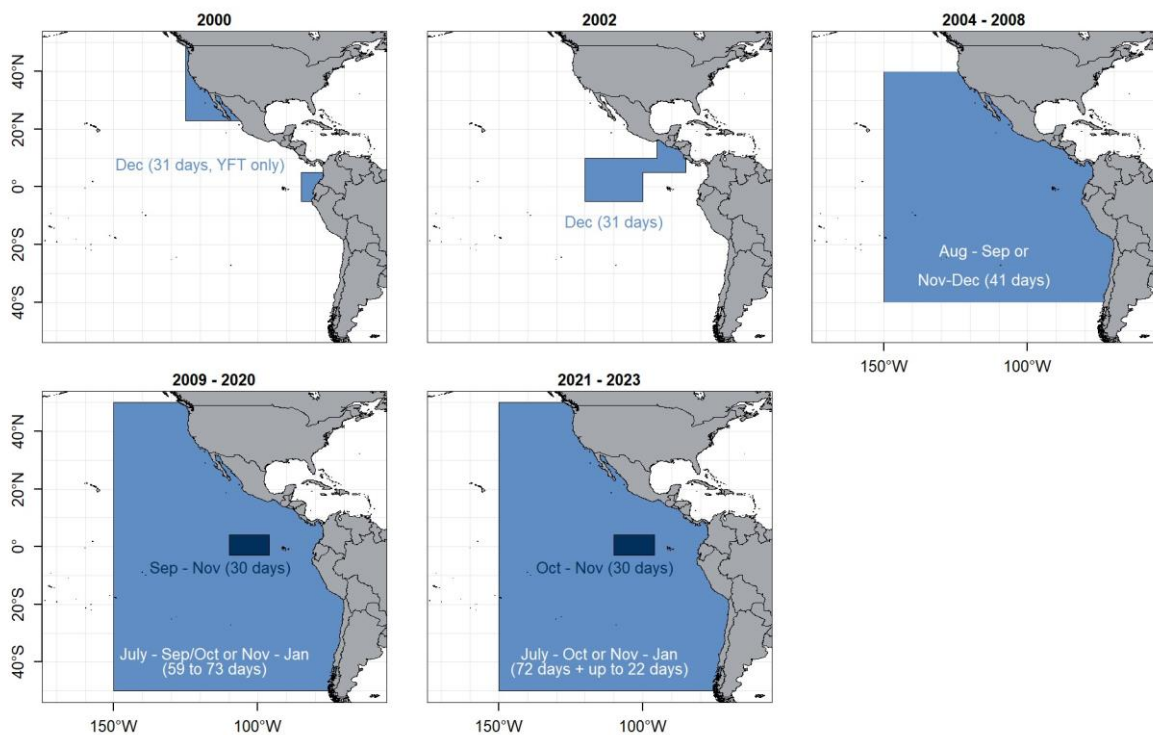


Figure 9 : Successive PS closures in IATTC since 2000. In 2023, the package of measures for the largest purse seiners includes a 72-day closure of the whole IATTC area for class 5-6 purse seiners with a choice between 2 periods (lighter blue), additional days for this closure for purse seiners that have exceeded a threshold of BET catches over 2017-2019 and a closure of the Corralito (dark blue) area for 1 month.

It is worth noting that IATTC closures are not specific to FOB fishing but apply to all types of fishing sets of purse seiners (FSC, FOB, dolphin-associated). Since 2000, these measures have been implemented as a mean to manage the capacity and catch of these fleets, the allocation of catches between purse seiners being a relatively complex process in IATTC, due to their relatively recent history (compared to longline fleets, that are subject to catch limits). The current IATTC Resolution C-21-04 that implements the closure periods for 2022- 2024 was adopted as a mean to prevent fishing mortality of BET to exceed the average fishing mortality of 2017-2019 (*status quo* conditions, IATTC Staff, 2022).

It is also worth noting that IATTC Resolution C-21-04 contains specific measures on dFADs such as a prohibition of dFAD deployment 15 days prior to the closure (as in ICCAT) or an obligation to recover dFADs before the closure. Additional measures on FOB fishing apply in IATTC outside the closed areas/seasons, they will be discussed in section 5.

3.3 The ICCAT closures to FOB activities or surface fishing

In the AO, the first closure (called a “FAD moratorium” in ICCAT) was implemented voluntarily by European Union (EU) PS fleets in 1997 and 1998 with the main objective to avoid high catches of BET juveniles, at a time when fishing effort of purse seine and longline was increasing, leading to growing concerns for this stock. The closure, that prohibited most activities on FOBs and buoys (including deployment and fishing) was adopted for all surface fisheries in 1999 (purse seine and baitboat). As issues of compliance occurred with some purse seine and baitboat fleets, this first closure was replaced with a no-take area of smaller size and shorter duration in 2005, before closures to FOB fishing were implemented again since 2012 (Escalle *et al.*, 2017). Redistribution of fishing effort has been observed outside the closed period/season (Davies *et al.*, 2012) and, since 2020, the closure to FOB activities applies in the whole ICCAT convention area (Figure 10, ICCAT Recommendation 22-01).

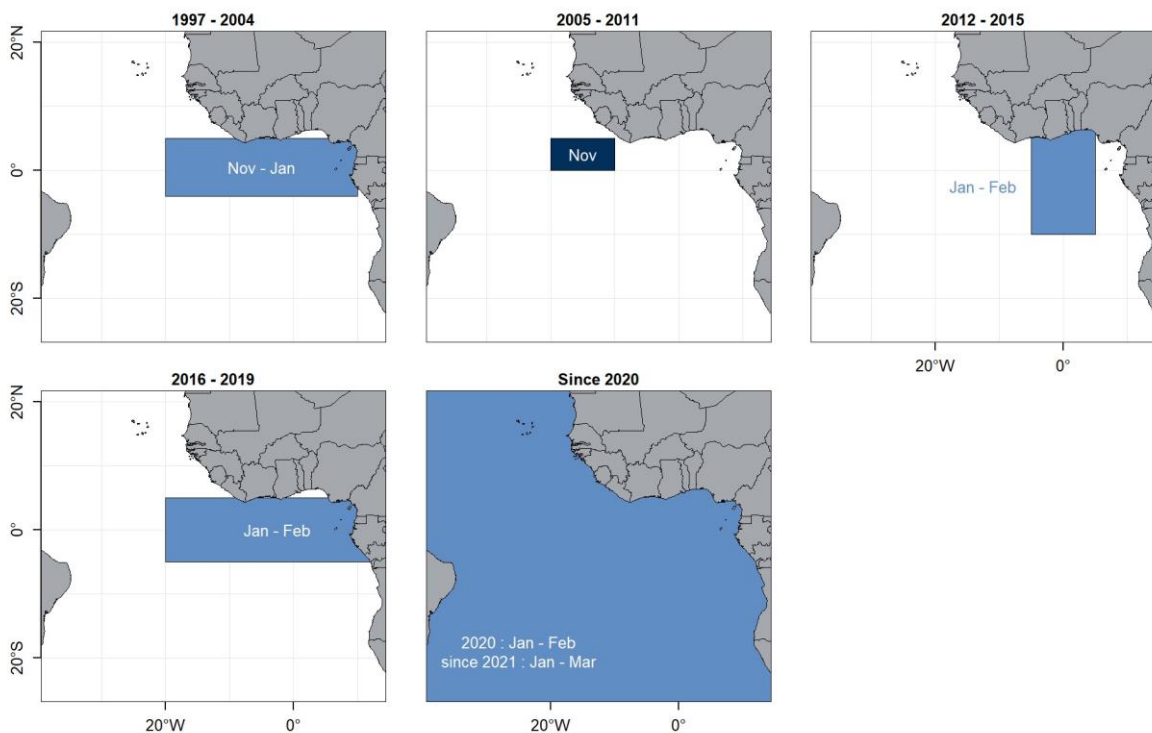


Figure 10 : Successive closures in ICCAT since 2000. Lighter blue : closures to FOB activities of surface fisheries (purse seine and baitboat). Dark blue: the *Piccolo* no-take area for surface fisheries. In 2023, the FAD closure was implemented from January 1st to March 13th.

It is worth noting that the rules on FOB activities during the closures have evolved over time in ICCAT (Table 4), with sometimes changes in terminology that have created less precise rules than in the past (e.g. the list of authorized activities on FOBs and buoys was more precise until 2004 than in 2023).

In its current form, the following rules apply during the closure in ICCAT :

- (1) dFAD deployment is prohibited, starting 15 days prior to the closure
- (2) FOB fishing is prohibited, except on logs that are not equipped with an instrumented buoy

Other types of activities on FOBs, logs and instrumented buoys are not explicitly covered by ICCAT Recommendation 22-01.

Table 4 : Rules applicable during the successive versions of the ICCAT FAD closure. Green : the rule is/was applied. Yellow : the terminology used is subject to interpretation or improvements are needed.

		2000 - 2004	2005 - 2011	2012 - 2015	2016 - 2019	Since 2020
Objectives	Reduced mortality of juvenile YFT					
	Reduced mortality of juvenile BET					
Vessel types	Purse seine					
	Baitboat					
	Supply / support vessels		(1)			
dFAD	Deployment before the closure					
	Deployment during the closure		(1)			(2)
	Fishing					
	Towing outside the area					
Log	Fishing if equipped with a buoy		(1)			
	Fishing if not equipped with a buoy		(1)			(3)
	Towing outside the area					
Buoy	Deployment				(2)	(2)
	Transfer				(2)	(2)
Monitoring	Onboard observers		(1)			(4)
Assessment	Assessment of efficacy by the SCRS					
	Annual report / FAD management plan					
	VMS					

(1) Not mentioned in ICCAT Recommendation 04-01, that was active until 2008.

(2) Subject to interpretation of the terminology of ICCAT Rec 15-01 :

(para 13) Fishing for, or **supported activities** to fish for bigeye, yellowfin and skipjack tunas in association with objects that could affect fish aggregation, including FADs, shall be prohibited

(3) Not mentioned directly in ICCAT Recommendations 20-01, 21-01 and 22-01. Subject to interpretation as only fishing is mentioned for purse seine and baitboat :

(para 27) In order to reduce the fishing mortality of juvenile bigeye and yellowfin tunas, purse seine and baitboat vessels fishing for, or vessels supporting activities to **fish for**, bigeye, yellowfin and skipjack tunas in association with FADs in the high seas or Exclusive Economic Zone (EEZ) shall be prohibited during a seventy-two-day period in 2023, as indicated in paragraph 28 below.

(4) Subject to interpretation due to the definition of dFAD that mixes the notion of dFAD and tracked for in ICCAT Recommendations 20-01, 21-01 and 22-01 :

(para 26) Fish-Aggregating device (FAD): Permanent, semi-permanent or temporary object, structure or device of any material, man-made or natural, which is deployed **and/or tracked**, and used to aggregate fish for subsequent capture.

3.4 The WCPFC closures to PS FOB fishing

In 2008, as the BET stock was assessed to be subject to overfishing, CMM 2008-01 was adopted by WCPFC, as a mean to reduce the fishing mortality for this stock and to maintain YFT at MSY levels. The measure introduced the first closure to FOB fishing, that progressively entered into force in 2009 and 2010 in all types of areas of the WCPO between 20°N and 20°S (Table 5). Since 2009, the closure has been implemented for 2 to 3 months with exemptions for PNA members in they own EEZ during the most recent years. The duration of the closure was set to 4 months between 2013-2017, with an exemption from the fourth month for fleets with a limit on FOB fishing sets. Deploying dFADs and aFADs, fishing on FOBs and “servicing” FOBs is prohibited during the closure.

Since 2014, additional months of closure (1 or 2 months) have been added in the high seas (with exemptions for a few WCPFC members in some areas). Fishing on FOBs is prohibited (i.e. no fishing set should occur within 1 nautical mile of a FOB, or, in case a dFAD is retrieved by another vessel, no fishing set should occur within 1 nautical mile of the retrieval position for 24 hours). Retrieving dFADs is authorized only if the instrumented buoy is retrieved as well and if “*the vessel does not conduct any set either for a period of seven days after retrieval or within a fifty mile radius of the point of retrieval of any FAD*”.

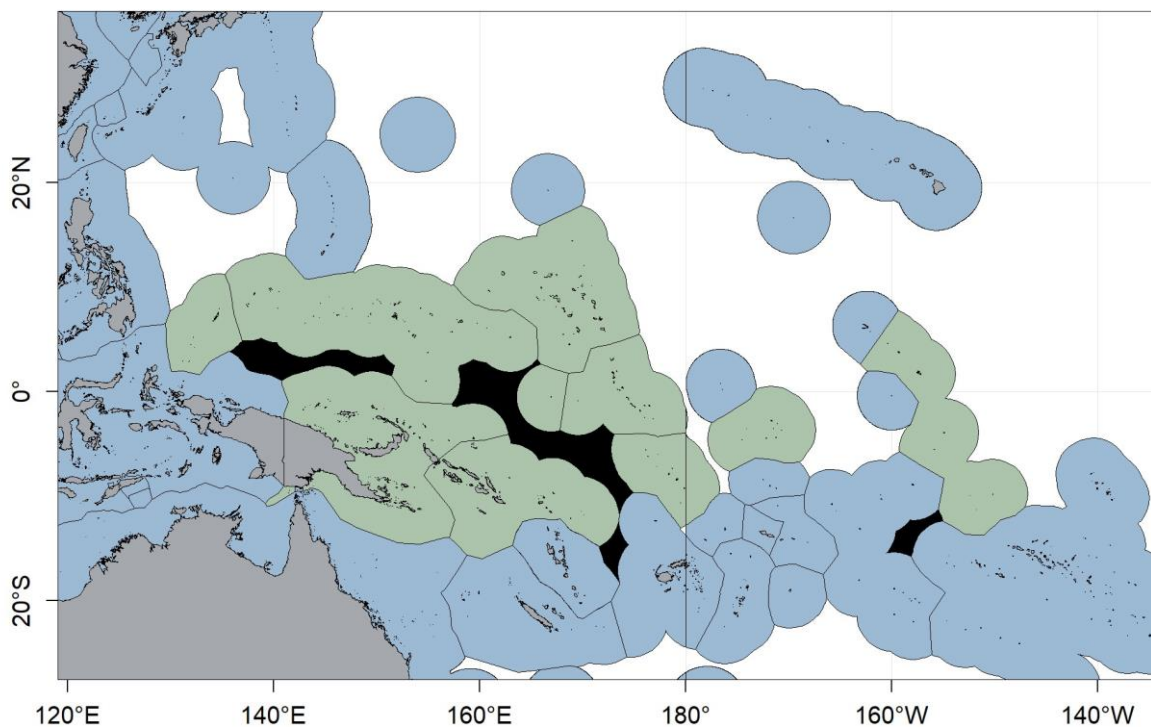


Figure 11 : The WCPFC convention area. In green : PNA EEZs. In blue : other EEZs. In black : high seas pockets. In 2023, PS FOB fishing is closed between 20°N and 20°S from the 1st July to the 30th September. An additional 2-month closure to PS FOB fishing apply in the high seas with a choice of two periods : April-May or November-December (WCPFC CMM 2021-01).

Complementary measures limit fishing effort of purse seiners all year round, either through limits of fishing days or through specific measures applicable in EEZs of PNA (Parties to the Nauru Agreements).

Table 5 : Rules applicable during the FOB closure in the WCPO since 2009, per year and per type of area. Closures to PS FOB fishing and other measures are applicable from 20°N to 20°S.

Year	High seas	EEZs
2009	Choice between : (i) FOB fishing closed from 1 st August – 30 th September (ii) BET catch limit (-10% compared to 2004 or avg of 2001-2004)	In PNA EEZs, combination of : (i) FOB fishing closed from 1 st August – 30 th September (ii) Vessel Day Scheme (number of days ≤ 2004) In other EEZs, choice of measures to reduce juvenile BET mortality.
2010 - 2012	FOB fishing closed from 1 st July – 30 th September High seas pockets surrounded by PNA EEZs closed all year	In PNA EEZs, combination of : (i) FOB fishing closed from 1 st July – 30 th September (ii) Vessel Day Scheme (number of days ≤ 2004) In other EEZs, choice of measures to reduce juvenile BET mortality.
2013 - 2014	FOB fishing closed from 1 st July – 30 th September Choice between : (i) FOB fishing closed in October (one additional month) (ii) Limit on FOB fishing sets	FOB fishing closed from 1 st July – 30 th September Choice between : (i) FOB fishing closed in October (one additional month) (ii) Limit on FOB fishing sets Vessel Day Scheme for PNA EEZs (fishing days ≤ 2010) In other EEZs, limitation of fishing effort (fishing days ≤ 2004 or avg of 2001-2004)

Table 5 (continued) : Rules applicable during the FAD closure in the WCPO since 2009, per year and per type of area. Closures to PS FOB fishing and other measures are applicable from 20°N to 20°S.

Year	High seas	EEZs
2015 - 2016	<p>FOB fishing closed from 1st July – 30th September</p> <p>Choice between :</p> <ul style="list-style-type: none"> (i) FOB fishing closed in January – February and number of FOB sets \leq average of 2010-2012 ⁽¹⁾ (ii) Limit on FOB fishing sets 	<p>FOB fishing closed from 1st July – 30th September</p> <p>Choice between :</p> <ul style="list-style-type: none"> (i) FOB fishing closed in January - February (ii) Limit on FOB fishing sets <p>Vessel Day Scheme for PNA (fishing days \leq 2010)</p> <p>In other EEZs, limitation of fishing effort (fishing days \leq 2010 or avg of 2001-2004)</p>
2017	<p>FOB fishing closed from 1st July – 30th September</p> <p>Choice between :</p> <ul style="list-style-type: none"> (i) FOB fishing closed in January – February and number of FOB sets \leq average of 2010-2012 (ii) Limit on FOB fishing sets <p>FOB fishing closed in the high seas ⁽²⁾</p>	<p>FOB fishing closed from 1st July – 30th September</p> <p>Vessel Day Scheme for PNA (fishing days \leq 2010)</p> <p>In other EEZs, limitation of fishing effort (fishing days \leq 2010 or avg of 2001-2004)</p>
2018 - 2022	<p>FOB fishing closed from 1st July – 30th September ⁽²⁾</p> <p>Choice between 2 periods for additional months of closure ⁽²⁾ :</p> <ul style="list-style-type: none"> (i) April - May (ii) November – December 	<p>FOB fishing closed from 1st July – 30th September</p> <p>Vessel Day Scheme for PNA</p> <p>Limitation of fishing effort in EEZs and in the high seas ⁽³⁾</p>

(1) Only for CCMs that are not Small Island Developing States (SIDs).

(2) Various exemptions apply for PNA members, specific rules apply for Philippines flagged vessels, exemptions apply for some WCPFC members in the high seas or in some high seas pockets

4. How is the efficiency of closures assessed in t-RFMOs and are they reaching their objectives?

4.1 Efficiency of the past FAD closure and PS/LL no-take area in the Indian Ocean

Following the voluntary closure of 1998/1999, the IOTC Commission requested that the Scientific Committee examined the potential benefits of implementing such a closure to reduce the fishing mortality of juvenile BET. Analyses of spatio-temporal patterns of catches of tropical tuna purse seiners during the 1990s indicated that a main season for FOB fishing occurred east of Somalia from August to November, with a peak of catches from September to October. Catches on FOBs representing the vast majority of catches in this area and during this season, a full closure to PS fishing was therefore recommended around September / October (Fonteneau *et al.*, 2000).

This proposal was not adopted by the Commission in 2000 (Morón, 2001) and the following closure to purse seine fishing only occurred 11 years later. For this closure, it was finally the month of November that was retained by the Commission (IOTC, 2010), at a time when purse seiners used to leave the Somali FOB fishing grounds to fish on Free Swimming Schools in the eastern part of the fishing grounds (Fonteneau *et al.*, 2000; Maufroy *et al.*, 2017).

A few months only after the implementation of one-month closures to LL and PS fishing in 2011, the Scientific Committee was already drawing the attention of the Commission on a potential lack of efficacy of the measure due to (1) a lack of clear objectives for the measure and (2) a potential redistribution of fishing effort outside the closed area (IOTC, 2011). Preliminary analyses indicated that the one-month closure or a year round closure of the target area, combined with other spatial management in place in the Indian Ocean, was likely to have little impacts on YFT due to a potential displacement of fishing effort (Martin *et al.*, 2011). In addition, though purse seine fishing was prohibited in November, support vessels could still access the area and make buoy transfers (change of buoys) which was perceived by some PS fishers as creating an unfair competition between purse seiners with or without a support vessel (Maufroy *et al.*, 2016).

4.2 Efficiency of PS closures in IATTC

In the EPO, decision-making on the management of tropical tuna has most of the time followed the recommendations of the IATTC scientific staff since the 1990s (Bayliff, 2016). Nevertheless, the management of catches of juvenile tropical tunas has remained a challenge in the EPO, as in the IO (see section 4.1) and the AO (see section 4.3).

Indeed, as explained earlier, closures to PS fishing have been implemented as a mean to avoid any further increase in fishing effort, both for purse seine fleets specialized in FOB and DEL fishing. 23 years after the first implementation of a closed area/season, the fishing effort of the purse seine fleet is still increasing (IATTC, 2021). In addition, changes in the behaviour of some PS fleets have been observed as mean to maintain the number of fishing days or fishing sets (e.g. reduced time spent at port ; Torres-Irriero *et al.*, 2017).

The duration of the closures have increased over time and could be an answer to such issues. However, increasing the duration of closures may also have undesired consequences, such as a too high reduction of SKJ catches in the EPO. The sole implementation of closures to PS fishing has therefore not be recommended in this area in the past (Harley and Suter, 2007) and complementary measures have been explored. They include a range of complementary input controls for PS FOB fishing (see section 5.2).

4.3 Efficiency of the ICCAT closures to FOB activities or surface fishing

In the Atlantic Ocean, the Scientific Committee on Research and Statistics (SCRS) has been in charge of assessing the efficiency of the successive closures in the ICCAT Convention area since the adoption of the first mandatory closure for the season November 2000 / January 2001. The work of the SCRS has often highlighted a lack of efficiency of the closures for several reasons.

First, though it has been the case in some versions of the FAD closure (e.g. from 2000 to 2004, to target the period of recruitment of BET, Goujon and Labaisse-Bodilis, 2000), the choice of the period and the area has most of the time not been based on sound scientific advice. The closures have therefore not always contributed to the desired reduction of the fishing mortality of BET (Fonteneau *et al.*, 2015) and fluctuations in catches have been more related to changes in fishing effort than to the effects of closures (Ariz *et al.*, 2009).

Secondly, the behaviour and strategies of surface fleets have challenged the closures, with issues of compliance for baitboat and non-EU purse seine fleets (Torres-Irineo *et al.*, 2011; Fonteneau *et al.*, 2015) or reallocation of effort (Goujon and Labaisse-Bodilis, 2000) outside closed area/seasons. Attempts have been made to overcome these issues by :

- (1) extending the PS FOB closure to all types of fishing activities (FOB and FSC) and surface fleets (purse seine and baitboat) for the 2005 – 2011 closure to facilitate verification of compliance
- (2) extending the PS FOB closure to the whole ICCAT convention area since 2020 as a mean to avoid reallocation of fishing effort as a mean to avoid the allocation of effort during the closure period.

Assessing the efficiency of closures whose spatial extent, period, duration and rules have highly changed over time is also a challenge in the Atlantic Ocean. In 2022, Santiago *et al.* conducted a comparison of the proportion of juveniles of BET and YFT in PS FOB catches during the five successive closures with the proportion of juvenile catches from 1991 to 1999, when no mandatory closure was in place in ICCAT. Though the results they obtained indicated an apparent reduction of juvenile catches during the successive closures, they should be taken with caution, since the period 1991-1999 is not necessarily comparable with the current situation and includes 1998-1999, when the mandatory EU PS FOB closure was in place already (Goujon and Labaisse-Bodilis, 2000). In addition, authors have also indicated that more reductions of YFT juvenile catches are expected during the 4th quarter and during the 1st and 4th quarter for BET juvenile catches. The authors also noted that the 1st and 4th quarters were the most important in terms of SKJ catches.

New analyses were recently presented in September 2023 by Akia *et al.*, 2023. Spatio-temporal hotspots of juvenile BET, juvenile YFT and SKJ catches caught on FOBs were identified with the objectives of identifying optimal FOB closure zones and seasons. Though preliminary, results indicate that the current whole AO moratorium could be replaced with smaller closures during the first quarter and from September to November. These closures would need to be combined with other management measures (e.g. restrictions to PS FOB fishing and LL fishing in spawning areas, catch limits, operational buoy limits, support vessel limits). Discussions of this document at SCRS level have raised the question of the past redistribution of fishing effort outside closed area/seasons.

27 years after the implementation of the first ICCAT closure, it is therefore still difficult to evaluate its efficiency and to provide scientific advice for its optimal implementation (*whole AO – short duration vs seasonal closures of hotspots*).

4.4 Efficiency of PS closures in WCPFC

In the WCPO, the stock of BET was assessed to be overfished, CMM 2008-01 was adopted by WCPFC in 2008 as a mean to reduce fishing effort of 30% (Hampton, 2010). During the following years, the assessed status of the BET stock aggravated and the stock was assessed to experience overfishing (Harley *et al.*, 2010, 2014; Davies *et al.*, 2011). As stock status of BET was not improving and solutions to avoid a further increase of fishing mortality for YFT were not found, repeated calls for improvement of management in WCPFC were made (e.g. Hanich, 2012). In 2017 however, a new BET stock assessment, using a revised growth curve and spatial structure was conducted, resulting in a more optimistic assessed stock status (not overfished, no subject to overfishing ; McKechnie *et al.*, 2017). The management objectives adopted at WCPFC levels therefore shifted from reducing fishing effort to preventing any further increase in fishing effort (SPC, *comm pers*).

The assessment of the efficiency of adopted CMMs is conducted by the Pacific Community (SPC) in the WCPO. The methodology used by SPC translates the CMMs into a range of possible scenarios of purse seine fishing effort and longline catch and assesses their consequences for the stocks of BET, YFT and SKJ. In the case of BET, a risk of increase of fishing mortality was found in 2022, with a risk of F exceeding MSY level for the most pessimistic scenario used in the assessment. Though these results are influenced by scenarios of recruitment, there is a non-negligible risk that CMM 2021-01 does not achieve its objectives for BET (SPC, 2022).

As for other oceans, it is worth noting the difficulties encountered in the WCPO, so as to inform IOTC or the issues that would need to be taken into account before deciding on the implantation on a FOB closure. The following observations should be made for the WCPO :

- (1) FOB closures have contributed to a large decrease of BET catches by purse seiners during the closure months (Post and Squires, 2020)
- (2) Effort creep has been experienced, with an increased productivity and a decreased number of days without fishing set (Tidd *et al.*, 2015, 2016). Note that in this region, only one FOB fishing set per day occurs at sunrise (SPC, *comm pers*)
- (3) Finding trade-offs between fleets and WCPFC members is a complex process. Longliners would be the main beneficiaries of reduced catches of juvenile BET but PNA members and PS operators are highly dependent on SKJ caught under FOBs (Hampton, 2010), though a significant fraction of SKJ is caught in FSC unlike in other oceans (Figure 4)
- (4) Closures may have strong negative economic consequences for fleets, coastal states and the supply chain. In the WCPO, where purse seine catches are not managed with quotas, it has been suggested that alternative management options, such as a limit on FOB fishing set would reduce economic burden and more efficiently limit fishing effort (Holmes *et al.*, 2019)
- (5) Exemptions from the FOB closures apply for some WCPFC members in their EEZ and/or specific HS pockets, which in turn leads to reflagging of distant water fleets to PNA flags, causing concerns on a potential increase of BET catches (Post and Squires, 2020). BET catches reached their highest levels since 2014 in 2021-2022 (Williams and Ruaia, 2023)

5. Are there alternative options in place in other t-RFMOs that may be useful to consider in IOTC ?

Managing the impacts of PS FOB fisheries through closed seasons or areas is not the only option currently in place or discussed in other RFMOs. Table 6 summarizes the management options available at each step of the lifecycle of FOBs and their instrumented buoys, their potential benefits and their current status in IOTC, IATTC, ICCAT and WCPFC. Complementary options and assessment of their efficacy can be found in Pons *et al.* (2023), ORTHONGEL (2021) and Maufroy and Goujon (2021).

Potential alternative management measures to closures, that are likely to have an effect on juvenile catches of BET (and to a lesser extent on catches of juveniles of YFT), without increasing other undesired effects of FOB use include :


























































- (1) Limits on dFAD deployments (not implemented in any t-RFMO)
- (2) Limits of operational buoys replaced by limits on a dFAD register (suggested in IOTC but not in place in any ocean, potentially not more efficient than current buoy limits / FAD logbooks for IOTC; Maufroy *et al.*, 2022. Currently, only PNA has a FAD register in place but it is not used to limit dFAD deployment use. IATTC has examined the implementation of a FAD register but abandoned this option).
- (3) PS catch limits split between juveniles and adults for YFT, so as to avoid the shift towards an increased use of FOB fishing observed after the implementation of the YFT catch limits in IOTC in 2017 (not in place in any t-RFMO and should be examined in the light of past experiences of catch/size limits in other t-RFMOs).

6. What would be the future steps in IOTC ?

Table 7 presents a summary of existing closures in other t-RFMO and the rules that apply during this FOB or full closures to purse seine fishing. This table will need to be examined during the 5th IOTC Working Group on FADs Meeting and could be used to inform IOTC Commissioners on potential types of closures. It is important to note that some of the rules applicable during FOB closures introduce exceptions or require a greater clarity (e.g. due to the definition of what is a FAD).

In this document, available information on catches and management decisions of IOTC, IATTC, ICCAT and WCPFC were examined, with a focus on options that could reduce the fishing mortality of juvenile BET and YFT caught under FOBs. Such kind of exercises are very useful to inform both the Scientific Committee and the Commission on ongoing work in other t-RFMO. One recommendation that can be drawn from this exercise would be to foster exchanges between t-RFMO. At science level, this could be achieved by regular contribution of scientists attending meeting of other t-RFMOs, regular participation of science staff of other t-RFMOs to IOTC FAD Working group or a joint t-RFMO science FAD Working group.

Table 6 : dFAD and buoy management measures implemented or examined in t-RFMO and their objectives. Measures that are likely to have undesired consequences on stocks are ecosystems are further discussed in ORTHONGEL, 2021.

When ?	How ?	What for ?	What for ?						IOTC	IATTC	ICCAT	WCPFC
			Tuna behaviour	Tuna juveniles	Non-target	Ghost fishing	Marine litter	Stranding				
Construction		NEFADs								2025	LER FADs	2024
		bioFADs							E	2030	E	E
		Buoy purchase limits										
Deployment		FAD deployment limits										
		FAD deployment zones										
		Support vessel limits							Limit	Ban		
Tracking		Operational buoy limits							300	340 < In 2026	300	350
		Support vessel limits							Limit	Ban		
		FAD / buoy register										PNA

	target of impact the measure		adopted
	potential unwanted increased impact		in progress or encouraged (E)
			examined and not adopted

Table 6 (continued) : dFAD and buoy management measures implemented or examined in t-RFMO and their objectives. Measures that are likely to have undesired consequences on stocks are ecosystems are further discussed in ORTHONGEL, 2021.

When ?	How ?	What for ?						IOTC	IATTC	ICCAT	WCPFC	
		Tuna behaviour	Tuna juveniles	Non-target	Ghost fishing	Marine litter	Stranding					
Visit and fishing		FOB fishing sets limits										
		FOB fishing moratorium								+ FSC		
		Fishing effort limit / VDS										
		Catch limits										
End of use		Recovery							E	E		E
		Buoy deactivation rules										

target of impact the measure
 potential unwanted increased impact

adopted
 in progress or encouraged (E)
 examined and not adopted

Table 7 : Summary of rules applicable during closures in IATTC, ICCAT, WCPFC. Note that the IATTC closures are full closures to PS fishing (FOBs, FSC and DEL associated-fishing sets).

Category	Restricted activity	IATTC	ICCAT	WCPFC
FAD	Deployment	Grey	Dark Green	Dark Green
	Fishing	Dark Green	Dark Green	Dark Green
	Retrieval	Grey	Grey	Light Green
Log	Fishing	Dark Green	Yellow	Dark Green
Buoy	Deployment	Grey	Yellow	Dark Green
	Transfer	Grey	Yellow	Dark Green
	Retrieval	Grey	Yellow	Light Green
FSC	Fishing	Dark Green	Grey	Light Green

activity is restricted during the closure
 allowed under conditions
 unclear terminology or exceptions apply

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