AN UPDATE ON THE DYNAMICS OF THE SATELLITE-TRACKED BUOYS USED IN THE LARGE-SCALE PURSE SEINE FISHERY OF THE INDIAN OCEAN, 2020-2023

IOTC Secretariat

Abstract

In 2023, the DFAD purse seine fishery in the Indian Ocean consisted of 47 large-scale purse seiners assisted by 11 support vessels. The total fishing capacity of the fishery was approximately 100,000 m^3 for that year, corresponding to about 74,000 t of fish. Despite recent changes in the fleet, the composition of the fishery has remained stable in recent years. The total number of buoys used in the fishery exhibits significant monthly variability due to the seasonality of the DFAD fishery and the catch limits imposed on purse seiners as part of the yellowfin tuna rebuilding plan. In 2023, an average of 10,700 buoys were used daily in the fishery, equating to roughly 226 buoys monitored daily by each vessel. Maintaining the standing stock of DFADs in purse seine fishing grounds requires continuous deployments to compensate for buoy loss caused by ocean currents, sinking, and retrieval by fishery vessels during buoy transfers to appropriate floating objects encountered at sea. Between January 2020 and December 2023, data collected by the Secretariat indicate that approximately 100,000 buoys were deactivated and replaced to support the fishing activities of the Indian Ocean large-scale purse seine fishery.

Introduction

The overarching objective of this paper is to provide participants at the 6th Working Group on FADs (WGFAD06) with a status update on the information available regarding the satellite-tracked buoys used to monitor the drifting fish aggregating devices and natural floating objects used in the large-scale purse seine fishery of the Indian Ocean. The dataset, compiled from the data submitted by the CPCs to the Secretariat provides an overview of the spatio-temporal extent and dynamics of buoy usage from January 2020 to December 2023.

Materials & Methods

Fishery vessels and capacity

Since 2003, the IOTC has monitored fishery vessels authorized to fish on the high seas of its area of competence through the Record of Authorized Vessels (RAV) (IOTC Res. 19/04). CPCs must report the active vessels list (AVL) to the Secretariat by February 15th each year, detailing fishery vessels recorded in the RAV that were active in the previous year (IOTC Res. 10/08). Information on vessel length overall (LOA; m), gross tonnage (GT), and fish hold volume (FHV; m3) is included in these reports. We compiled information on active large-scale purse seiners using DFADs and their support vessels up to 2024 to describe the main recent features of the Indian Ocean DFAD fishery (IOTC Secretariat 2023).

FOB-tracking data

CPCs with fishing vessels using drifting floating objects (FOBs) have the obligation to report daily information on all active FOBs monitored at sea with satellite-tracked buoys since January 1st, 2020 (IOTC Res. 19/02). Drifting FOBs include both fish aggregating devices (FADs), man-made rafts constructed by the industry on land or at sea, and natural or artificial objects of animal origin or resulting from human activities (**Appendix I**). The information reported to the Secretariat must follow the structure of reference codes embedded in IOTC form 3BU and contain the date of the month, the instrumented buoy ID, the assigned purse seine vessel, and one single daily position

for each monitored buoy. The forms must be compiled at monthly intervals and reported to the IOTC Secretariat with a time delay of at least 60, but no longer than 90, days from the end of the reference month.

Data coverage

This global dataset covers the period from 01 January 2020 to 31 December 2023 and does not include any information for (i) the six Kenyan-flagged purse seine vessels of around 50 m length overall which operated in the Indian Ocean between January 2020 and September 2021 despite some anecdotal evidence of the presence of electronic buoys on the vessels and (ii) one Omani purse seine vessel (**Appendix II**).

FOB trajectories

For each buoy, we reconstructed different FOB trajectories at sea, defined as series of uninterrupted successive positions with no temporal gaps in location data exceeding seven days. Additionally, we ensured that the distance between successive points was less than 861 km, which represents the maximum observed distance travelled by a buoy during seven consecutive days. Observations associated with speeds higher than 5.5 knots (corresponding to the 99.9th percentile of the dataset) were excluded. To analyse the dynamics of buoys, we computed for each day the number of buoys that were activated and supposedly deployed at sea to become operational (i.e., not present in the previous days) and number of buoys deactivated (i.e., removed from the stock of operational buoys due to loss, transfer, etc.).

Results & Discussion

Composition of the fishery

Since 2020, the number of active large-scale purse seine vessels has been stable at around 46, representing an annual mean capacity of 96,200 m^3 (**Fig. 1**). Based on the linear relationship established between fish hold volume (m^3) and fish carrying capacity (metric tonnes; t) from a subset of large-scale purse seiners in the eastern Pacific Ocean (Justel-Rubio and Recio 2023), this corresponds to approximately 75,000 t of fish. Between 2023 and 2024, the total number of purse seiners decreased from 47 to 45 following the departure of three Mauritian (BELLE ISLE, BELLE RIVE, BELOUVE) and one French vessel (TALENDUIC) to the Pacific Ocean, and the arrival of the GALERNA LAU and CAPE CORAL under the Mauritian flag.

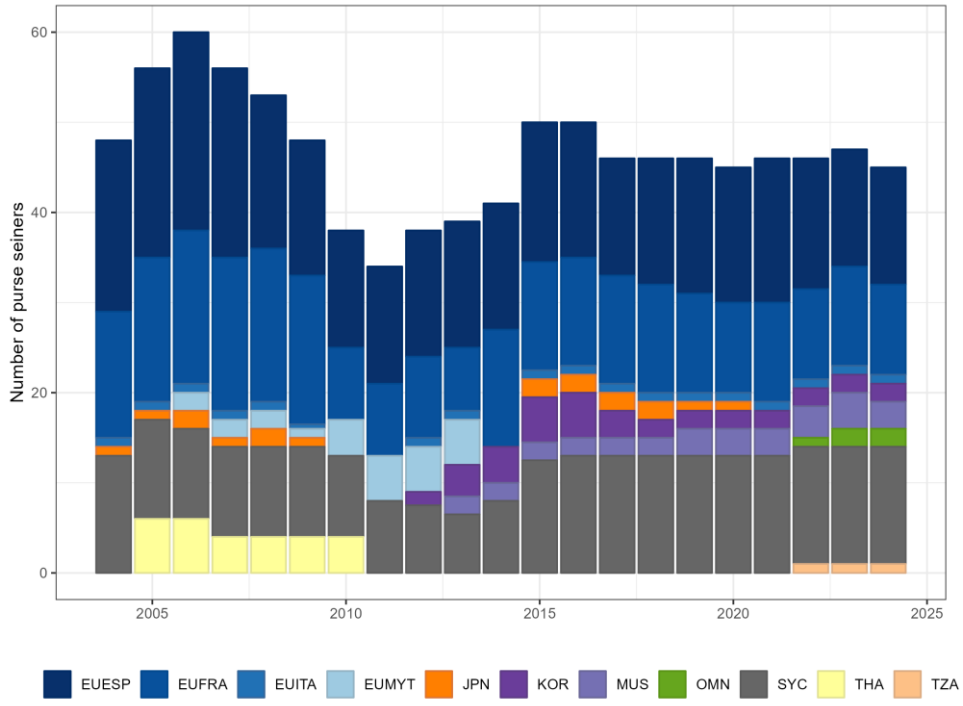

Fig. 1. Fleet composition of the Indian Ocean large-scale purse seine fishery. Number of purse seine vessels by fleet during the period 2004-2024. A weight of 0.5 was given to the vessels that changed flag during a given year

In 2023, the number of support vessels in the fishery was 11, corresponding to an overall ratio of about 4 purse seiners per support vessel (**Fig. 2**).

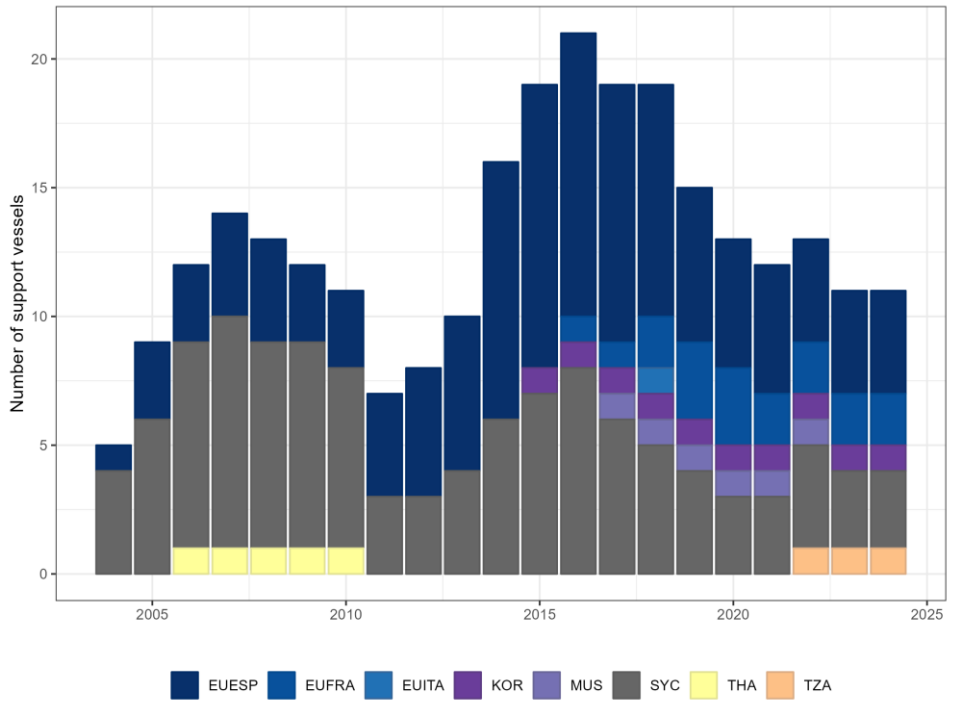

Fig. 2. Fleet composition of the Indian Ocean large-scale purse seine fishery. Number of support vessels by fleet during the period 2004-2024

FOBs monitored at sea

The total number of buoys transmitting daily has shown large variations since January 2020, with strong seasonality observed. Monthly mean values ranged from a high of 11,873 in February 2020 to a low of 8,785 in

December 2021 (**Fig. 3**). Each year, the maximum number of buoys observed corresponds to August-September, when most purse seine fishing activities occur in the northwestern part of the western Indian Ocean, off the coasts of Somalia. At the end of the year, there is a substantial decrease in the number of buoys, likely related to some purse seine vessels stopping operations after reaching their individual catch limits in connection with the rebuilding of the yellowfin tuna stock (Res. 21/01).

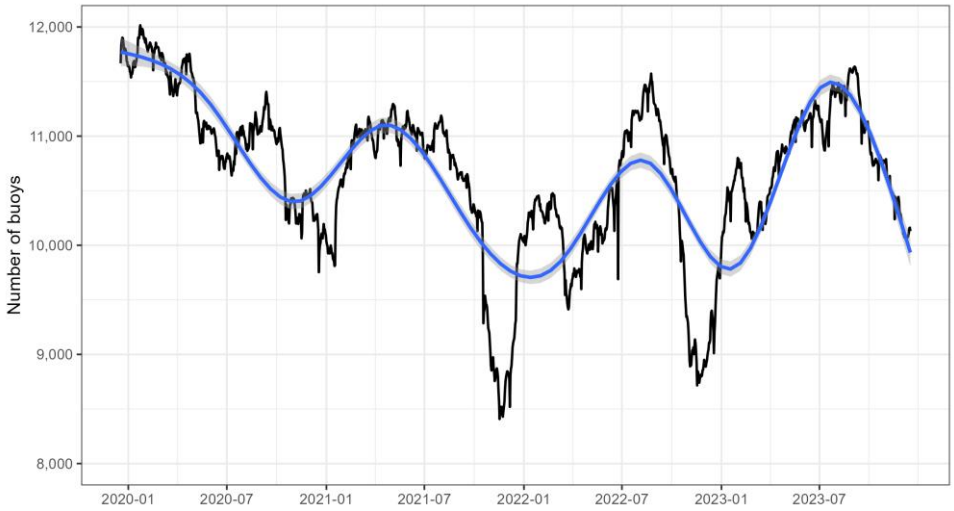

Fig. 3. Daily number of drifting floating objects (FOBs) monitored in the large-scale purse seine fishery of the Indian Ocean between 2020-01-01 and 2023-12-31. The blue solid line is a generalised additive model fitted to the data to visualise the temporal trend

Between early January 2020 and late December 2023, the mean number of buoys monitored daily in the fishery was 10,653. To maintain their stocks of buoys at sea, both purse seine and support vessels continuously deploy new DFADs equipped with buoys while retrieving or losing others (Imzilen et al. 2022). The dynamics of buoy activation and deactivation are high, and the cumulative numbers of these two processes show similar patterns, with values reaching about 100,000 by late 2023 (**Fig. 4**).

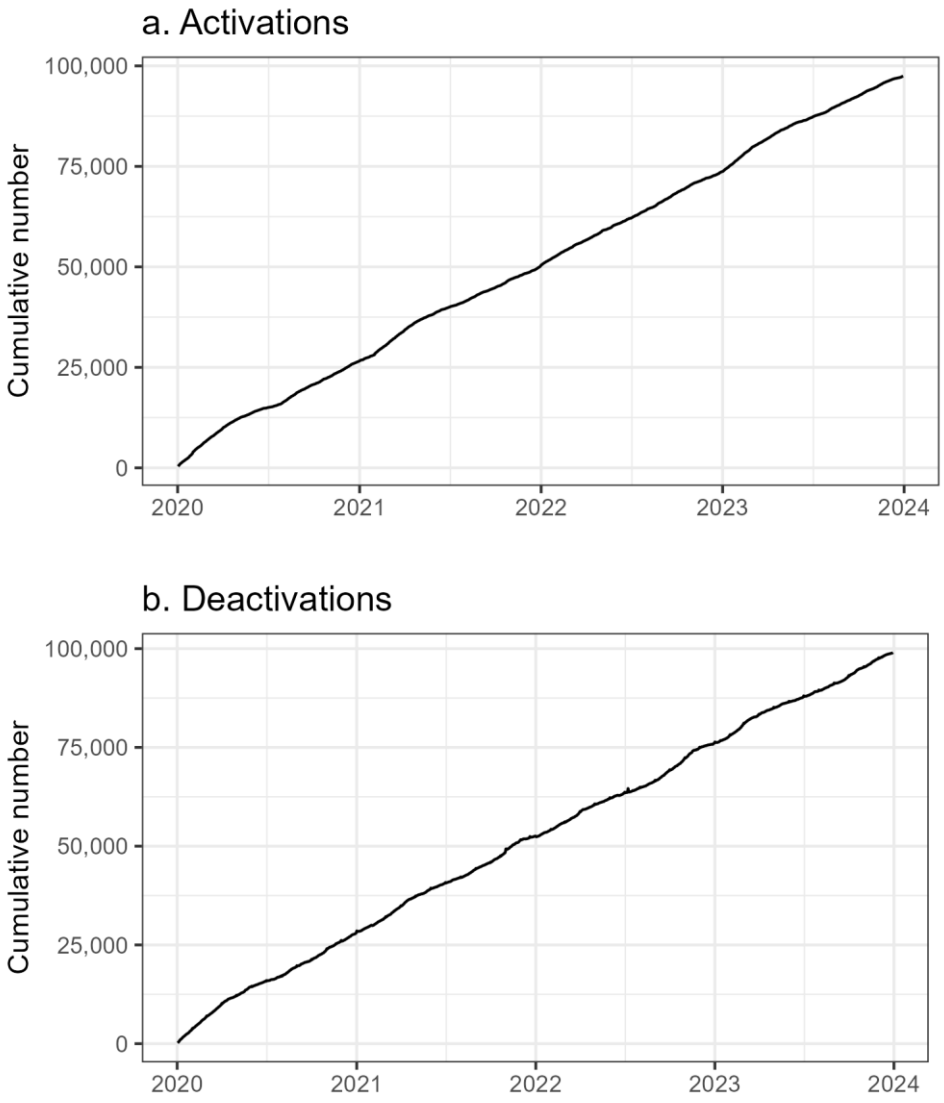

Fig. 4. Cumulative daily number of buoy (a) activations and (b) deactivations in the Indian Ocean large-scale purse seine fishery between 2020-01-01 and 2023-12-31

Acknowledgments

We are grateful to the Observatoire des Ecosystèmes Pélagiques Tropicaux exploités (Ob7) from the French national Research Institute for Sustainable Development (IRD) for providing access to the TURBOBAT vessel registry.

References

Imzilen, T., Lett, C., Chassot, E., Maufroy, A., Goujon, M., and Kaplan, D.M. 2022. Recovery at sea of abandoned, lost or discarded drifting fish aggregating devices. Nature Sustainability: 1–10. doi:10.1038/s41893-022-00883-y.

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Appendix I: IOTC classification of types of drifting floating objects

Tab. A1: Classification of types of drifting floating objects in use at the IOTC Secretariat

CODE	FOB_TYPE
ANLOG	Natural object of animal origin
DFAD	Drifting FAD
FALOG	Artificial object resulting from human activity (and related to fishing activities)
HALOG	Artificial object resulting from human activity (not related to fishing activities)
VNLOG	Natural object of plant origin

Appendix II: Buoy data coverage

Tab. A2: Overview of the buoy position data set between 01 January 2020 and 31 December 2023 as available at the IOTC Secretariat. PS = Number of purse seiners. Note the same purse seiner may appear in different fleets in case of change of flag over the period considered. Buoys shared among the fleets of EU,France, EU,Italy, Mauritius, and Seychelles are repeated for each of them

YEAR	CPC	FLEET_CODE	PS	DAYS	POSITIONS	BUOYS
2020	EU	EUESP	15	366	1,459,581	14,242
2020	EU	EUFRA	11	366	3,086,904	8,546
2020	EU	EUITA	1	366	226,579	2,504
2020	JPN	JPN	2	88	4,353	109
2020	KOR	KOR	2	366	288,086	1,381
2020	MUS	MUS	3	366	515,353	2,788
2020	SYC	SYC	13	366	1,406,849	13,394
2021	EU	EUESP	16	365	1,343,232	13,956
2021	EU	EUFRA	10	365	3,088,548	9,000
2021	EU	EUITA	1	365	285,636	3,494
2021	KOR	KOR	2	273	219,619	1,348
2021	MUS	MUS	3	365	975,284	3,933
2021	SYC	SYC	13	365	1,491,882	13,728
2022	EU	EUESP	15	365	1,265,491	12,871
2022	EU	EUFRA	10	365	2,880,152	8,934
2022	EU	EUITA	1	365	255,214	3,315
2022	KOR	KOR	2	365	188,334	1,503
2022	MUS	MUS	4	365	915,327	4,054
2022	OMN	OMN	1	171	31,621	441
2022	SYC	SYC	13	365	1,110,494	11,841
2022	TZA	TZA	1	283	58,436	745
2023	EU	EUESP	13	365	1,168,754	10,535
2023	EU	EUFRA	11	365	2,874,140	9,301
2023	EU	EUITA	1	365	270,936	3,327
2023	KOR	KOR	2	365	185,683	1,663
2023	MUS	MUS	4	365	734,192	3,367

YEAR	CPC	FLEET_CODE	PS	DAYS	POSITIONS	BUOYS
2023	OMN	OMN	1	365	76,996	819
2023	SYC	SYC	13	365	1,179,652	11,446
2023	TZA	TZA	1	365	83,834	1,090

Appendix III: Composition of the large-scale purse seine fishery, 2024

Tab. A3: Number of active vessels in the large-scale purse seine fishery of the Indian Ocean in 2024

VESSEL_TYPE	FLEET_CODE	FLEET	N
Purse seine vessel	EUESP	EU (Spain)	13
	EUFRA	EU (France)	10
	EUITA	EU (Italy)	1
	KOR	Republic of Korea	2
	MUS	Mauritius	3
	OMN	Sultanate of Oman	2
	SYC	Seychelles	13
	TZA	United republic of Tanzania	1
Support vessel	EUESP	EU (Spain)	4
	EUFRA	EU (France)	2
	KOR	Republic of Korea	1
	SYC	Seychelles	3
	TZA	United republic of Tanzania	1