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FLOATING-OBJECT FISHERY INDICATORS: A 2024 REPORT

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SUMMARY

The importance of monitoring the FAD fishery as a whole has widely been claimed by scientists, managers and other stakeholders. Based on the recommendations and guidelines of the joint technical Working Group on FADs (Lopez, 2019), as well as the repeated requests by some member countries on the production of specific data and analyses (e.g. IATTC-93 INF-A), this document compiles a comprehensive series of spatial and temporal indicators for the floating-object fishery in the EPO with the aim to better monitor and assess its potential impacts in the short, medium and long term. The indicators have been grouped into 8 categories: catch and effort, activities on FADs, satellite buoy-based indices, capacity, technology, ecosystem impacts, socio-economic, and biology, ecology and behavior. This document also informs data collection and reporting needs on FADs and prioritize FAD-related future actions for conservation and management of target, non-target species and the ecosystem.

1. INTRODUCTION

The tropical tuna purse-seine fishery in the eastern Pacific Ocean (EPO) is one of the biggest in the world, with recent annual catches exceeding 950,000 tons (SAC-16-01). Also, recently, about 65% of the catches correspond to the floating object (OBJ) fishery, which includes man-made fish aggregating devices (FADs) and natural objects (logs). However, the vast majority of activities conducted by purse seiners (e.g. sets, deployments) since mid-90s are on FADs (SAC-16-01).

Despite being a very efficient fishing tool, the continual increase in the use of FADs by the purse seine fishery raises the possibility of several potential negative impacts on ecosystems and tuna populations. Examples include i) a reduction in yield per recruit of some tuna species, ii) increased bycatch and perturbation of pelagic ecosystem balance, iii) increased amount of marine debris and stranding events on sensitive habitats, and, iv) alteration of the normal movements of the species associated with FADs (Dagorn et al. 2012; Escalle et al. 2019). Because of the multi-dimensional potential impacts of the fishery, it must be holistically monitored through a series of comprehensive metrics and indicators that capture its evolution and dynamics at different spatial and temporal scales. Considering a wide variety of indicators can improve both the integral assessment of the impacts of the fishery and the utility and interpretation of the results, whereas single indicators can be misleading and lead to conservation measures that do not meet management objectives.

The importance of monitoring the FAD fishery as a whole has widely been claimed by scientists, managers and other stakeholders, who, during the 1st joint t-RFMO Working Group (WG) on FADs meeting in Madrid in 2017, agreed to establish a small technical working group (TWG) to progress on key areas for future action. These aspects, largely technical or of scientific nature, range from the development of harmonized definitions to the coordination of regional and international research plans, but also include the development of fishery indicators, a task led by the IATTC staff within the TWG between 2018 and 2020. An extensive list with more than 40 indicators grouped in 8 categories (Table 1), from catch and effort to ecosystem indicators (Lopez, 2019), was presented and discussed during the 2nd joint t-RFMO Working Group on FADs meeting in San Diego in 2019. The process resulted in 4 of the categories considered as "major" priority indicators: catch and effort, activities on FADs, satellite buoy-based indices, and capacity (Table 1). Indicators related to the technology onboard and ecosystem impacts were classified as "moderate" priority level. Socio-economic and biology, ecology and behavior indicators, although important, were considered as "minor" priority level by this first assessment, particularly due to the difficulties to regularly obtain reliable and significant amounts of data on these matters.

Based on the recommendations and guidelines of the TWG , as well as the repeated requests by some member countries on the production of specific data and analyses (e.g. IATTC-93 INF-A), this document compiles a comprehensive series of spatial and temporal indicators for the floating-object fishery in the EPO with the aim to better monitor and assess its potential impacts in the short, medium and long term. It also informs data collection and reporting needs on FADs and prioritize FAD-related future actions for conservation and management of target, non-target species and the ecosystem.

TABLE 1. A list of the indicator types considered by Lopez *et al.* 2019 and discussed and prioritized during the 2nd joint t-RFMO working group on FADs.
TABLA 1. Lista de los tipos de indicadores considerados por Lopez *et al*. 2019 que fueron discutidos y priorizados durante la segunda reunión del Grupo de Trabajo conjunto de las OROP atuneras sobre plantados.

Indicator Type	Priority level (1 Major, 2 Moderate, 3 Minor)
Catch and effort	1
Activity	1
Buoy/FAD use	1
Capacity	1
Technology	2
Ecosystem Impacts	2
Socio-Economic	3
Biology, Ecology and Behavior	3

2. MATERIALS AND METHODS

2.1. Data

Five main datasets were used in the study:

a. 2019-2024 [1] AIDCP observer data for Class-6 vessels (>363 mt), which contain FAD-related information such as deployment, origin, and object characteristics, as well as on fishing activities on FADs. This dataset was used to estimate the indicators in the following categories: fleet behavior, activities, and technology.
b. Catch and effort data for all vessels (Classes 1-6), from observers and vessel logbooks. This dataset was exclusively used to estimate catch and effort indicators, including catch by set type, catch by species, and number of OBJ sets, among others.
c. Daily active buoy data for 166 vessels (Classes 1-6) reporting under Resolution C-17-02 and C-20-06 between 2018-2021 and Resolution C-21-04 in 2022-2024. Daily vessel coverage and reporting rates vary by size class and month (e.g., min = 135, mean = 152, max = 166 for 2024), with not all vessels present in the active buoy dataset at any one time. See 2024 report of the Review Committee for further details on data reporting rates and categories. This dataset was used to estimate the indicators in the buoy-based indices category.
d. 2022-2024 monthly remote deactivation and reactivation data for all vessels (Classes 1-6), reported by the fleet under Resolution C-21-04. This data was used to estimate remote deactivation and reactivation indicators in section 3.4.6.
e. 2020-2024 FAD form data for all vessels without observers (Class 1-5), reported by the fleet under Resolution C-19-01 and C-23-05. This data was used to complement table 2 and 3 in the activities category.

Indicators for categories biology, ecosystem impacts and capacity were not estimated in this study but extracted from the fishery status report (FSR) (SAC-16-01) and the Ecosystem Consideration report (EB-03-01). The indicators included in this document refer mainly to FADs, unless the contrary is specified.

[1] Except for the long-term deployment and retrieval indicator, where 2005-2024 data were used

2.2. Methods

Because the degree to which each vessel fishes on OBJ is vessel-specific, all the indicators were, when possible, broken down into different OBJ-usage strategies and categories (see section 3.1. below for details) to better understand and detect the fishery evolution and dynamics.

All the indicators were estimated for 2024 and averaged for the previous five years (i.e. 2019-2023) to allow comparison between periods and detect potential anomalies; the exceptions are catch and effort indicators, which are taken from the FSR and have longer time series, and the long-term deployment and retrieval trend, an indicator repeatedly requested by some Members. In addition, yearly indicators were also estimated, as well as trip (e.g. activities within the trip), quarterly (e.g. activities), monthly (e.g. buoy-densities) or daily (e.g. total active buoys) indicators, when appropriate and depending on data availability, quality and resolution. A 1°x1° cell resolution was used to estimate spatial indicators. Summary statistics, convex hull areas (i.e., density areas where 66% of the activites of the fleet segments occur), and boxplots, as well as frequency and density histograms were also produced to describe the general trends of many indicators, particularly those based on observer data to depict cluster-specific dynamics (see section 3.1 for clustering details).

When observer data were used to estimate indicators, data corresponding to Class 1-5 vessels and Class-6 vessels conducting less than 5 OBJ sets per year were not included based on the following reasons: i) few Class-6 vessels conduct less than 5 OBJ sets per year and their impact on the OBJ fishery is negligible compared to the rest of the FAD-oriented vessels, which are the focus of this document; ii) Class 1-5 vessel data are not collected systematically for the whole fleet, lack consistency (e.g. voluntary versus mandatory programs, yearly differences in coverage and quality, time series), and in the past, have typically corresponded to vessels that needed to carry an observer for specific reasons (e.g., certification purposes, closure fishing). The lack of clarity on the representativeness of the FAD form 09-2018[2] is latter is of particular importance (a logbook designed to be used by skippers of small unobserved vessels; Res C-19-01) as it intends to collect the most significant FAD-oriented data for vessels not carrying observers (e.g., activities, bycatch of sensitive groups of species, FAD characteristics by Class 1-5 vessels). Due to recent improvements, the reporting ratio and the quality of the data currently being provided on the FAD form may be indicative for this component of the fleet, although numbers should be considered with caution at this stage. Because of this, some of the indicators estimated using only Class-6 data (e.g. activities), or using data not fully reported (e.g., buoy-based indices), might be understimates. Nonetheless, we believe that those indicators represent well Class-6 vessels patterns and depict properly overall trends for the whole fleet.
Specifics on the exceptions, rules and assumptions considered in the development of each indicator, if any, are specified for each indicator below.

3. INDICATORS

3.1. Fleet behavior

To identify fleet segments among Class-6 vessels based on their fishing strategies, a cluster analysis was conducted using operational characteristics related to OBJ fishing (number of vessels per year included in the analysis: min = 127, max = 153, mean = 140). Only Class-6 vessels making at least five OBJ sets per year during 2019-2024 were considered (for convenience, detailed results of the cluster are only shown for the analysis year, 2024). The methodology described in Lennert-Cody et al. (2018) was applied, where vessels were grouped into different fleet segments based on the following variables: (i) proportion of OBJ sets by object "origin" category (FADs deployed by the vessel on the current trip or a previous trip; FADs

[2] Download at https://www.iattc.org/Downloads.htm

deployed by other vessels, either “given” by another vessel or encountered opportunistically, “taken”; unmonitored drifting objects – presumably natural objects such as logs); (ii) proportion of sets made by type (on tuna associated with dolphins, “DEL”; on unassociated schools of tuna, “NOA”; on OBJ); and (iii) proportion of OBJ sets made in the western EPO (west of 100°W).

The cluster analysis indicated several clear vessel groupings with different fishing behaviors (Figs 1-2). There are three main clusters in the dendrogram produced by the cluster analysis, labelled Clusters A-B-C. Cluster A is comprised of vessels for which about 30% or more of their sets were DEL, with many making almost exclusively DEL sets. Most of the OBJ sets made by the vessels in Cluster A tended to be on FADs that were “taken” or were on unmonitored drifting objects, presumably logs. The majority of OBJ sets conducted by vessels in Cluster A were west of 100°W. The number of vessels in Cluster A ranged from 19 to 40 in the study period and the 2024 value was 20 (Figs 1-2). Cluster B is comprised of vessels that primarily made OBJ sets, with a few vessels also making UNA sets and almost no vessels making DEL sets. OBJ sets of the vessels in Cluster B tended to be west of 100°W and were primarily on FADs deployed by the vessels themselves or on FADs that were “given”. The number of vessels in Cluster B ranged from 35 to 79 in the study period and the 2024 value was 79 (Figs 1-2). Cluster C is comprised of vessels that mostly made a lesser proportion of OBJ sets and a greater proportion of UNA sets, as compared to the vessels in Cluster B, with few vessels making DEL sets. Vessels in Cluster C tended to make more OBJ sets east of 100°W and a greater proportion of their OBJ sets were on FADs that were “taken” or were on unmonitored drifting objects, presumably logs. The number of vessels in Cluster C ranged from 44 to 77 in the study period and the 2024 value was 44 (Figs 1-2). The number of vessels in Cluster B and C increased and decreased, respectively, in 2024 compared to those found by Lopez et al. 2020 (FAD-05-INF-A), Lopez et al. 2021 (FAD-05-INF-C), Lopez et al. 2022 (FAD-06-01), Lopez et al. 2022 (FAD-07-01), and Lopez et al. 2023 (FAD-08-01) for 2018-2023 and by Lennert-Cody et al. (2018) for 2012-2015, suggesting that a growing proportion of vessels have relied more heavily on FAD-oriented fishing strategies (i.e., monitoring and fishing their own-FADs) in 2024. All three fleet segments seem to represent different OBJ-fishing strategies (e.g., Cluster B – nearly pure OBJ-oriented, fishing FADs monitored by themselves, so a clearer connection between active FADs and number of sets should be expected, for example). Therefore, the cluster analysis results were used to break down the indicators by cluster when possible, so that a better understanding of the relationship between the different metrics and the trends included in this document is possible.

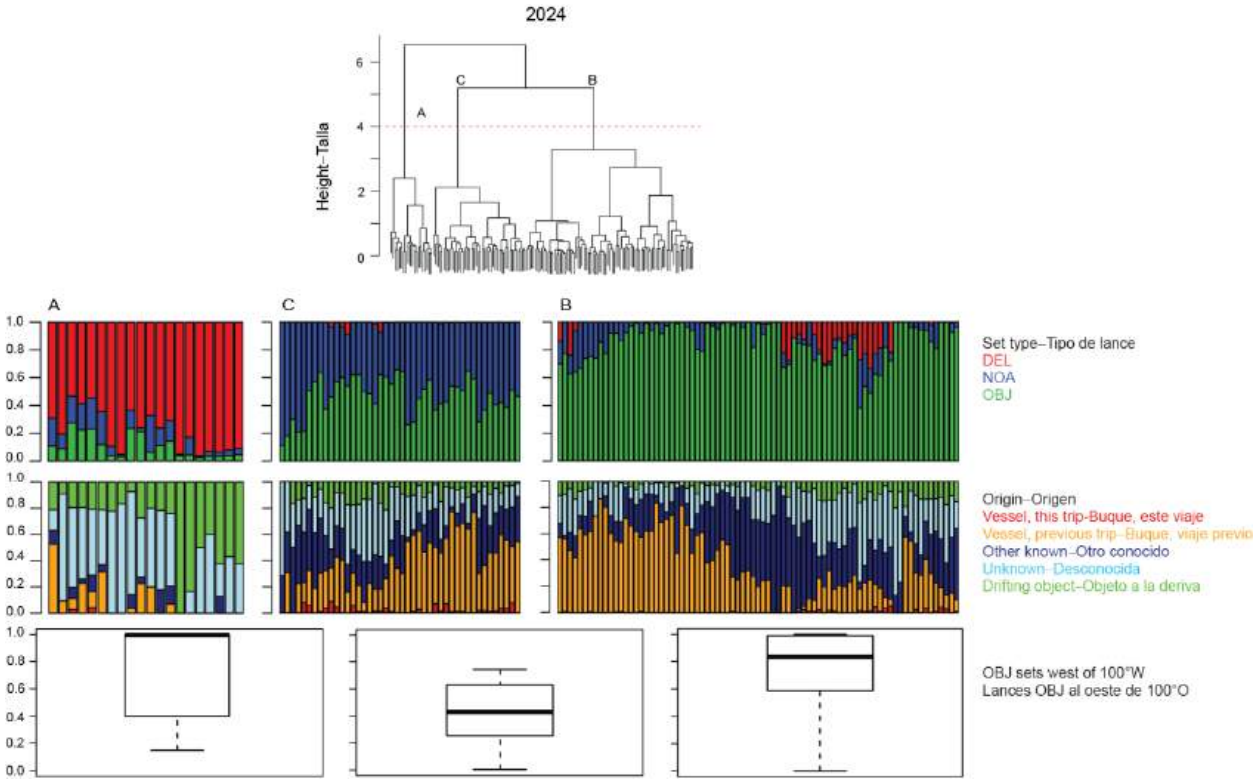

FIGURE 1. Fleet segments identified by the cluster analysis, 2024. Cluster A, B and C include 20, 79 and 44 vessels, respectively.
FIGURA 1. Segmentos de la flota identificados por el análisis de conglomerados, 2024. Los conglomerados A, B y C incluyen 20, 79 y 44 buques, respectivamente.

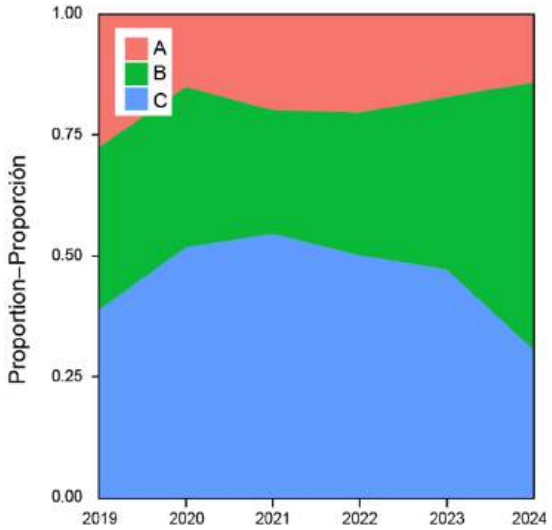

FIGURE 2. Evolution of the proportion of Clusters A, B, and C, 2019-2024.
FIGURA 2. Evolución de la proporción de los conglomerados A, B y C, 2019-2024.

3.2. Catch and effort

The purse-seine tropical tuna catch (section 3.2.1; catch by set type, Fig. 3; catch by species in mt and numbers, Fig. 4-5; spatial distribution of catches, Fig. 6) and effort (section 3.2.2; Number of set per set

type, Fig. 7; OBJ sets by class, Fig. 8; Sets by OBJ type, Fig. 9; Cumulative number of OBJ sets, Fig. 10) indicators included in this section were taken,modified, or updated from documents SAC-15-01, SAC 15 INF-F and IATTC-93 INF-A, whereas the catch per set indicators (section 3.2.3; Fig. 11) were estimated using Class-6 observer data only to depict cluster-specific differences based on different OBJ-fishing strategies.

3.2.1. Catch

3.2.1.a Catch by set type

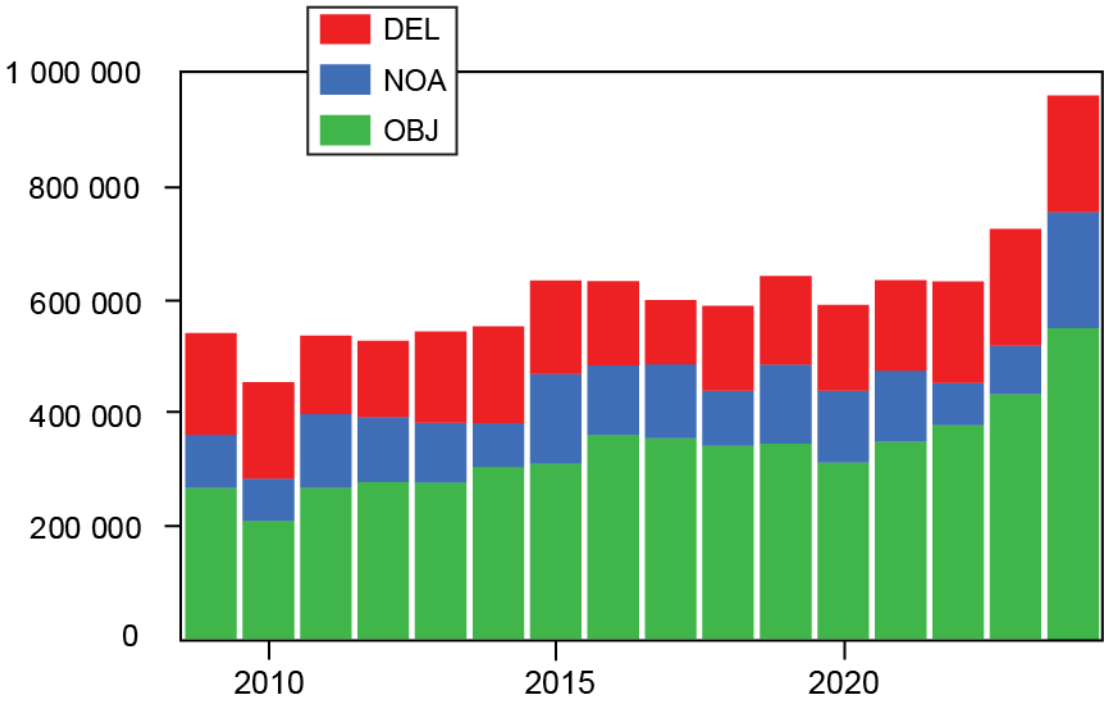

FIGURE 3. Evolution of purse-seine tropical tuna catches, by set type (OBJ: floating object; DEL: dolphin; NOA: unassociated), 2009-2024. Source: Document SAC-16-01, Table A-7.
FIGURA 3. Evolución de las capturas cerqueras de atunes tropicales, por tipo de lance (OBJ: objeto flotante; DEL: delfín; NOA: no asociado), 2009-2024. Fuente: Documento SAC-16-01, Tabla A-7.

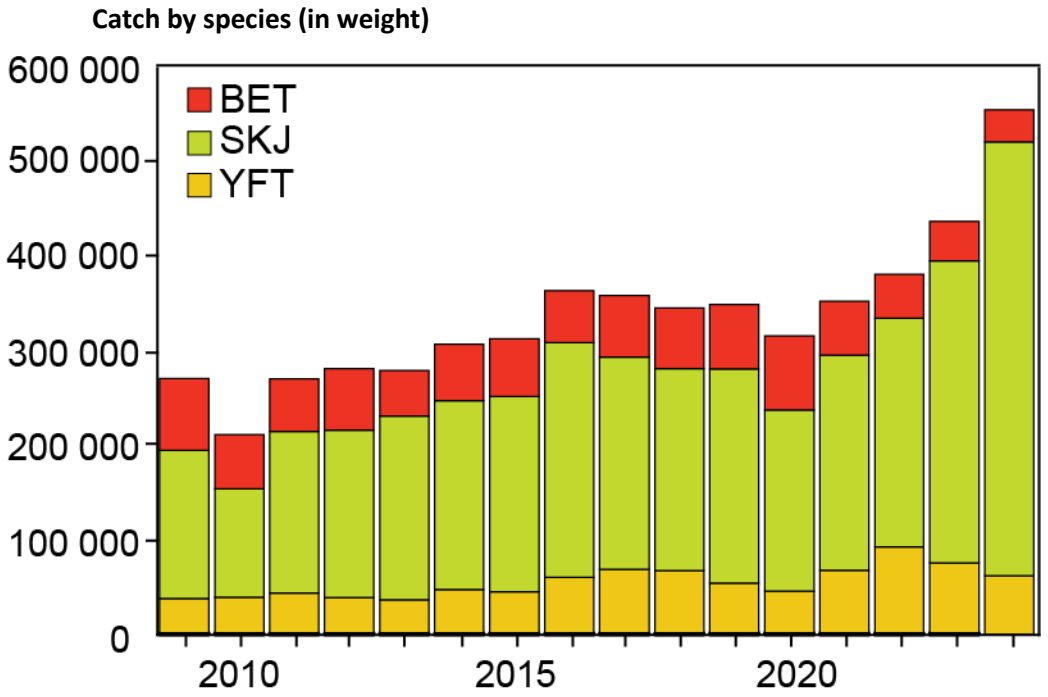

FIGURE 4. Evolution of purse-seine OBJ catches (mt), by species (BET: bigeye; SKJ: skipjack; YFT: yellowfin), 2009-2024. Source: Document SAC-16-01**, Table A-7**.

FIGURA 4. Evolución de las capturas OBJ de cerco (t), por especie (BET: patudo; SKJ: barrilete; YFT: aleta amarilla), 2009-2024. Fuente: Documento SAC-16-01, Tabla A-7.

3.2.1.b Catch by species (in numbers)

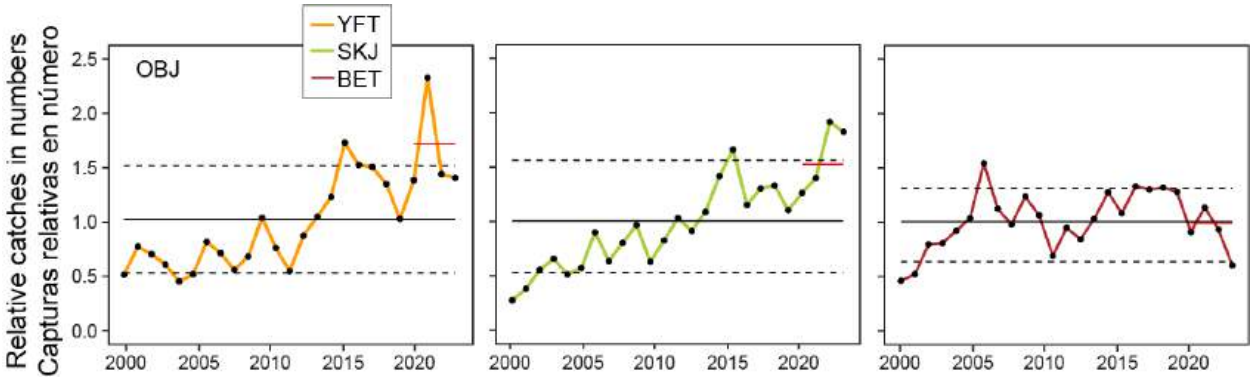

FIGURE 5. Indicators based on purse-seine catch in numbers, 2000-2024. Source: Document SAC-16-02**,** Fig 2b. The red horizontal lines mark the benchmark reference levels (average conditions in 2021-2023).
FIGURA 5. Indicadores basados en la captura de cerco, en número, 2000-2024. Fuente: Documento SAC-16-02, Fig. 2b. Las líneas horizontales rojas marcan los niveles de referencia (condiciones promedio en 2021-2023)

3.2.1.c Spatial distribution of OBJ catches

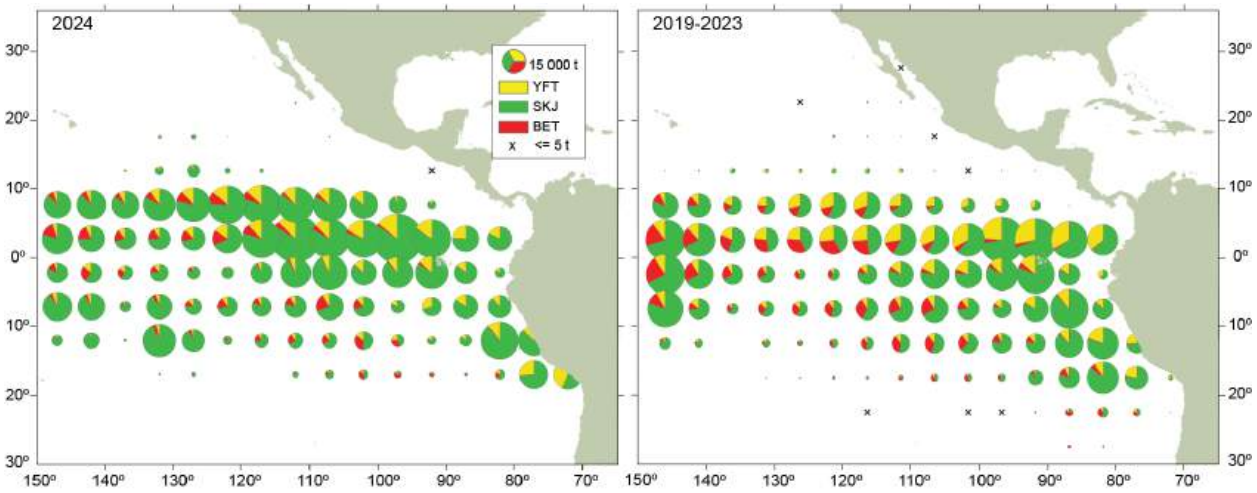

FIGURE 6. 5°x5° purse-seine catches on OBJ by species for 2024 (left panel) and the 2019-2023 averages (right panel).
FIGURA 6. Capturas OBJ de cerco 5°x5° por especie, en 2024 (panel izquierdo) y los promedios de 2019-2023 (panel derecho).

3.2.2. Effort

Number of set per set type

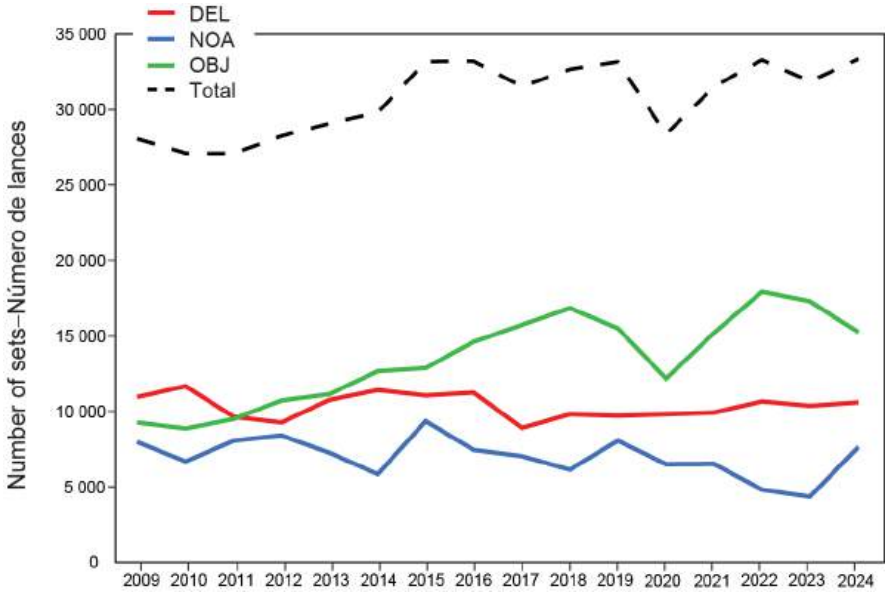

FIGURE 7. Evolution of the number of purse-seine sets, by set type (OBJ: floating object; DEL: dolphin; NOA: unassociated), 2009-2024. Source: Document SAC-16-01, Table A-7.
FIGURA 7. Evolución del número de lances cerqueros, por tipo de lance (OBJ: objeto flotante; DEL: delfín; NOA: no asociado), 2009-2024. Fuente: Documento SAC-16-01, Tabla A-7.

3.2.2.a OBJ sets by class

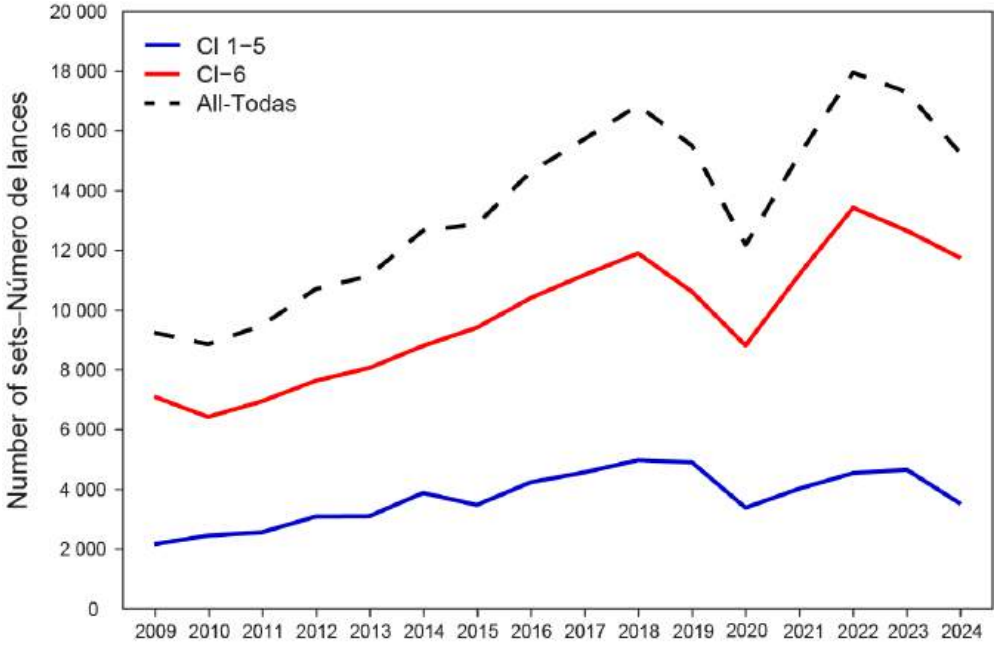

FIGURE 8. Evolution of the number of floating-object sets by Class 1-5 and Class 6 vessels, 2009-2024. Source: Document SAC-16-01, Table A-7.

FIGURA 8. Evolución del número de lances sobre objetos flotantes por buques de clases 1-5 y clase 6, 2009-2024. Fuente: Documento SAC-16-01, Tabla A-7.

3.2.2.b Sets by OBJ type

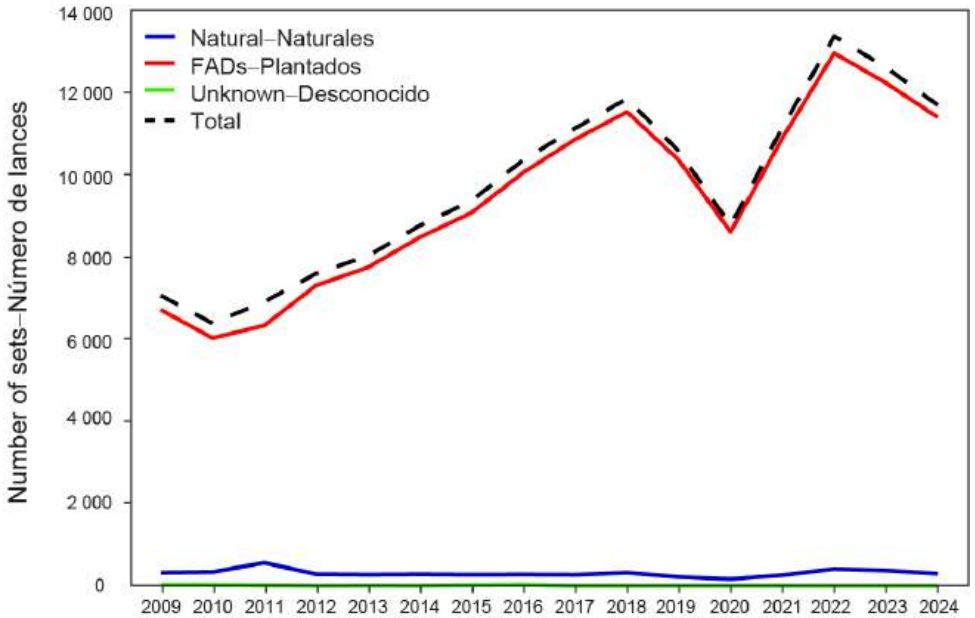

FIGURE 9. Evolution of the number of floating-object sets by Class-6 vessels, by type of floating object, 2009-2024. Source: Document SAC-16-01, Table A-8.

FIGURA 9. Evolución del número de lances sobre objetos flotantes por buques de clase 6, por tipo de objeto flotante, 2009-2024. Fuente: Documento SAC-16-01, Table A-8.

3.2.2.c Cumulative number of OBJ sets

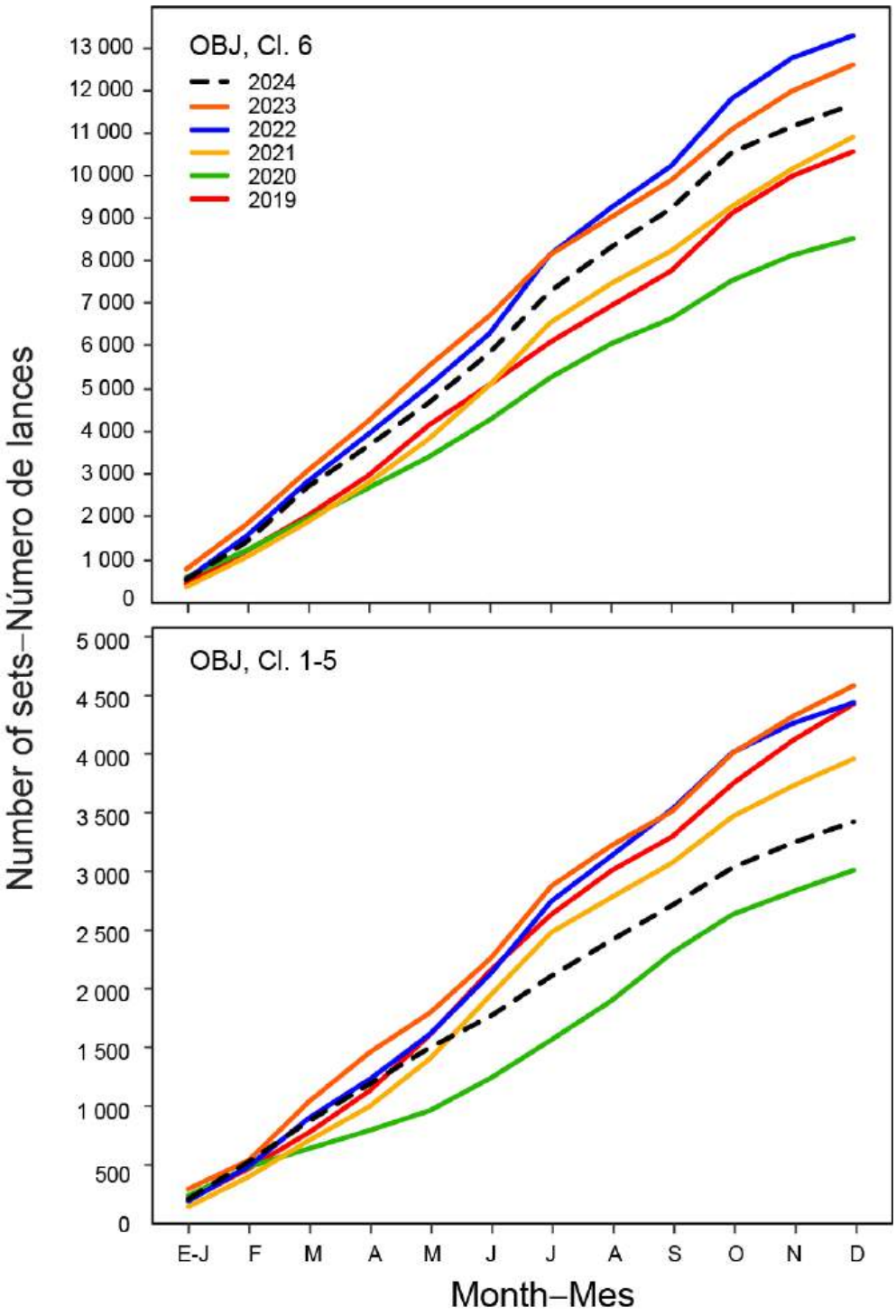

FIGURE 10. Cumulative number of floating-object (OBJ) sets, by month, 2019-2024: Class-6 vessels (top); Class 1-5 vessels (bottom). Updated from Document IATTC-93 INF-A.
FIGURA 10. Número acumulativo de lances sobre objetos flotantes (OBJ), por mes, 2019-2024: buques de clase 6 (arriba); buques de clases 1-5 (abajo). Actualizada del Documento IATTC-93 INF A.

3.2.3. Catch per set

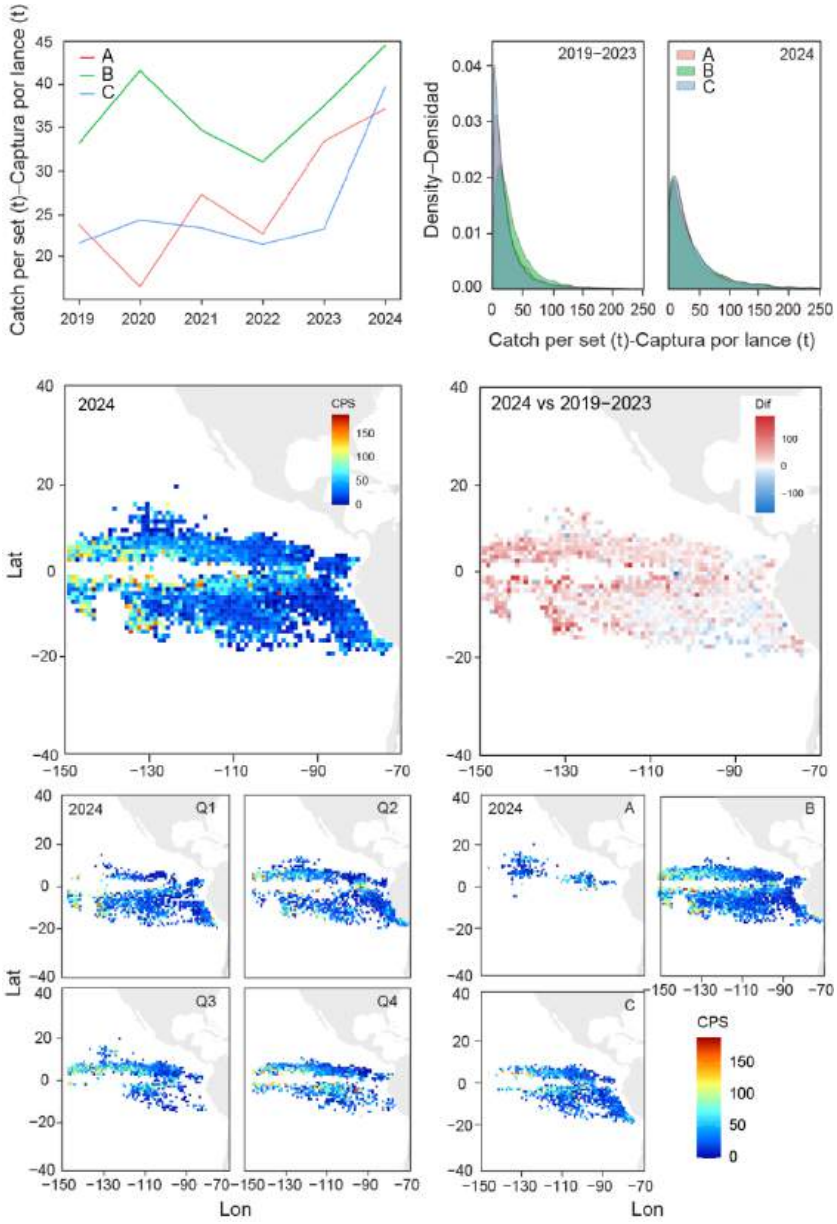

FIGURE 11. Top left: Evolution of catch per set, by cluster, 2019-2024 (see section 3.1 for details); Top right: Density plot of catch per set for 2019-2023 average and 2024, by cluster; Center left: average catch per set, by 1°-area, for 2024; Center right: differences of average catch per set, by 1°-area, 2024 vs 2019-2023; Bottom left: average catch per set, by 1°-area and quarter, for 2024; Bottom right: average catch per set, by 1°-area and cluster, for 2024**.**

FIGURA 11. Panel superior izquierdo: evolución de la captura por lance, por conglomerado,2019-2024 (ver sección 3.1 para más detalles); panel superior derecho: gráfica de densidad de la captura por lance del promedio de 2019-2023 y de 2024, por conglomerado. Panel central izquierdo: captura promedio por lance, por área de 1°, 2024; panel central derecho: diferencias de la captura promedio por lance, por área de 1°, 2024 vs. 2019-2023. Panel inferior izquierdo: captura promedio por lance, por área de 1° y trimestre, 2024; panel inferior derecho: captura promedio por lance, por área de 1° y conglomerado, 2024.

3.3. Activity

The indicators in this section were estimated for all activities, based on OBJ origin information and fishing activity records from observers, for the entire Class 6 fleet, by trip and vessel (section 3.3.1, Table 2a), and by cluster (section 3.3.2, Table 4), as well as by cluster, vessel and trip for activities of special interest: sets, deployments and encounters (Tables 3, 5; section 3.3.3, Fig. 12). A first approximation of activities was also estimated using the FAD form for vessels without observers for recent years, 2020-2024 (Table 2b and 3b). Because of their importance, sets, deployments and encounters were also analyzed in detail for the whole Class 6 fleet, by cluster, spatially (section 3.3.4-3.3.8, Figs 13-17), and within the trip (section 3.3.9, Fig. 18). A long-term deployment and retrieval indicator was also prepared for the Class 6 fleet, a figure repeatedly requested by some Members (section 3.3.7, Fig. 16). For indicators on encounters (sections 3.3.8-3.3.9; Figs. 17-18), deployments and OBJ sets were disregarded, as results were otherwise completely driven by those activities and would hinder any interesting spatial and temporal patterns. In these cases, encounters reflect the evolution and the areas where FADs were visited but led to no OBJ sets or floating-object deployments/re-deployments. A spatial indicator of the differences between encounters and OBJ sets was also computed to highlight areas where presence of objects was associated with subsequent fishing, or the lack of it. Similarly, the evolution of the different locating methods of floating-objects was also estimated for encounters and sets, by cluster (section 3.3.11, Fig. 20), to inform different OBJ-oriented location strategies.

3.3.1. General activity table

TABLE 2.A Class 6 vessels activities on floating-objects, 2024 and 2019–2023 averages. Included, for information, the number of vessels (Ves) and trips in the analysis. “Dep”: deployment, “Unk”: unknown, “Oth”: other, “Enc”: encounter.
TABLA 2.A Actividades de buques de clase 6 sobre objetos flotantes, 2024 y promedios de 2019–2023 Se incluye, con fines informativos, el número de buques y viajes en el análisis.

Year	Own Now	Own Prev	Dep	Given	Taken	Adrift	Unk	Oth	Enc	Sets	Ves	Trips
2019–2023	19	6,386	25,378	3,864	7,132	2,840	6	5	48,254	10,804	140	656
2024	12	6,311	27,795	3,846	7,315	2,368	1	18	49,575	11,278	143	817

TABLE 3.B Class 1-5 vessels activities on floating-objects, 2024 and 2020–2023 averages, reported by the vessels without observers using the FAD form under Resolution C-19-01 and C-23-05. Included, for information, the number of vessels (Ves) and trips in the analysis.
TABLA 2.B Actividades de buques de clases 1-5 sobre objetos flotantes, 2024 y promedios de 2020–2023, reportados por los buques sin observador usando el formulario de plantados bajo la resolución C-19-01 y C-23-05. Se incluye, con fines informativos, el número de buques y viajes en el análisis.

Year	Dep	Enc	Sets	Ves	Trips
2020–2023	919	3900	2011	31	172
2024	659	2603	1197	22	134

TABLE 4.A Class-6 vessel floating-object deployment, encounter and OBJ set average rates, by vessel and trip, for 2024 and 2019–2023.
TABLA 3.A Tasas promedio de siembras, encuentros y lances OBJ de buques de clase 6, por buque y viaje, en 2024 y 2019–2023.

Year	Deployments		Encounters		Sets	
	Vessel	Trip	Vessel	Trip	Vessel	Trip
2019–2023	181.8	38.7	345.7	73.6	77.4	16.5
2024	194.4	34.0	346.7	60.7	78.9	13.8

TABLE 5.B Class 1-5 vessel floating-object deployment, encounter and OBJ set average rates, by vessel and trip, for 2024 and 2020–2023. Events reported by the vessels without observers using the FAD form under Resolution C-19-01 and C-23-05.
TABLA 3.B Tasas promedio de siembras, encuentros y lances OBJ de buques de clases 1-5, por buque y viaje, en 2024 y 2018–2023. Eventos reportados por los buques sin observador usando el formulario de plantados bajo la resolución C-19-01 y C-23-05.

Year	Deployments		Encounters		Sets	
	Vessel	Trip	Vessel	Trip	Vessel	Trip
2020–2023	29.6	5.3	125.8	22.6	64.8	11.6
2024	29.9	4.9	118.3	19.4	54.4	8.9

3.3.2. Activity table by cluster

TABLE 6. Class 6 vessel activities on floating-objects, by cluster, for 2024 and 2019–2023 averages. Included, for information, is the number of vessels (Ves) and trips in the analysis. “Dep”: deployment, “Unk”: unknown, “Oth”: other, “Enc”: encounter.
TABLA 4. Actividades de buques de clase 6 sobre objetos flotantes, por conglomerado, 2024 y promedios de 2019–2023. Se incluye, con fines informativos, el número de buques y viajes en el análisis.

Year	Cluster	Own Now	Own Prev	Dep	Given	Taken	Adrift	Unk	Oth	Enc	Sets	Ves	Trips
2019–2023	A	1	51	92	76	509	206	4	1	962	553	28	97
	B	7	3,984	18,590	1,731	1,877	440	1	2	28,482	4,519	44	203
	C	12	2,351	6,696	2,056	4,746	2,193	1	2	18,810	5,732	68	356
2024	A	0	62	64	51	289	131	0	2	600	451	20	75
	B	8	3,881	19,171	2,627	4,319	1,161	0	16	32,839	7,317	79	406
	C	4	2,368	8,560	1,168	2,707	1,076	1	0	16,136	3,510	44	336

TABLE 7. Class-6 vessel floating-object deployment, encounter and OBJ set average rates, by cluster, vessel and trip, for 2024 and 2019–2023.
TABLA 5. Tasas promedio de siembras, encuentros y lances OBJ de buques de clase 6, por conglomerado, buque y viaje, en 2024 y 2019–2023.

Year	Cluster	Deployments		Encounters		Sets	
		Vessel	Trip	Vessel	Trip	Vessel	Trip
2019–2023	A	3.3	1.0	34.4	9.9	19.8	5.7
	B	424.4	91.6	650.3	140.3	103.2	22.3
	C	98.8	18.8	277.4	52.9	84.5	16.1
2024	A	3.2	0.9	30.0	8.0	22.6	6.0
	B	242.7	47.2	415.7	80.9	92.6	18.0
	C	194.5	25.5	366.7	48.0	79.8	10.4

3.3.3. Evolution of activities by cluster

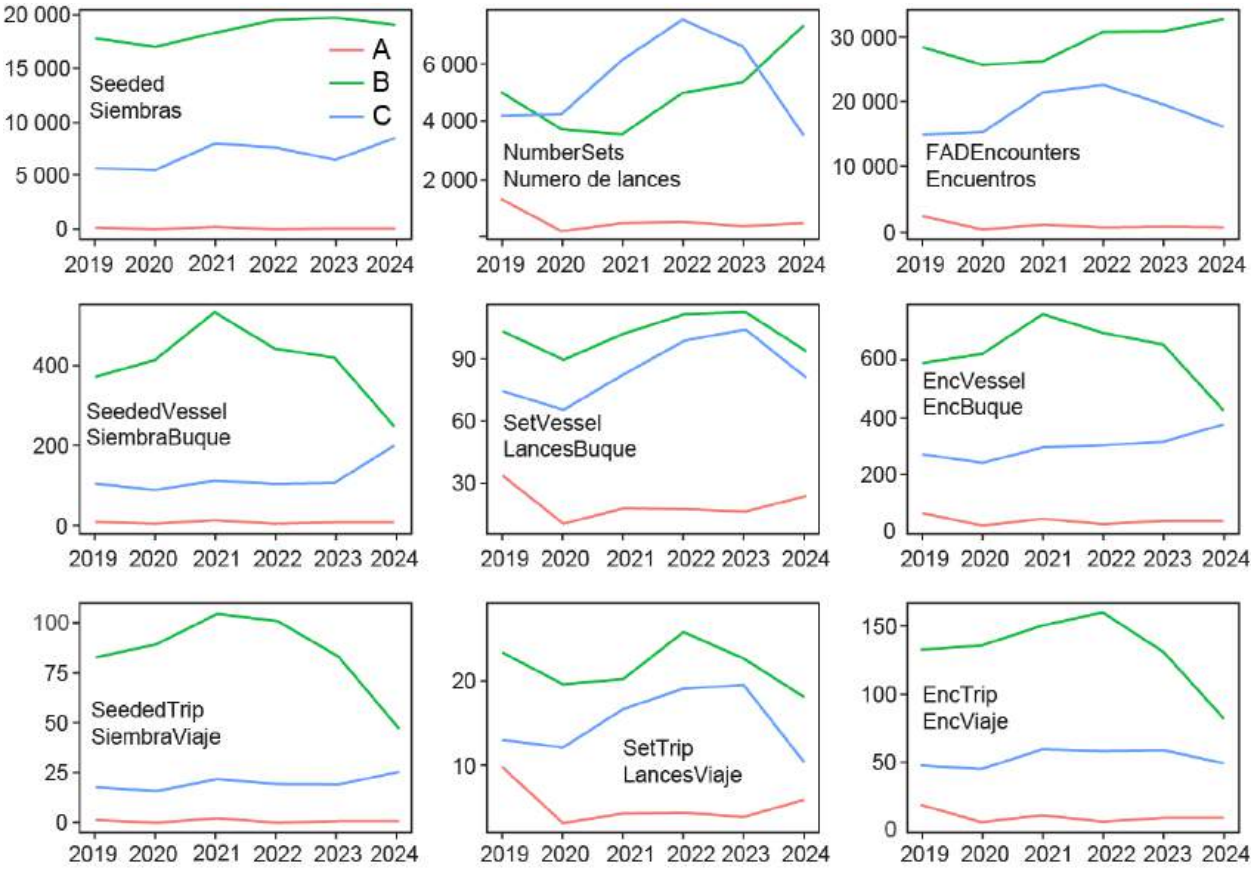

FIGURE 12. Top: Evolution of floating-object deployments, sets and encounters, by cluster, 2019-2024; Center: Evolution of floating-object deployments, sets and encounters, by cluster-vessel average, 2019-2024; Bottom: Evolution of floating-object deployments, sets and encounters, by cluster-trip average, 2019-2024.

FIGURA 12. Arriba: evolución de las siembras, lances y encuentros de objetos flotantes, por conglomerado, 2019-2024. Centro: evolución de las siembras, lances y encuentros de objetos flotantes, por promedio de conglomerado-buque, 2019-2024. Abajo: evolución de las siembras, lances y encuentros de objetos flotantes, por promedio de conglomerado-viaje, 2019-2024.

3.3.4. OBJ sets

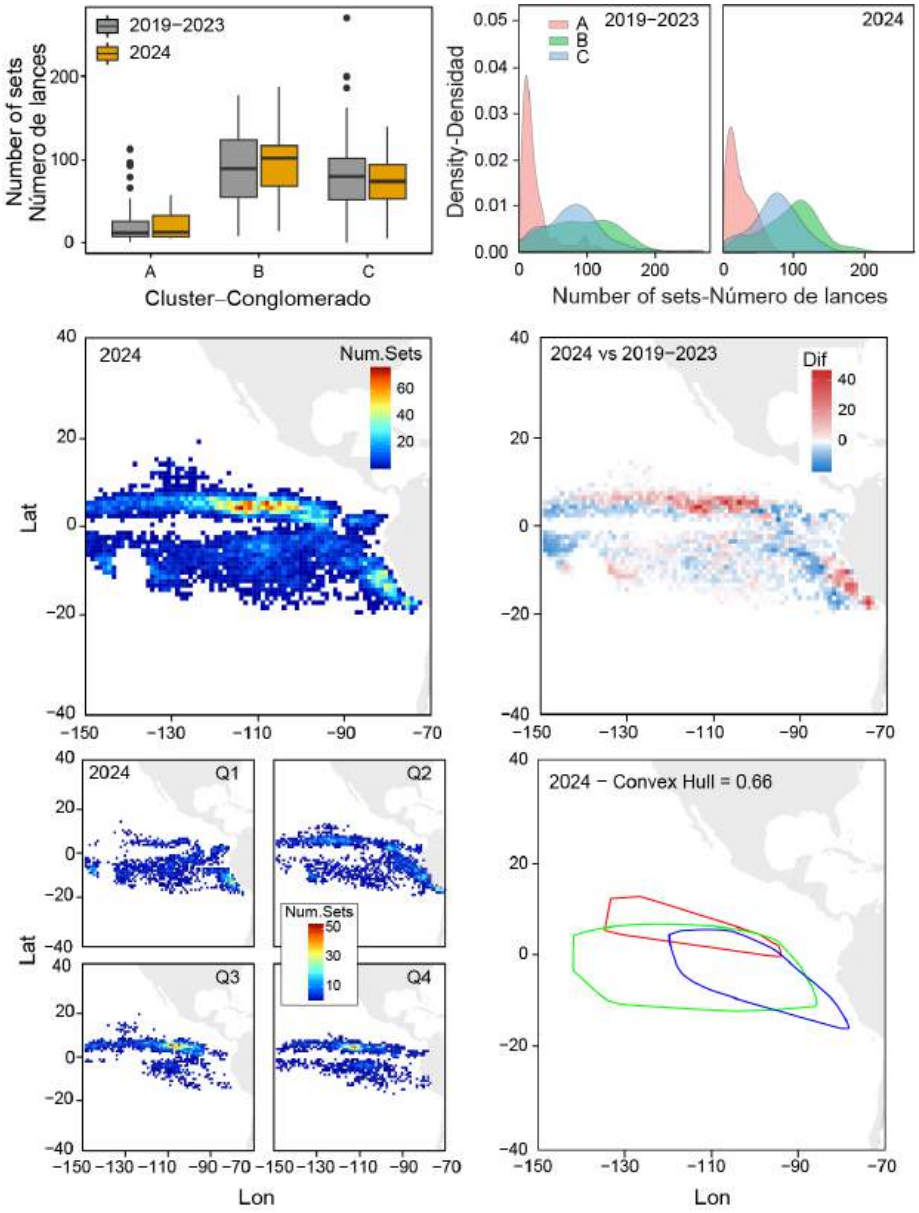

FIGURE 13. Top left: Boxplots of the number of OBJ sets per vessel, by cluster, 2019-2023 average and 2024; Top right: Density plot of OBJ sets per vessel for 2019-2023 average and 2024, by cluster; Center left: number of OBJ sets, by 1°-area, for 2024; Center right: differences of OBJ sets, by 1°-area, 2024 vs 2019-2023 average; Bottom left: number of OBJ sets, by 1°-area and quarter, for 2024; Bottom right: convex hull estimates of 66% of OBJ sets, by cluster (Red = A, Green = B, Blue = C), for 2024.

FIGURA 13. Panel superior izquierdo: diagramas de caja del número de lances OBJ por buque, por conglomerado, promedio de 2019-2023 y 2024; panel superior derecho: gráfica de densidad de lances OBJ por buque para el promedio de 2019-2023 y 2024, por conglomerado. Panel central izquierdo: número de lances OBJ, por área de 1°, para 2024; panel central derecho: diferencias de lances OBJ, por área de 1°, 2024 vs promedio de 2019-2023. Panel inferior izquierdo: número de lances OBJ, por área de 1° y trimestre, para 2024; panel inferior derecho: estimaciones de la envolvente convexa del 66% de los lances OBJ, por conglomerado (rojo = A, verde = B, azul = C), para 2024.

3.3.5. Set time

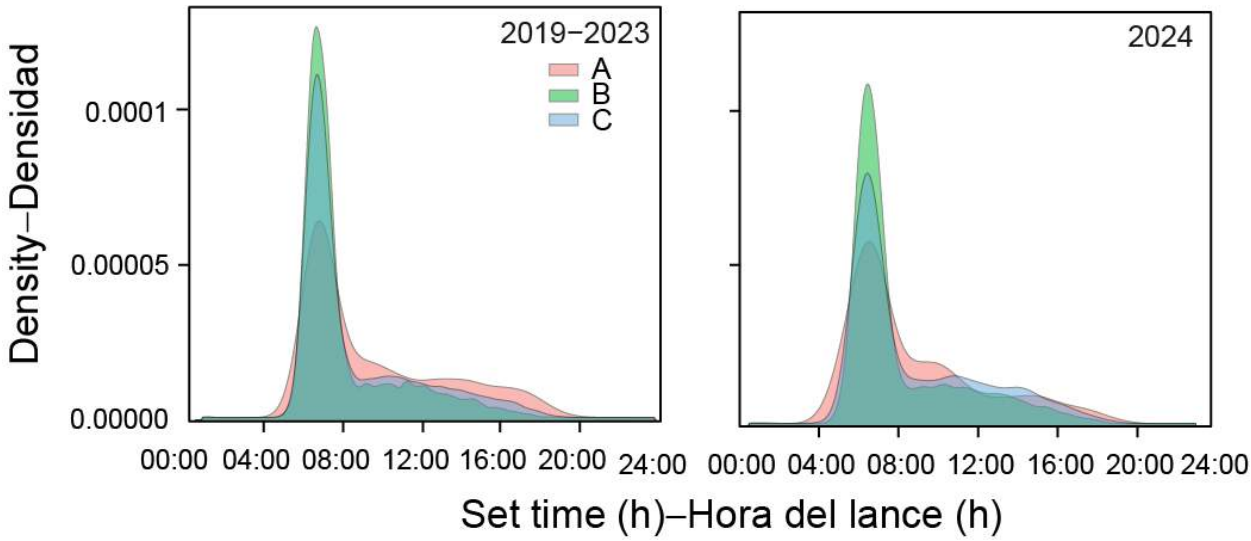

FIGURE 14. Density plot of OBJ set time, by cluster, 2019-2023 average and 2024.
FIGURA 14. Gráfica de densidad de la hora de los lances OBJ, por conglomerado, promedio de 2019-2023 y 2024.

3.3.6. Deployments

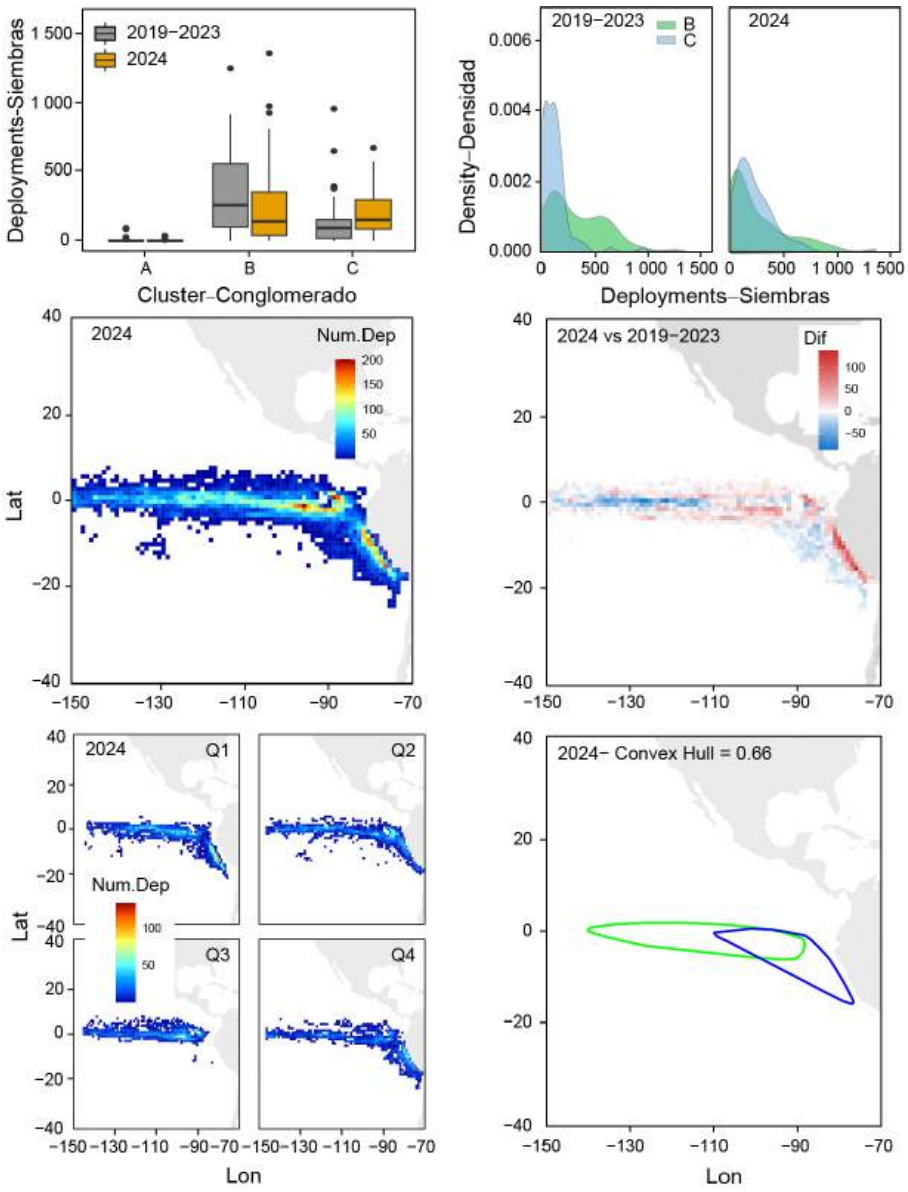

FIGURE 15. Top left: Boxplots of the number of deployments per vessel, by cluster, 2019-2023 average and 2024; Top right: Density plot of deployments per vessel for 2019-2023 average and 2024, by cluster; Center left: number of deployments, by 1°-area, for 2024; Center right: differences of deployments, by 1°-area, 2024 vs 2019-2023 average; Bottom left: number of deployments, by 1°-area and quarter, for 2024; Bottom right: convex hull estimates of 66% of deployments, by cluster (Green = B, Blue = C), for 2024.

FIGURA 15. Panel superior izquierdo: diagramas de caja del número de siembras por buque, por conglomerado, promedio de 2019-2023 y 2024; panel superior derecho: gráfica de densidad de siembras por buque para el promedio de 2019-2023 y 2024, por conglomerado. Panel central izquierdo: número de siembras, por área de 1°, para 2024; panel central derecho: diferencias de siembras, por área de 1°, 2024 vs promedio de 2019-2023. Panel inferior izquierdo: número de siembras, por área de 1° y trimestre, para 2024; panel inferior derecho: estimaciones de la envolvente convexa del 66% de las siembras, por conglomerado (rojo = A, verde = B, azul = C), para 2024.

3.3.7. Long-term deployment and retrieval trend

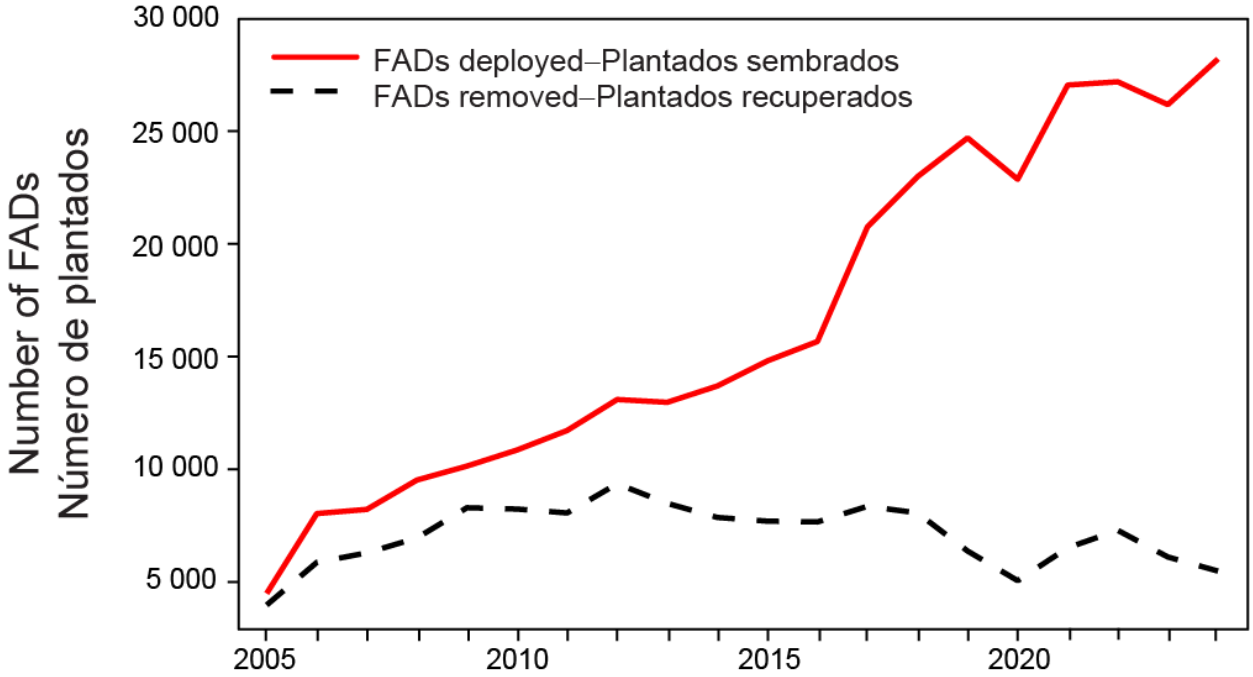

FIGURE 16. FAD deployments and retrievals by Class-6 vessels, 2005-2024. Adapted from document IATTC-93-INF-A.

FIGURA 16. Siembras y recuperaciones de plantados por buques de clase 6, 2005-2024. Adaptado del documento IATTC-93-INF-A.

3.3.8. Encounters

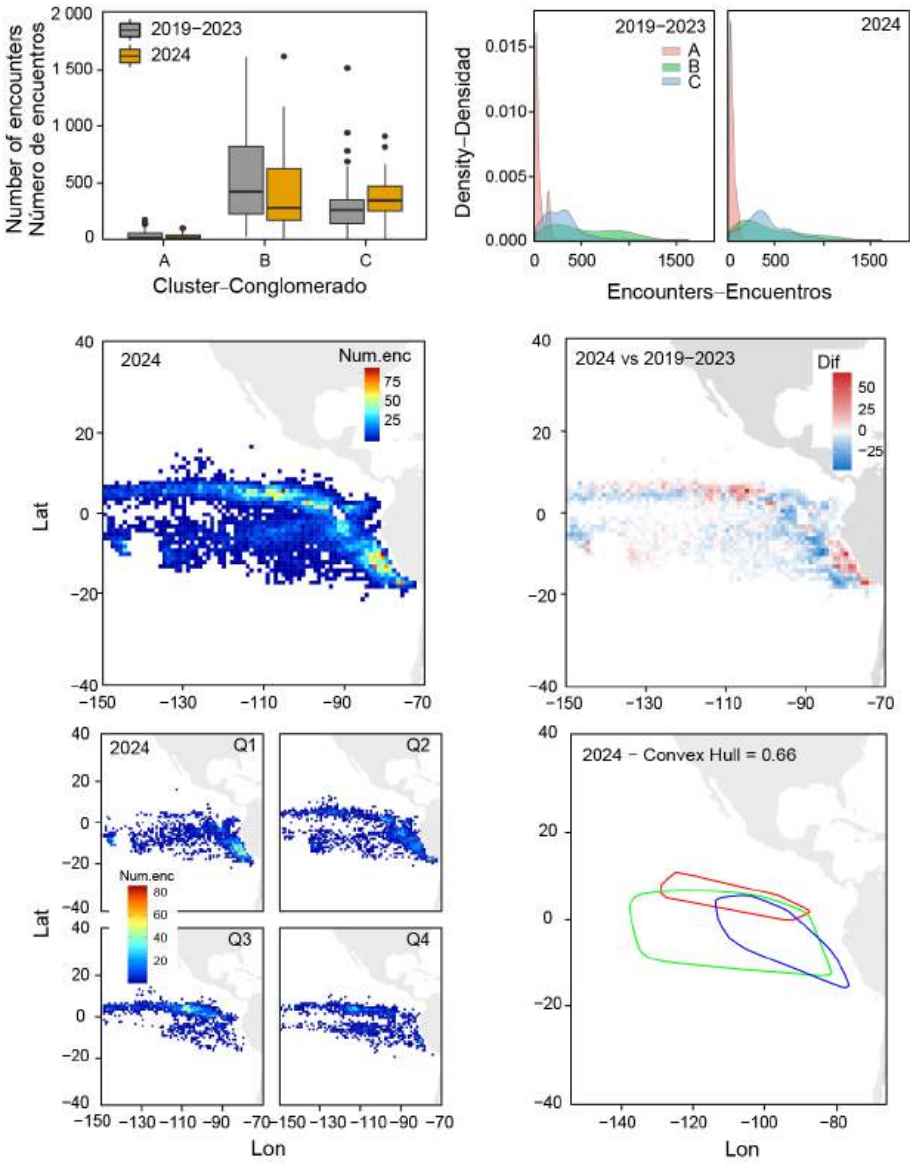

FIGURE 17. Top left: Boxplots of the number of OBJ encounters per vessel, by cluster, 2019-2023 average and 2024; Top right: Density plot of OBJ encounters per vessel for 2019-2023 average and 2024, by cluster; Center left: OBJ encounters, by 1°-area, for 2024; Center right: differences of OBJ encounters, by 1°-area, 2024 vs 2019-2023 average; Bottom left: OBJ encounters, by 1°-area and quarter, for 2024; Bottom right: convex hull estimates of 66% of OBJ encounters, by cluster (Red = A, Green = B, Blue = C), for 2024.

FIGURA 17. Panel superior izquierdo: diagramas de caja del número de encuentros OBJ por buque, por conglomerado, promedio de 2019-2023 y 2024; panel superior derecho: gráfica de densidad de encuentros OBJ por buque para el promedio de 2019-2023 y 2024, por conglomerado. Panel central izquierdo: encuentros OBJ, por área de 1°, para 2024; panel central derecho: diferencias de encuentros OBJ, por área de 1°, 2024 vs promedio de 2019-2023. Panel inferior izquierdo: encuentros OBJ, por área de 1° y trimestre, para 2024; panel inferior derecho: estimaciones de la envolvente convexa del 66% de los encuentros OBJ, por conglomerado (rojo = A, verde = B, azul = C), para 2019-2023.

3.3.9. Encounters versus sets

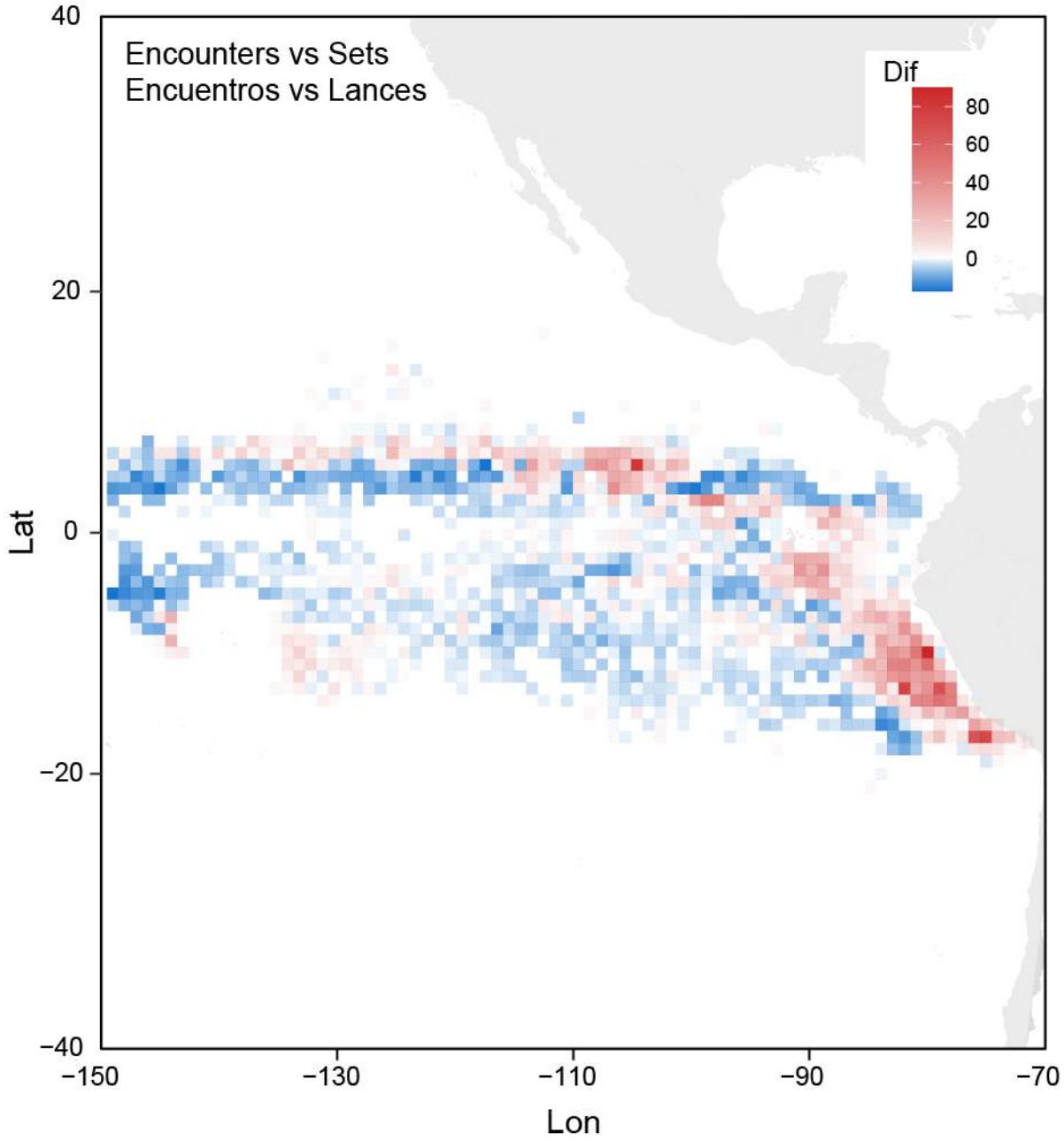

FIGURE 18. Differences between the number of OBJ encounters and the number of OBJ sets, by 1°-area, 2024. Red areas denote hotspots of visits on floating objects with no fishing activity associated. Blue cells, instead, denote areas where visits led to fishing sets.

FIGURA 18. Diferencias entre el número de encuentros OBJ y el número de lances OBJ, por área de 1°, 2024. Las áreas rojas indican sitios clave de visitas de objetos flotantes sin actividad de pesca asociada. Las celdas azules, en cambio, indican áreas donde las visitas resultaron en lances de pesca.

3.3.10. Activity dynamics within the trip

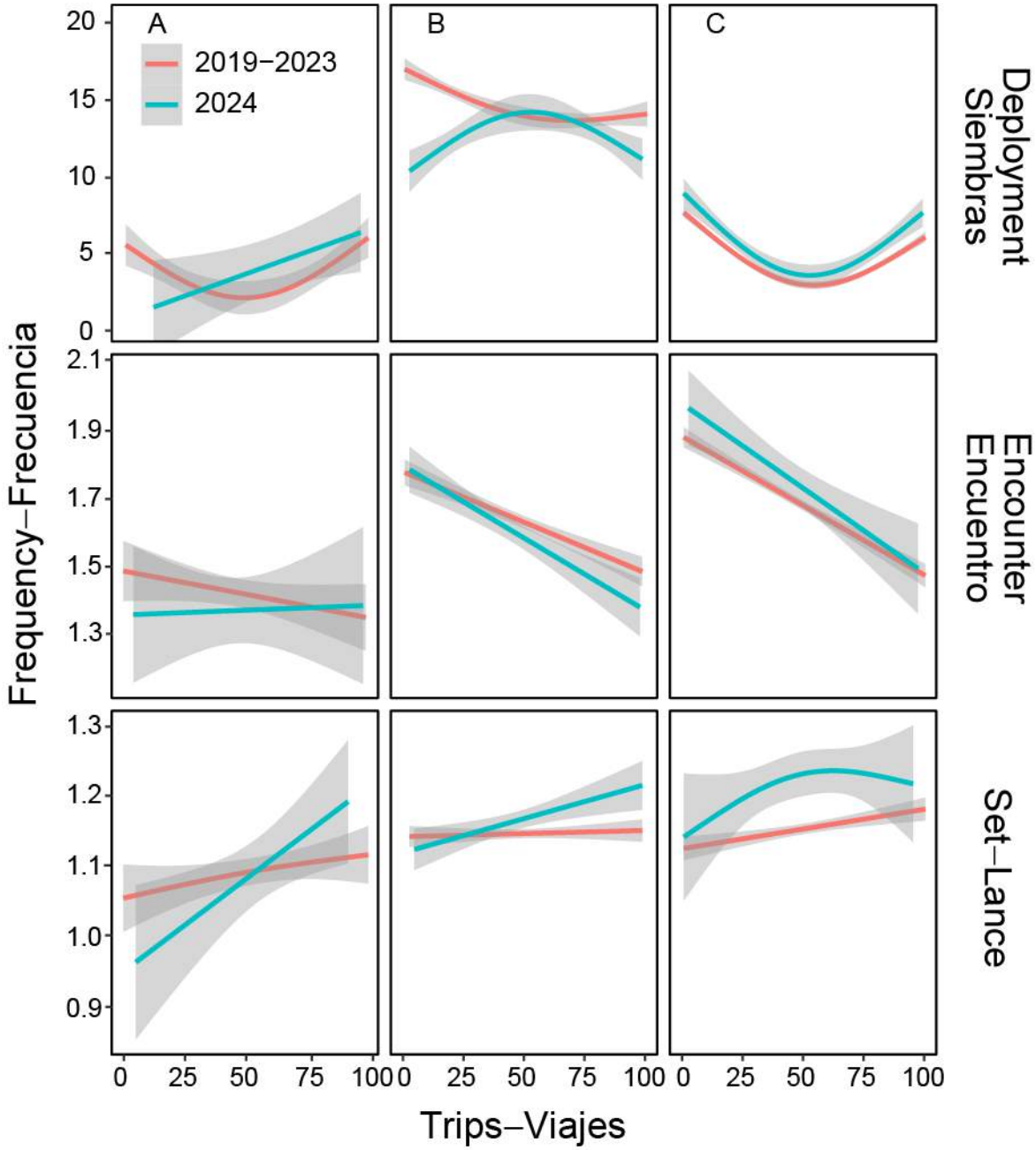

FIGURE 19. Evolution of floating-object deployment, encounter and set activities (number of each activity) within the trip, 2019-2023 averages and 2024. Only trips with a duration of 25-90 days were considered, quantiles 5 and 95, respectively. Trips were divided into 100 equal parts for standardization purposes.
FIGURA 19. Evolución de las actividades de siembras, encuentros y lances de objetos flotantes (número de cada actividad) en el viaje, promedio de 2019-2023 y 2024. Solo se consideraron viajes con una duración de 25 a 90 días, cuantiles 5 y 95, respectivamente. Los viajes se dividieron en 100 partes iguales con fines de estandarización.

3.3.11. Evolution of location method

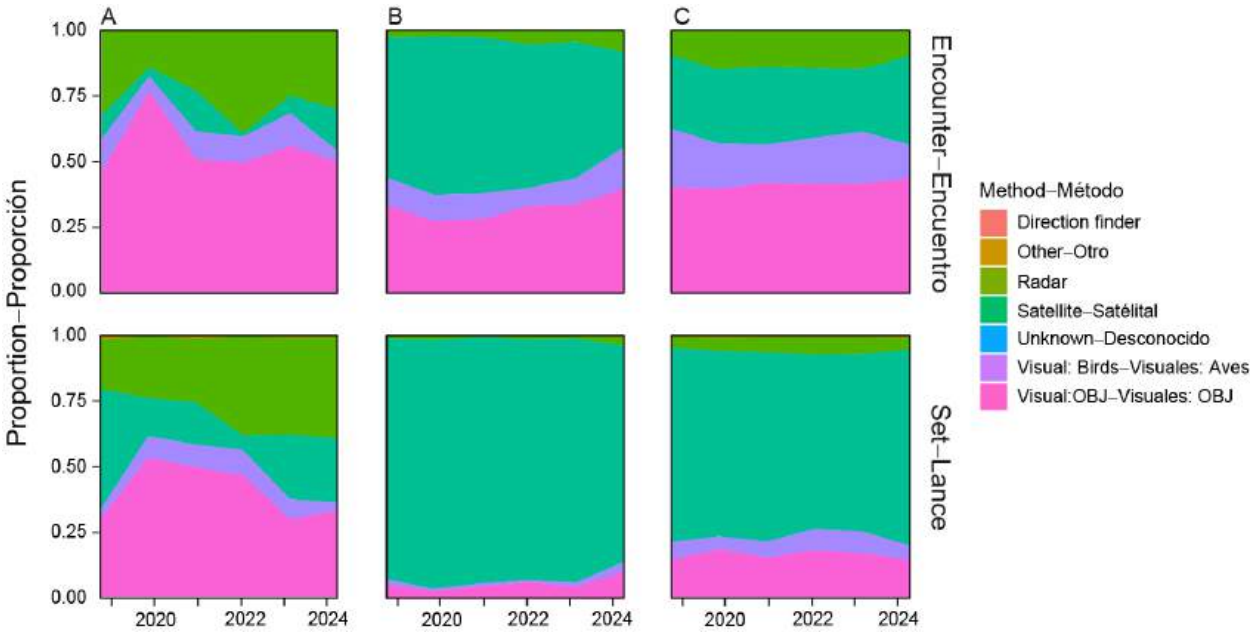

FIGURE 20. Evolution of locating methods for OBJ encounters and sets, by cluster, 2019-2024.
FIGURA 20. Evolución de los métodos de localización para encuentros y lances OBJ, por conglomerado, 2019-2024.

3.4. Buoy-based indices

The indicators in this section have been estimated using buoy data for 166 Class 1-6 vessels reporting in 2024 (43 and 132 vessels for Class 1-5 and Class 6, respectively). Because the limits on the number of active FADs per vessel (i.e. active buoys) are class-specific, as established by Resolution C-21-04[3], the indicators in this category have been estimated for each class-limit, when appropriate (sections 3.4.1-3.4.2, Table 6, Fig. 21). In addition, the indicators in this category have been mainly estimated for 2024 and for 2018-2024 to help inform interpretations on the short, medium and long-term evolution of the fishery.

Most of the vessels that deploy FADs comply with the requirement of Resolution C-21-04 to report daily FAD data. Observer data indicate that reporting rates for Class 6 vessels deploying and fishing on their own FADs are high (>90%). Reporting rates for Class 1-5 vessels cannot be estimated, as that fleet segment does not routinely and systematically carry observers, as noted above. The staff considers that extrapolating from these data to estimate the total number of FADs is not advisable yet, since the fishing strategies used by vessels vary by capacity, company, flag, season, or a combination of these and other factors, and the assumptions that would have to be made may lead to misleading results and interpretation. Since 2022, the staff has access to raw buoy data reported under Resolution C-21-04 (in 2025-2026 under C-24-01) and analyzing it will help better understand this relationship in the near future. Thus, active FADs do not represent total FADs at sea, because (a) buoys can be deactivated remotely but the FAD remains at sea, and (b) not all vessels report continuously (e.g., buoys are deactivated during the closure periods, reporting gap exist), so these are probably underestimates.

[3] Class 6 ($\geqslant$ 1,200 m^3) = 340; Class 6 (< 1,200 m^3) = 210; Class 4-5 = 85, Class 1-3 = 50 for 2024

Section 3.4.7 shows the buoy derived indices for the three tropical tuna species using historic data (mostly) voluntarily provided for 2012-2023. The figure has been adapted from document FAD-08-02 (see document for details on the methods and specifics of the data used). No buoy derived index was prepared for the 2012-2024 period as no benchmark tuna assessments were scheduled with 2024 data.

3.4.1. Daily active buoys per vessel

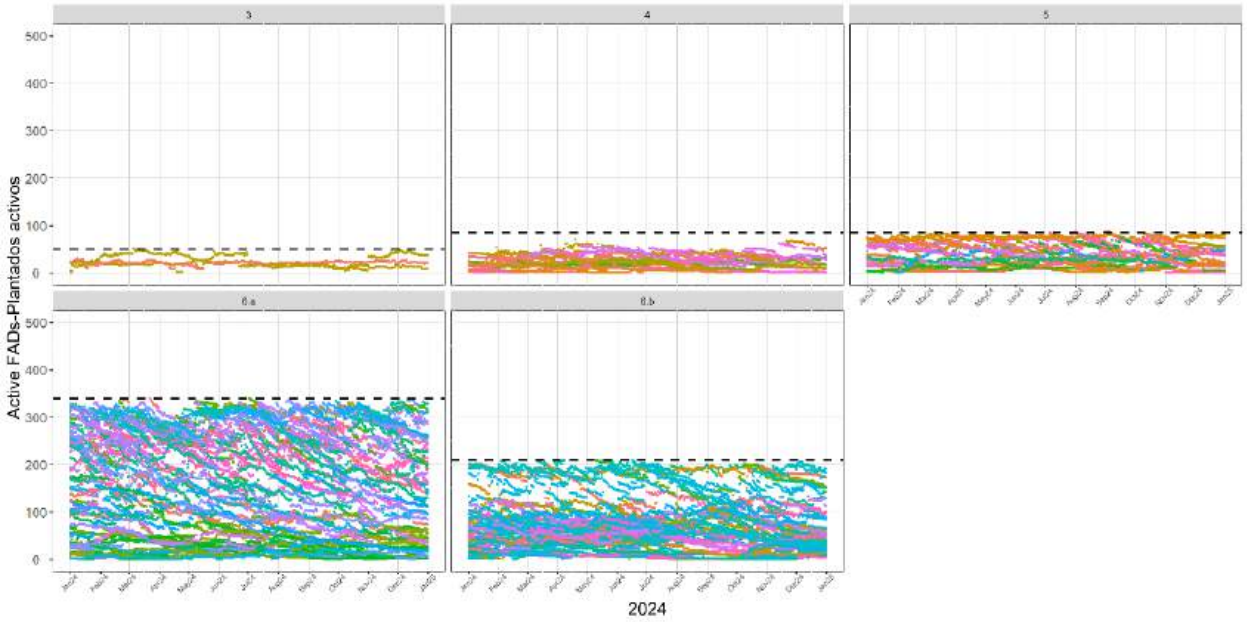

FIGURE 21. Evolution of daily active FADs per vessel and class, 2024. Each color represents a vessel (166 total). Points are used to show data reporting gaps per vessel. The following class and class-limits are considered: Class 6 ≥ 1,200 m^3 = 340 (6.a in the figure); Class 6 < 1,200 m^3 = 210 (6.b in the figure); Class 4-5 = 85, Class 1-3 = 50.

FIGURA 21. Evolución de plantados activos diarios por buque y clase, 2024. Cada color representa un buque (166 en total). Se usan puntos para mostrar las deficiencias en la notificación de datos por buque. Se consideran las siguientes clases y límites de clase: clase 6 ≥ 1,200 m^3 = 340 (6.a en la figura); clase 6 < 1,200 m^3 = 210 (6.b en la figura); clases 4-5 = 85; clases 1-3 = 50.

3.4.2. Annual and monthly statistics

TABLE 8. Monthly and annual minimum, mean, maximum, and standard deviations of active FADs (i.e. buoys), by class-limit, 2024. The analysis includes 57 Class-6 <1200 m^3, 75 Class-6 ≥ 1200 m^3, 40 Class-4-5, and 3 Class-1-3 vessels.

TABLA 6. Mínimo, promedio, máximo y desviación estándar mensuales y anuales de plantados activos (es decir, boyas), por límite de clase, 2024. El análisis incluye 57 buques de clase 6 <1200 m^3, 75 de clase 6 ≥ 1200 m^3, 40 de clases 4-5, y 3 de clases 1-3.

	Class 1-3				Class 4-5				Class 6 < 1200				Class 6 >1200			
Month	Min	Mean	Max	SD	Min	Mean	Max	SD	Min	Mean	Max	SD	Min	Mean	Max	SD
Jan	1	20.7	30	5.6	1	27.9	78	21.4	1	69.4	202	54	1	156.3	331	106.3
Feb	16	27.1	42	8.6	1	30.8	80	21	1	72.6	210	52.6	1	161.5	337	105.9
Mar	17	29.1	52	11.5	1	31.3	83	20.9	7	72	209	52.2	1	156.4	340	106.6
Apr	1	24.7	46	12.1	2	31.7	80	21.8	1	71	210	48.6	1	149	318	103.3
May	9	22.6	45	7.9	1	35	81	21	6	74.1	210	49.8	1	153.4	334	107.1
Jun	14	27.6	44	9.1	1	35.2	85	20.1	1	75.4	209	50.6	1	151.4	331	107.7
Jul	11	17.7	25	3.2	2	34.3	85	20.1	1	72.6	202	52.6	1	157.1	340	110.3
Aug	13	18.2	24	3	2	31.2	85	20.5	1	70.7	200	51.1	4	153.5	336	105.3
Sep	8	17.8	25	4.5	1	30.1	85	20.5	1	72.3	199	49.4	1	151.8	334	103.5
Oct	5	15.3	26	6.5	2	32.7	82	20.8	1	71	203	54.6	1	151.8	331	110.2
Nov	10	24.5	44	10.1	1	31.1	82	20.7	1	70.7	201	54.1	1	155.7	332	109.5
Dec	9	26.1	50	12.4	1	29.9	82	22.2	1	69.7	206	53.8	1	147.5	338	105.1
Annual	1	20.7	30	5.6	1	27.9	78	21.4	1	69.4	202	54	1	156.3	331	106.3

3.4.3. Daily total active buoys

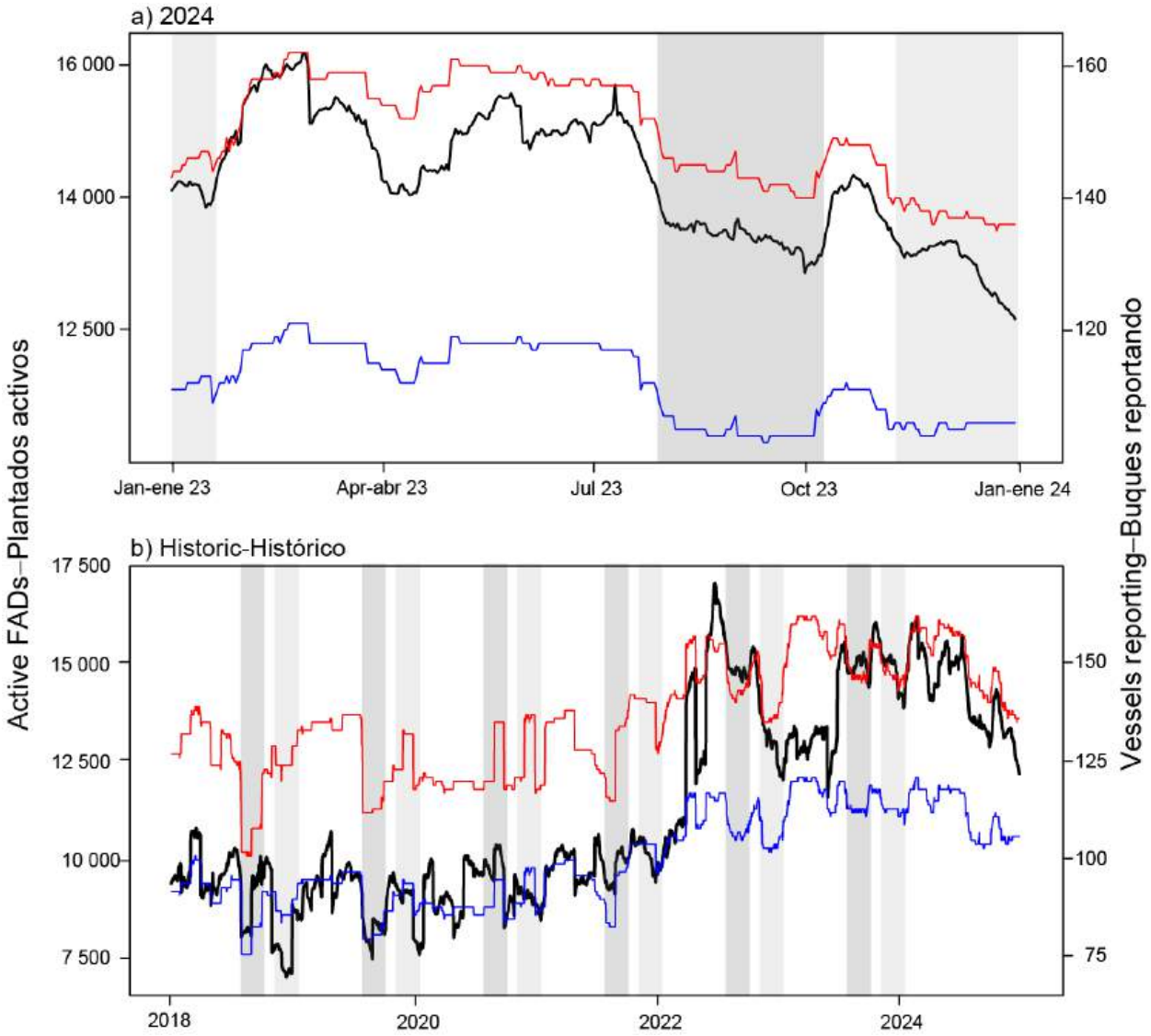

FIGURE 22. Number of active FADs (black line) reported by the purse-seine fleet in 2024 (a, top panel) and historically, 2018-2024 (b, bottom panel), and number of vessels reporting daily (red: total; blue: Class-6 vessels). Includes 132 Class-6 vessels, 21 Class-5, 19 Class-4, and 3 Class-2-3 in 2024. The number of total vessels reporting daily in 2024 ranged from 135 to 166 (median = 152, average = 153). The number of total daily active buoys reported in 2024 ranged from 12154 to 16197 (median = 14230, mean = 14295), and historically from 7013 to 17035 (median = 10157, mean = 11314).

FIGURA 22. Número de plantados activos (línea negra) reportados por la flota cerquera en 2024 (a, panel superior) e históricamente, 2018-2024 (b, panel inferior), y número de buques que reportan diariamente (rojo: total; azul: buques de clase 6). Incluye 132 buques de clase 6, 21 de clase 5, 19 de clase 4, y 3 de clase 2-3 en 2024. El número de buques totales que reportan diariamente en 2024 osciló entre 135 y 166 (mediana = 152, promedio = 153). El número de boyas activas diarias totales reportadas en 2024 osciló entre 12154 y 16197 (mediana = 14230, promedio = 14295), e históricamente entre 7013 y 17035 (mediana = 10157, promedio = 11314).

3.4.4. Monthly buoy densities

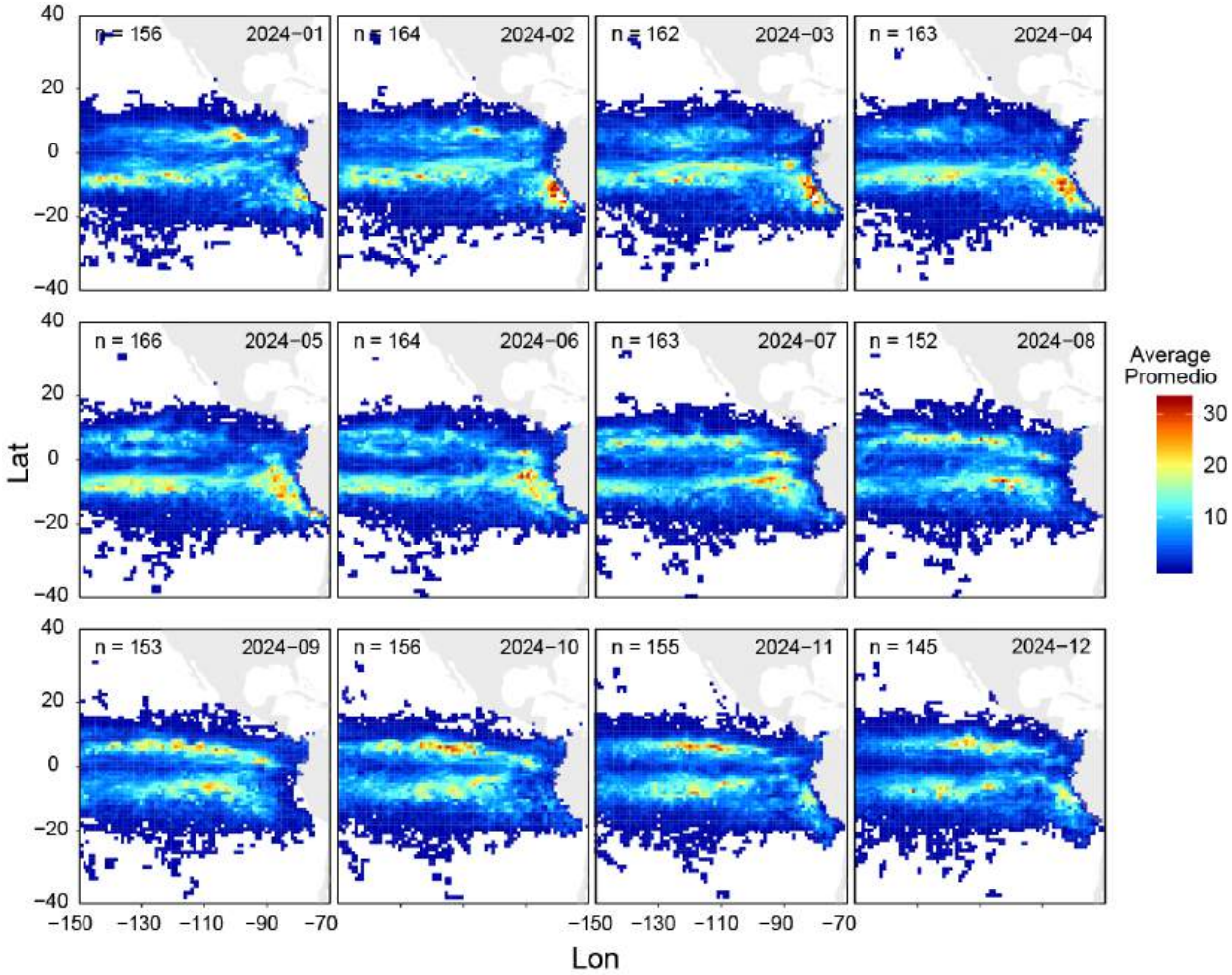

FIGURE 23. Average number of active FADs, by 1°-area, reported by between 145 and 166 vessels (mean = 158), by month, during the January-December 2024 period.

FIGURA 23. Número promedio de plantados activos, por área de 1°, reportado por entre 145 y 166 buques (promedio = 158), por mes, durante el periodo de enero-diciembre de 2024.

TABLE 9. Total number of active FADs in the EPO, reported by between 145 and 166 vessels (mean = 158), by month, and average, 2024. Number of active FADs ranged from 13040 to 16005 (average = 14513). Values correspond to those shown in Figure 23 above. Although very similar, these numbers do not match exactly the values provided in Figure 22 as the methods to estimate these figures vary.
TABLA 7. Número total de plantados activos en el OPO, reportado por entre 145 y 166 buques (promedio = 158), por mes y promedio, 2024. El número de plantados activos osciló entre 13040 y 16005 (promedio = 14513). Los valores corresponden a los que se muestran en la Figura 23 anterior. Aunque muy similares, estos números no coinciden exactamente con los valores provistos en la Figura 22, ya que los métodos para estimar estas figuras varían.

Month	Sum of average active FADs	Number of vessels
Jan	14337	156
Feb	16005	164
Mar	15324	162
Apr	14459	163
May	15466	166
Jun	15173	164
Jul	15037	163
Aug	13826	152
Sep	13734	153
Oct	14171	156
Nov	13589	155
Dec	13040	145
Average	14513	158

3.4.5. Annual buoy densities

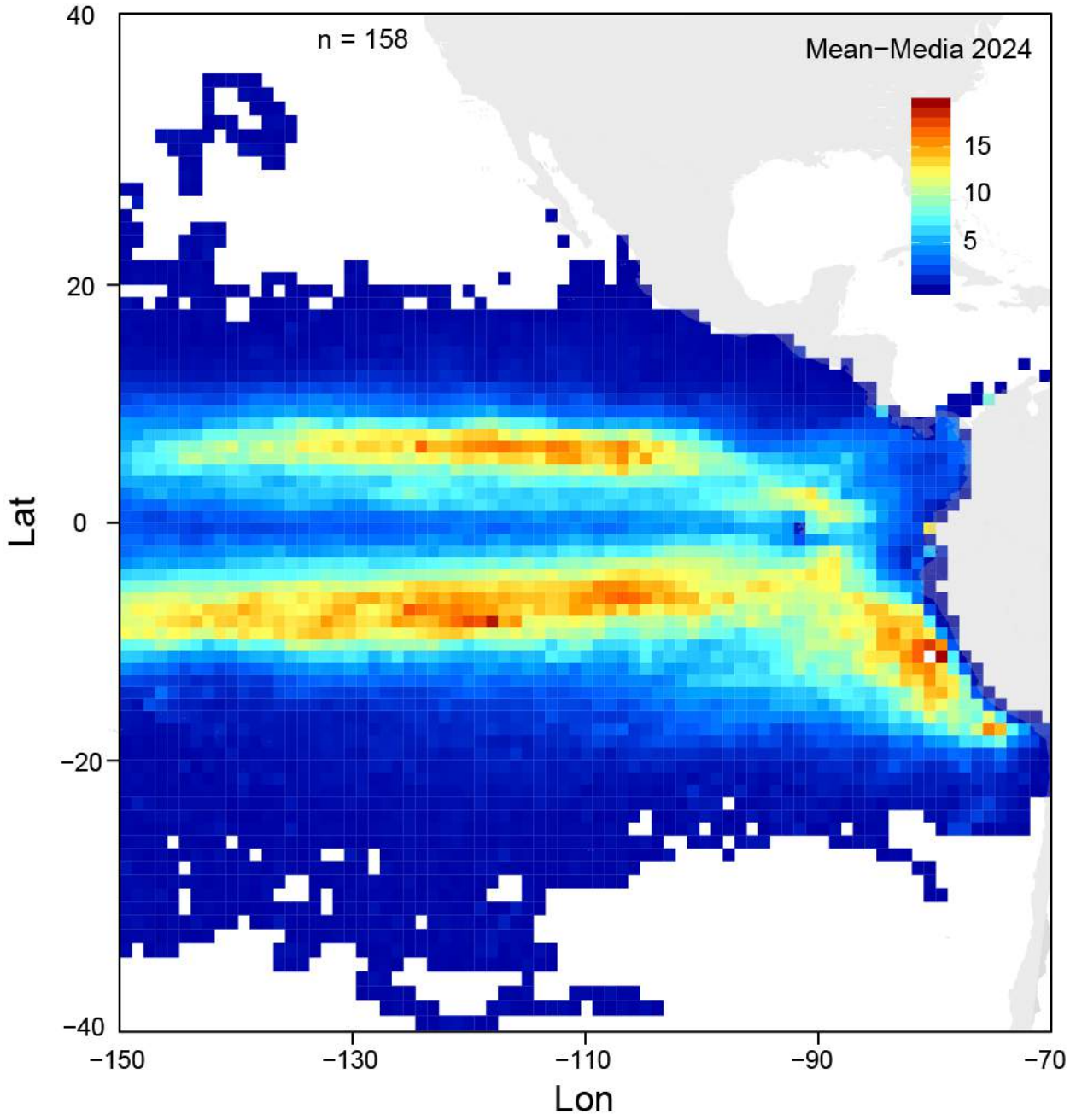

FIGURE 24. Average number of active FADs, by 1°-area, reported by between 145 and 166 vessels (mean = 158) during the January-December 2024 period.

FIGURA 24. Número promedio de plantados activos, por área de 1°, reportado por entre 145 y 166 buques (promedio = 158) durante el periodo de enero-diciembre de 2024.

3.4.6. Remote deactivations and reactivations

TABLE 8. Number of remote deactivation and reactivations reported, per reason, as specified in Resolution C-21-04, reported by 72 vessels (7 Class 1-5; 65 Class 6) and 620 monthly files, 2024 (average reported number of monthly files per vessel in 2024 was 8.6). A total of 19145 and 6495 deactivation and reactivations were reported, respectively, in 2024. Showed, for comparison purposes, results for 2022-2023, where 51 and 81 vessels reported 120 and 791 monthly files in 2022 and 2023, respectively (a total of 3931 and 563 records for deactivations and reactivations, respectively, in 2022; and a total of 23744 and 6704 deactivations and reactivations, respectively, in 2023). Average number of reported monthly files per vessel in 2022-2023 was 6.9).

TABLA 8. Número de desactivaciones y reactivaciones remotas reportadas, por tipo de razón, tal y como se especifica en la resolución C-21-04, reportado por 72 buques (7 clases 1-5, 65 clase 6) y 620 ficheros mensuales, 2024 (el número medio de ficheros mensuales reportados por buque en 2024 fue 8.6). Un total de 19145 y 6495 desactivaciones y reactivaciones remotas fueron reportadas, respectivamente, en 2024. Se muestra, por razones comparativas, los resultados para 2022-2023, para el cual 51 y 81 buques reportaron 120 y 791 ficheros mensuales en 2022 y 2023, respectivamente (un total de 3931 y 563 registros fueron reportados para desactivaciones y reactivaciones, respectivamente, en 2022; un total de 23744 y 6704 desactivaciones fueron reportadas, respectivamente, en 2023). El número medio de ficheros mensuales reportados por buque en 2022-2023 fue 6.9).

		2024		2022-2023	
Type	**Reason**	**No. records**	**%**	**No. records**	**%**
Deactivation	Beaching	125	0.7%	135	0.5%
	FAD outside the areas (par. 20; c-21-04)	5986	31.3%	7545	27.3%
	Other	1958	10.2%	3112	11.2%
	Signal loss	4982	26.0%	8716	31.5%
	Stolen FAD	3724	19.5%	5329	19.3%
	Temporarily during closure periods	41	0.2%	512	1.9%
	Transferred ownership	2329	12.2%	2326	8.4%

		2024		2022-2023	
Type	**Reason**	**No. records**	**%**	**No. records**	**%**
Reactivation	After a temporary deactivation during the closure period	61	0.9%	252	4.9%
	Other	1666	25.7%	298	5.8%
	Recovery of a signal loss	2264	34.9%	1897	37.0%
	Transfer of ownership	2504	38.6%	2675	52.2%

3.4.7. Buoy derived abundance indices

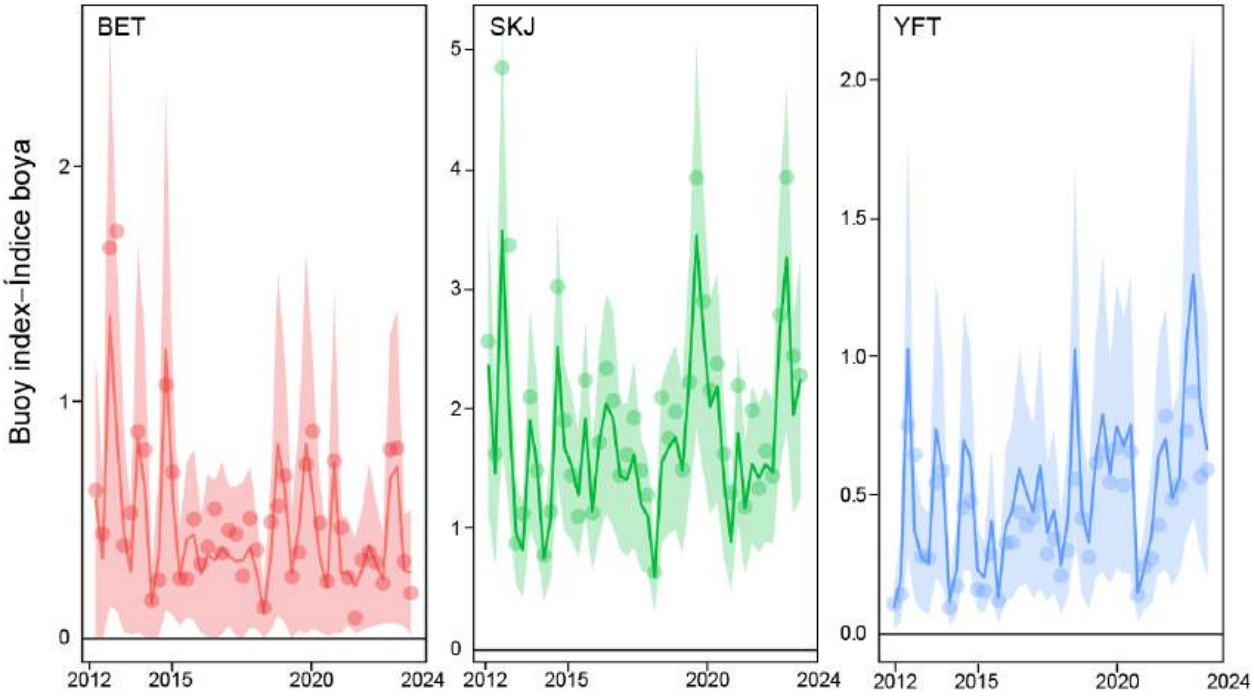

FIGURE 255. Buoy derived index for all three tropical tuna species, 2012-2023. Modified from FAD-08-02.
FIGURA 25. Índice derivado de las boyas para las tres especies de atunes tropical, 2012-2023. Modificado de FAD-08-02.

3.5. Capacity indicators

The IATTC uses well volume, in cubic meters (m^3), to measure the carrying capacity of purse-seine vessels. When reliable well volume data are not available for a purse-seine vessel, it is calculated by applying a conversion factor to its capacity in tons. In 2024, the estimated carrying capacity is 260,573 m^3 for a total of 238 purse seine vessels (Figure 26).

The cumulative capacity at sea during 2024 is compared to those of the previous five years in Figure 27.

The monthly values of the averages of the total well volumes at sea (VAS), in thousands of cubic meters, are estimated at weekly intervals by the IATTC staff. The average monthly VAS values for 2014-2023 and 2024 were slightly lower 146,000 m^3 (57% of total capacity) and about 137,000 m^3 (52% of total capacity), respectively.

The figures and indicators in this category were taken from section 6.1 of SAC-15-01 (Tables A-10, A-11a, A-11b and A-12; Figs. 2-3).

3.5.1. Carrying capacity

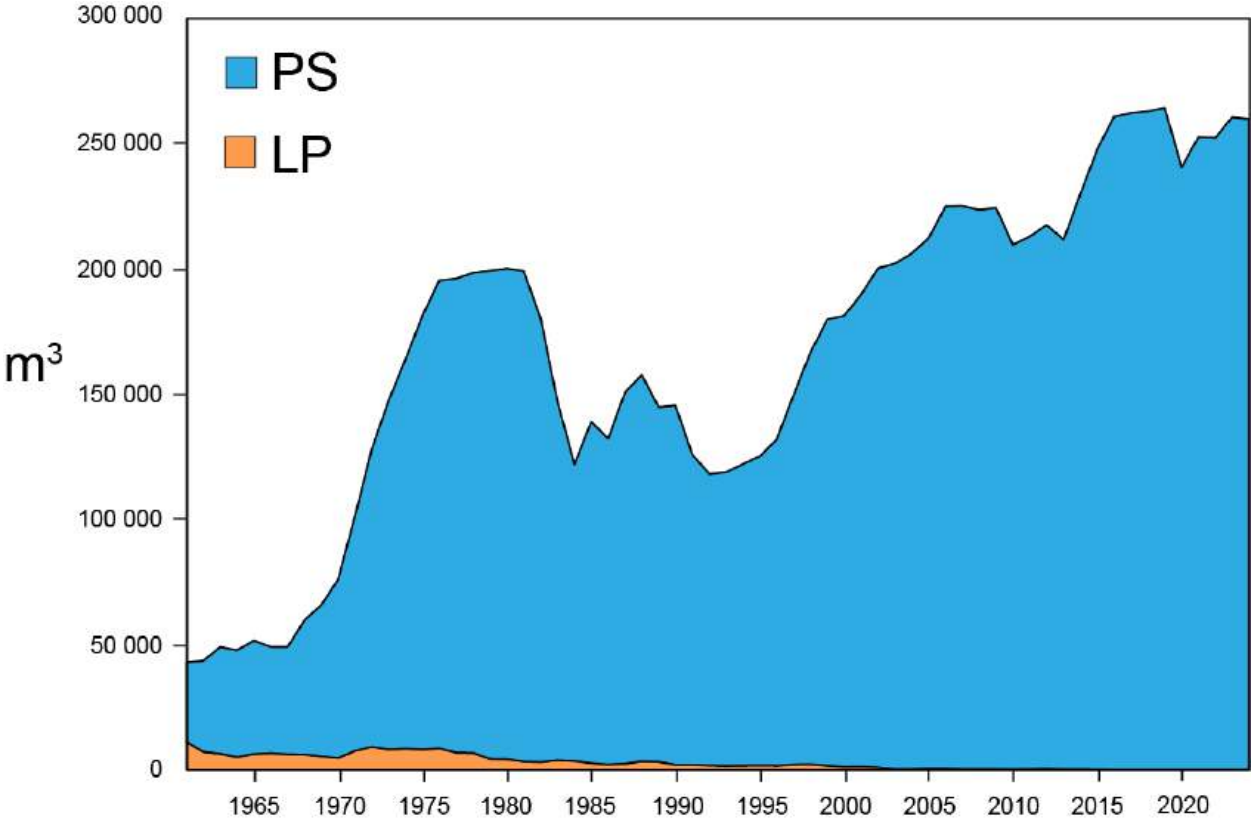

FIGURE 266. Carrying capacity, in cubic meters of well volume, of the purse-seine and pole and line fleets in the EPO, 1961-2024. Source: SAC-16-01 (Fig. 2).
FIGURA 26. Capacidad de acarreo, en metros cúbicos de volumen de bodega, de las flotas de cerco y de caña en el OPO, 1961-2024. Fuente: SAC-16-01 (Fig. 2).

3.5.2. Cumulative capacity

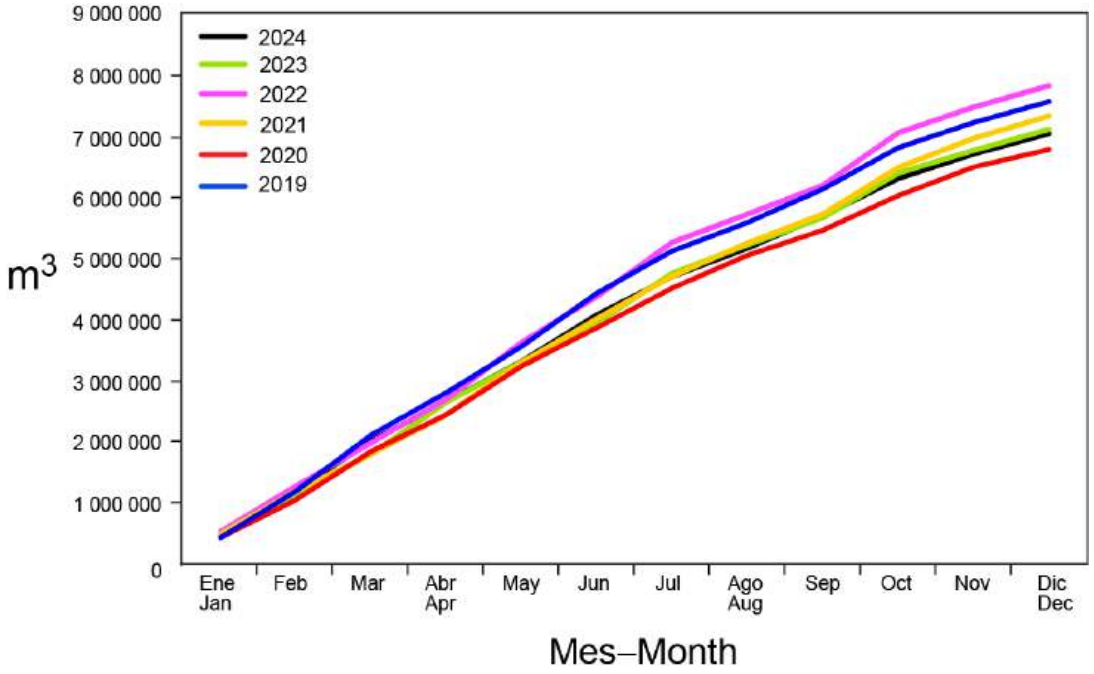

FIGURE 277. Cumulative capacity of the purse seine and pole and line fleet at sea, by month, 2019-2024. Source: SAC-16-01 (Fig. 3).
FIGURA 27. Capacidad acumulativa de la flota cerquera y cañera en el mar, por mes, 2019-2024. Fuente: SAC-16-01 (Fig. 3).

3.6. Technology

Fishing efficiency is known to be related to the gear and onboard technology used by vessels. Because of that, in this first approximation, a series of indicators showing the evolution of FAD designs (e.g. FAD depth), net size (i.e. depth), as well as their spatial distribution have been analyzed. Only information related to deployments and fishing sets was used to estimate FAD depth (Fig. 28) and net size (Fig. 29) indicators, respectively. Besides, the proportion of trips using specific technologies, by cluster (Fig 30), was analyzed to inform the evolution of OBJ-oriented fishing strategies in the study period.

3.6.1. FAD depth

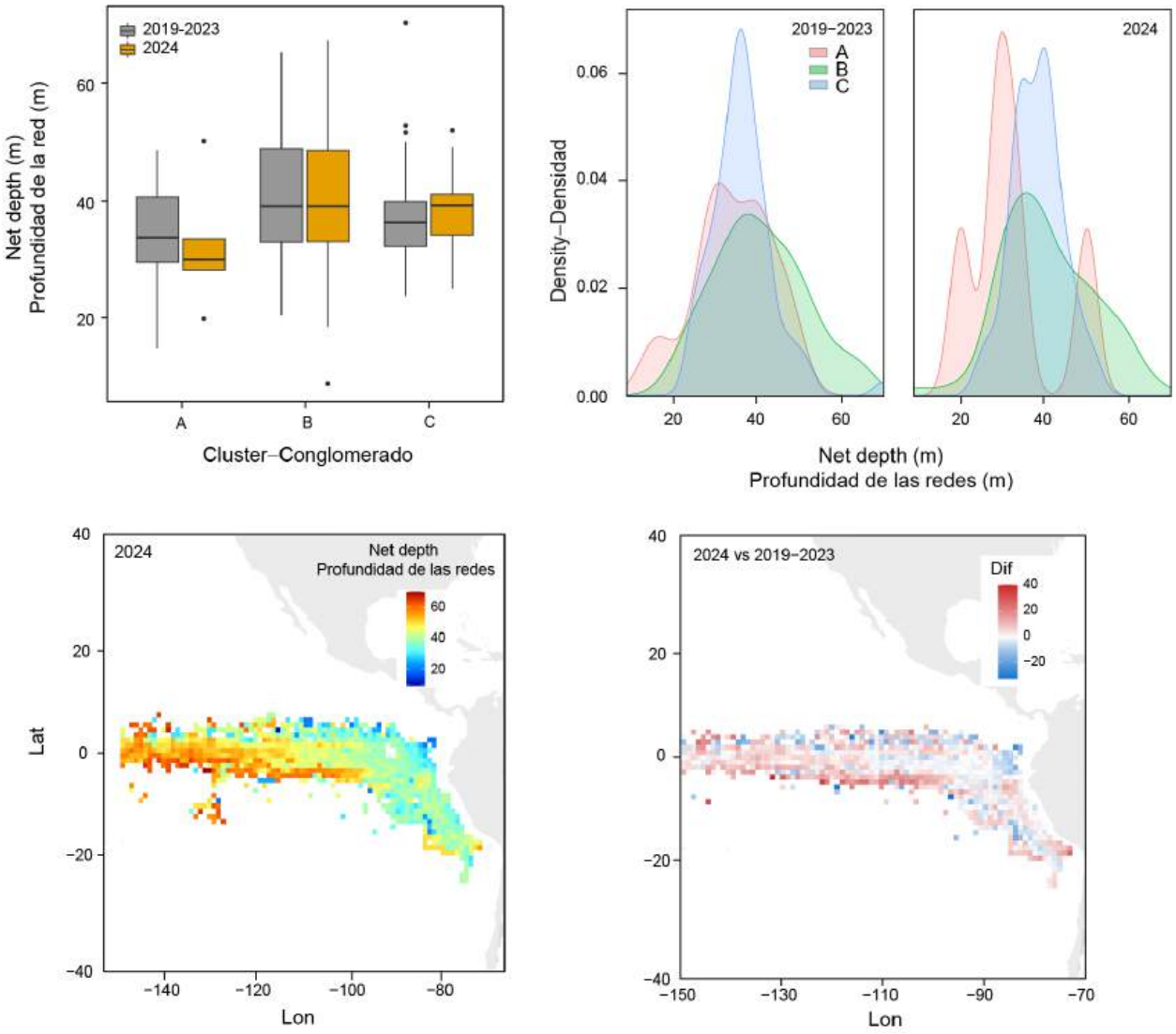

FIGURE 288. Top left: Boxplots of FAD depth for deployments, by cluster, 2019-2023 average and 2024; Top right: Density plot of FAD depth for deployments, 2019-2023 average and 2024, by cluster; Bottom left: average FAD depth, by 1°-area, for 2024; Bottom right: differences of FAD depth, by 1°-area, 2024 vs 2019-2023 average. All indicators are in meters. A clear tendency of deploying deeper FADs is observed in 2024, compared to the average of the previous five years (2019-2023).

FIGURA 28. Panel superior izquierdo: diagramas de caja de la profundidad de los plantados para las siembras, por conglomerado, promedio de 2019-2023 y 2024; panel superior derecho: gráfica de densidad de la profundidad de los plantados para las siembras, promedio de 2019-2023 y 2024, por conglomerado. Panel inferior izquierdo: profundidad promedio de los plantados, por área de 1°, en 2024; panel inferior derecho: diferencias de la profundidad de los plantados, por área de 1°, 2024 vs promedio de 2019-2023. Todos los indicadores están en metros. Se observa una clara tendencia a la siembra de plantados más profundos en 2024, en comparación con el promedio de los cinco años anteriores (2019-2023).

3.6.2. Net size

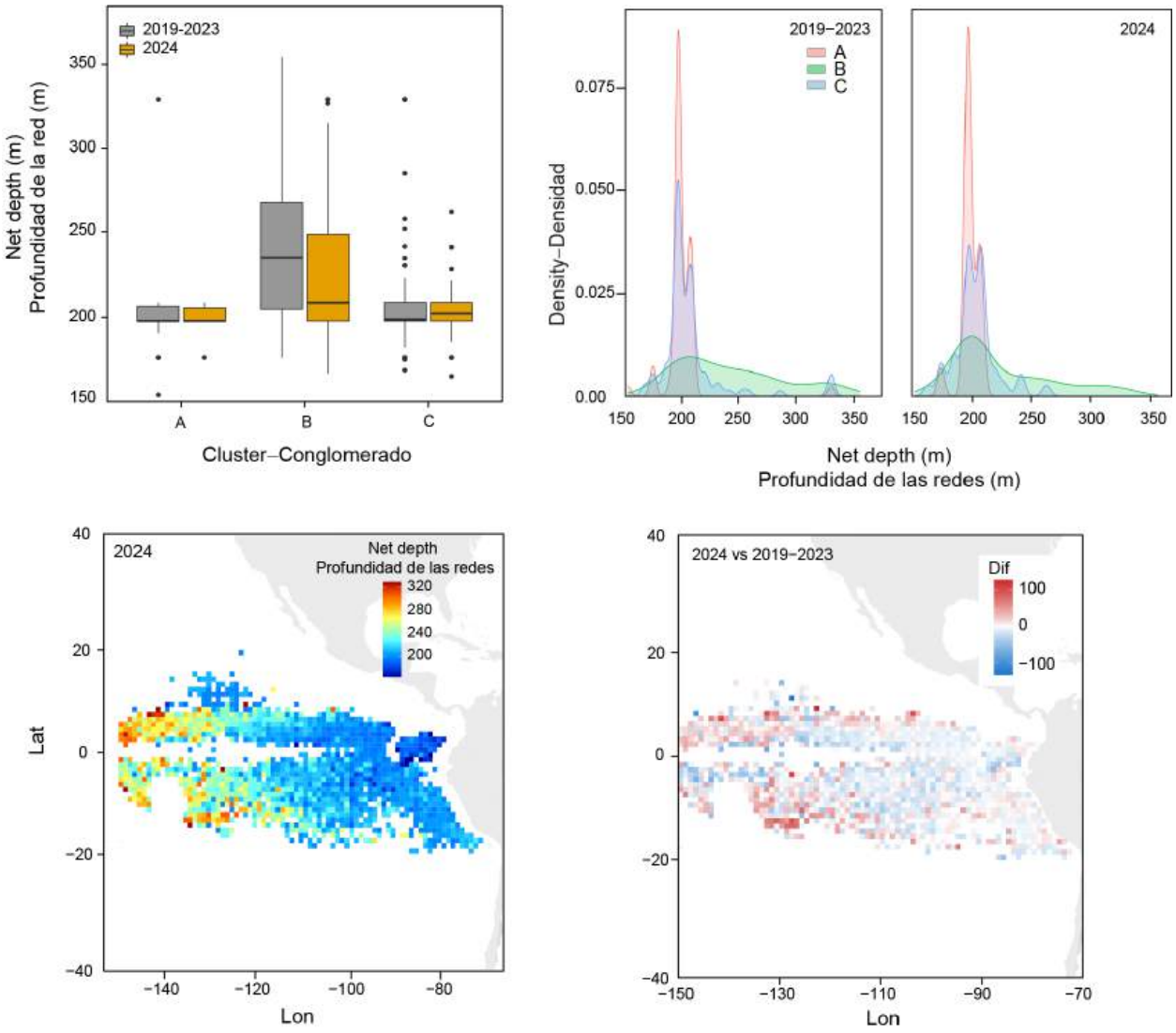

FIGURE 299. Top left: Boxplots of the net depth used in OBJ fishing sets, by cluster, 2019-2023 average and 2024; Top right: Density plot of the net depth used in OBJ fishing sets, 2019-2023 average and 2024, by cluster; Bottom left: average net depth used in OBJ fishing sets, by 1°-area, for 2024; Bottom right: differences of the net depth used in OBJ fishing sets, by 1°-area, 2024 vs 2019-2023 average. All indicators are in meters. A clear tendency of fishing with deeper nets is observed primarily in the western region of the EPO along the equator, as well as in the southern area, in 2024.

FIGURA 29. Panel superior izquierdo: Diagramas de caja de la profundidad de las redes usadas en los lances OBJ, por conglomerado, promedio de 2019-2023 y 2024; panel superior derecho: gráfica de densidad de la profundidad de las redes usadas en los lances OBJ, promedio de 2019-2023 y 2024, por conglomerado. Panel inferior izquierdo: profundidad promedio de las redes usadas en los lances OBJ, por área de 1°, en 2024; panel inferior derecho: diferencias de la profundidad de las redes usadas en los lances OBJ, por área de 1°, 2024 vs promedio de 2019-2023. Todos los indicadores están en metros. Se observa una clara tendencia a la pesca con redes más profundas para zonas al oeste del OPO a lo largo de la línea ecuatorial, así como al sur de la región, en 2024.

Onboard equipment

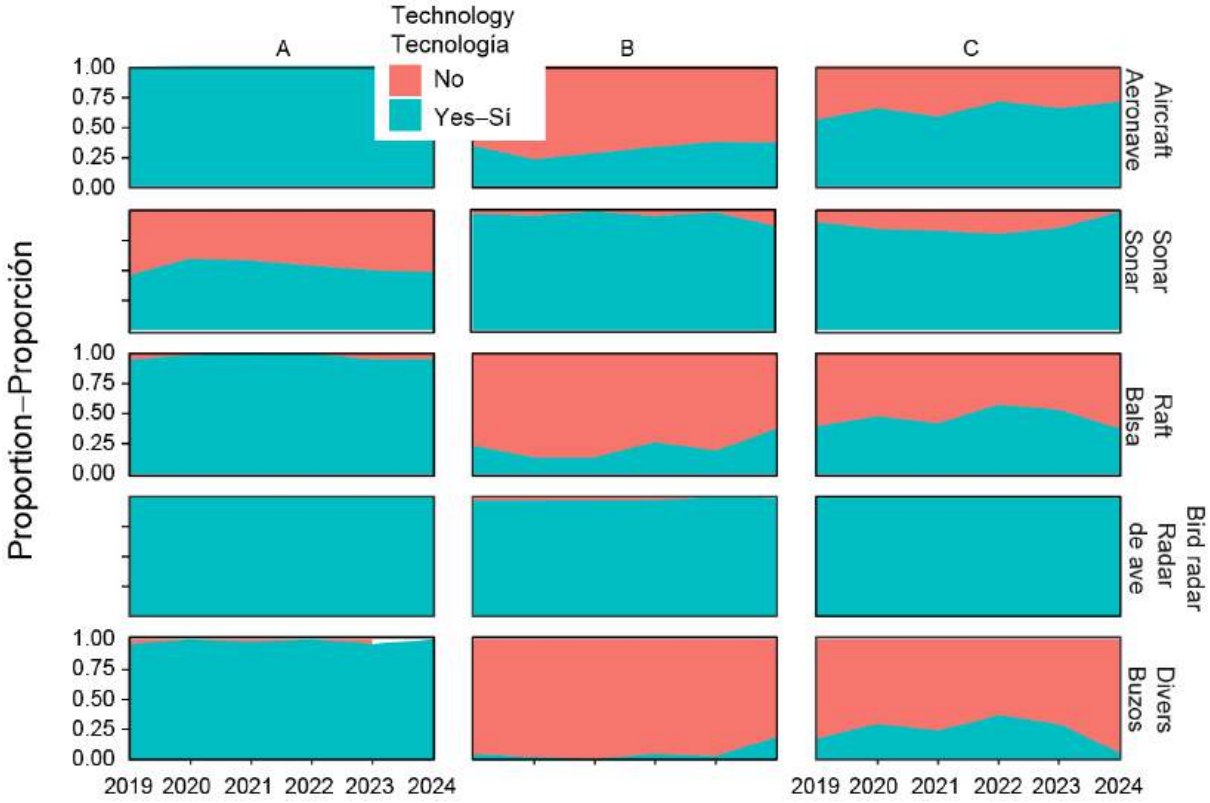

FIGURE 30. Evolution of the proportion of trips using different technologies, by cluster, including the use of aircrafts, sonar, rafts, bird radar and divers, for 2019-2024. Although some of these technologies have traditionally been used for dolphin fishing (e.g., rafts, divers, aircrafts), they have been included in the analysis, as they are an important component of the technology used by some clusters (see section 3.1 for details on clustering).

FIGURA 30. Evolución de la proporción de viajes en los que se usan diferentes tecnologías, por conglomerado, incluyendo el uso de aeronaves, sonares, balsas, radares de aves, y buzos, para 2019-2024. Aunque algunas de estas tecnologías se emplean tradicionalmente en la pesca sobre delfines (por ejemplo, balsas, buzos, aeronaves), se incluyeron en el análisis ya que son un componente importante de la tecnología empleada por algunos conglomerados (ver la sección 3.1 para más detalles sobre los conglomerados).

3.7. Ecosystem impacts

The Ecosystem Considerations document (EB-03-01) is an extensive review of many different aspects of the tuna fisheries in the EPO. Of particular importance are the estimates of bycatch for the different components of the purse-seine fishery, including the OBJ fishery. Appendix 1 (Tables 9–13) shows 2019-2024 bycatch estimates of the OBJ fishery for many sensitive taxa including turtles and elasmobranchs.

3.8. Biology indicators

Length-frequency samples are necessary to obtain age-structured estimates of the populations for various purposes, primarily for the integrated modeling that the staff uses to assess the status of the stocks. Length-frequency samples are obtained from the catches of purse-seine vessels in the EPO by IATTC personnel at ports of landing in Ecuador, Mexico, Panama, and Venezuela. The methods for sampling the catches of tunas are described in the appendix of Suter (2010).

Historical long-term time series of size-composition data for yellowfin and bigeye are available in the Stock Assessment Reports, and the average length stock status indicators are available for the three tropical tuna species in SAC-16-02. In this document, data on the size composition of OBJ catches during 2019-2024 are presented (Fig. 31). The indicators in this section were extracted from SAC-16-01, section 5.

3.8.1. Size composition of tuna catches

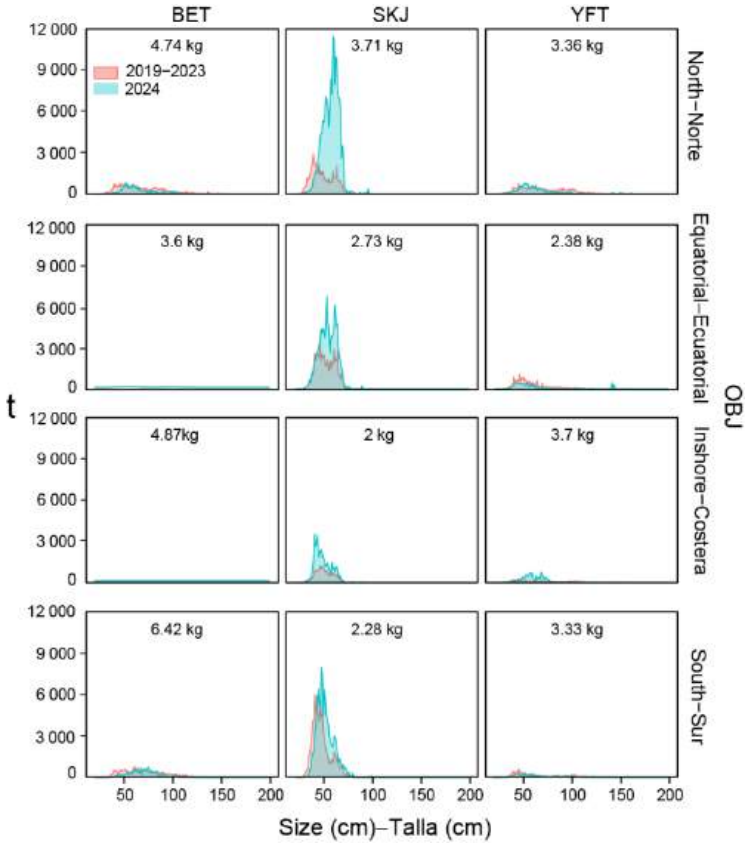

FIGURE 30. Estimated size compositions of bigeye, skipjack and yellowfin caught in the EPO, 2024 and 2019-2023 averages for each purse seine fishery defined by the IATTC staff for analyses of tropical tunas in the EPO (see Figure A-5 of SAC-16-01 for details on the designated areas). The value at the top of each panel is the average weight of the fish in the samples for 2024. Source of data: SAC-16-01.
FIGURA 31. Composiciones por talla estimadas del patudo, barrilete y aleta amarilla capturados en el OPO, 2024 y promedio de 2019-2023, para cada pesquería cerquera definida por el personal de la CIAT para los análisis de los atunes tropicales en el OPO (ver detalles sobre las áreas designadas en Figura A-5 de SAC-16-01). El valor en la parte superior de cada panel es el peso promedio de los peces en las muestras para 2024. Fuente de datos: SAC-16-01.

4. FUTURE PROSPECTS

Although this document presents the first holistic assessment for the OBJ fishery in the EPO through a set of ~50 indicators, there is still room for improvement. Some of the categories, particularly the socio-economic, the ecosystem impacts, or the biology-ecology and behavior are underrepresented due to the difficulties to systematically obtain large amounts of reliable data. Future versions of this document will attempt to increase the number of indicators to comply with the joint tuna-RFMO Technical Working Group recommendations. Indeed, the staff is currently involved in projects that could produce additional indicators in a yearly basis, such as the buoy-derived abundance index (i.e., no buoy derived index was

prepared for the 2012-2024 period as no benchmark tuna assessments were scheduled with 2024 data) (e.g., FAD-08-02), quantifying the impact of stranding events in sensitive areas by lost or abandoned FADs (Project M.5.b), and analyzing observer data from class 1-5 vessels that is voluntarily collected in TUNACONS vessels (see DAT-02-01 and DAT-02-02).

The data collected using different methodologies and used to produce the indicators in this document have proven to be useful for monitoring the OBJ fishery and its evolution. However, there are still many key aspects that remain unknown. For instance, catch per set analyses are merely descriptive and have not been standardized. The staff has emphasized the need of collecting additional data, including historical high-resolution buoy data, to connect databases and advance scientific analysis and management advice. This information became available to the staff in 2022 (see Resolution C-21-04 for details on raw buoy data reporting). However, improving our understanding between the fishing strategies and the number of FADs (available at sea or monitored by a given vessel) and the production of fisheries independent echo-sounder buoy indices relies on the availability of long-term data. We hope that initiatives like the one presented in this document will be well received by the scientific community, managers, buoy manufacturers and stakeholders in general, and will help promote historical data exchange between institutions for a better assessment of fishery impacts and management.

In addition, the staff plans to increase interaction with the fishing community, an endless source of first-hand information about the stock, the environment, and the fishery in general. Over the years, skippers' workshops have been conducted with the participation of the staff members for various reasons. The staff sees these forums as an excellent opportunity to build capacity and increase staff's knowledge of changes in the fleet behavior and strategy, the species, or the dynamics of the environment in a more tangible and immediate way. Starting in 2020, the workshops have been accompanied by a series of brief questionnaires on the most urgent matters, as well as basic questions about the fishery (e.g., biodegradable FADs, fishing strategy, best handling and release practices). The results of these consultations will be included in future versions of this document but have been made available in documents FAD-09-02, SAC-16-10 and SAC-16 INF-S.

5. RECOMMENDATIONS

Please refer to the staff recommendations document (SAC-16-11) for recommendations on the FAD fishery, including recommendations for data collection and any other relevant matter.

REFERENCES

Dagorn, L., K. N. Holland, V. Restrepo and G. Moreno (2012). "Is it good or bad to fish with FADs? What are the real impacts of the use of drifting FADs on pelagic marine ecosystems?" Fish and Fisheries: n/a-n/a.

Escalle, L., J. Scutt Phillips, M. Brownjohn, S. Brouwer, A. Sen Gupta, E. Van Sebille, J. Hampton and G. Pilling (2019). "Environmental versus operational drivers of drifting FAD beaching in the Western and Central Pacific Ocean." Scientific Reports 9(1): 14005.

Lennert-Cody, C. E., G. Moreno, V. Restrepo, M. H. Román and M. N. Maunder (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(75): 1748-1757.

Lopez, J. (2019). "FAD fishery indicators." 2nd joint t-RFMO WG on FADs, 8-10 May 2019, San Diego, USA.

Lopez, J., C. Lennert-Cody, M. Maunder and A. Aires-da-Silva (2019). "Adjusting current FAD limits to meet 2019 staff recommendations for tropical tuna management in the eastern Pacific Ocean." Document FAD-04-01 Ad-Hoc Permanent Working Group on FADs, Bilbao 2019.

Suter, J. M. (2010). "An evaluation of the area stratification used for sampling tunas in the eastern Pacific Ocean and implications for estimating total annual catches." La Jolla, CA, Inter-American Tropical Tuna Commision, 114pp. (Special Report, 18).

APPENDIX 1. OBJ bycatch rates, 2019–2024.

Source: from EB-03-01, Tables J-2a; J-4a, J-5a, J-6a, J-7.

TABLE 9. Purse-seine interactions and mortalities of sea turtles (numbers of individuals) associated with floating objects as reported by onboard observers for size-class 6 vessels with a carrying capacity >363 t (2019–2024). Data for 2023–2024 are considered preliminary. Adapted from EB-03-01, table J-2a.
TABLA 9. Interacciones y mortalidades cerqueras reportadas por observadores a bordo, en número de tortugas, para buques de clase 6 con una capacidad de acarreo >363 t (2019–2024). Los datos de 2023–2024 se consideran preliminares. Adaptada de EB-03-01, tabla J-2a.

	Lepidochelys olivacea, Olive ridley		*Chelonia agassizii, Chelonia mydas, eastern Pacific green*		*Caretta caretta, loggerhead*		*Eretmochelys imbricata, hawksbill*		*Dermochelys coriacea, leatherback*		Unidentified turtles	
Year	Interactions	Mortalities	Interactions	Mortalities	Interactions	Mortalities	Interactions	Mortalities	Interactions	Mortalities	Interactions	Mortalities
2019	170	1	72	-	14	-	5	-	-	-	193	-
2020	91	-	29	-	17	-	5	-	2	-	108	1
2021	191	1	32	-	13	-	4	-	1	-	102	-
2022	133	-	40	-	19	-	10	-	2	-	92	-
2023	65	-	13	-	12	-	2	-	3	-	55	-
2024	154	1	19	-	14	-	5	-	3	-	102	-
Average	134	1	34	-	15	-	5	-	2	-	109	-

TABLE 10. Estimated purse-seine OBJ catches in metric tons (t) of sharks for size-class 6 vessels with a carrying capacity >363 t (2019–2024). Data for 2023–2024 are considered preliminary. "Other sharks" include whale shark (*Rhincodon typus*) and unidentified sharks (Euselachii). Adapted from EB-03-01, table J-4a.

TABLA 10. Capturas OBJ cerqueras estimadas de tiburones, en toneladas (t), para buques de clase 6 con una capacidad de acarreo >363 t (2019–2024). Los datos de 2023–2024 se consideran preliminares. "Otros tiburones" incluyen el tiburón ballena (*Rhincodon typus*) y tiburones (Euselachii) no identificados. Adaptada de EB-03-01, tabla J-4a.

Year	*Carcharhinus falciformis*, silky shark	*Carcharhinus longimanus*, oceanic whitetip	*Prionace glauca*, blue shark	Other Carcharhinidae, requiem sharks
2019	392	5	<1	26
2020	345	4	<1	87
2021	542	12	<1	30
2022	614	12	1	30
2023	473	12	<1	26
2024	626	21	<1	25
Average	499	11	<1	37

Year	*Sphyrna zygaena*, smooth hammerhead	*Sphyrna lewini*, scalloped hammerhead	*Sphyrna mokarran*, great hammerhead	*Sphyrna* spp., hammerheads, nei
2019	17	11	1	5
2020	7	13	<1	5
2021	13	31	2	7
2022	11	47	<1	9
2023	15	19	<1	8
2024	11	15	3	4
Average	12	23	1	6

Year	*Alopias pelagicus*, pelagic thresher	*Alopias superciliosus*, bigeye thresher	*Alopias vulpinus*, thresher shark	*Alopias* spp., thresher shark, nei
2019	1	<1	-	<1
2020	<1	<1	-	<1
2021	<1	<1	<1	<1
2022	<1	<1	<1	<1
2023	<1	<1	-	<1
2024	<1	<1	-	<1
Average	<1	<1	<1	<1

Year	*Isurus* spp., mako sharks	Lamnidae spp., mackerel sharks, porbeagles nei	Triakidae spp., houndsharks, nei	Other sharks
2019	<1	-	-	6
2020	2	-	-	3
2021	2	-	-	6
2022	1	-	-	2
2023	1	-	-	1
2024	<1	-	-	2
Average	1	-	-	3

TABLE 11. Estimated purse-seine OBJ catches in numbers of individual rays for size-class 6 vessels with a carrying capacity >363 t (2019–2024). Data for 2023–2024 are considered preliminary. Adapted from EB-03-01, table J-5a.

TABLA 11. Capturas OBJ cerqueras estimadas de rayas, en número de individuos, para buques de clase 6 con una capacidad de acarreo >363 t (2019–2023). Los datos de 2023–2024 se consideran preliminares. Adaptada de EB-03-01, tabla J-5a.

Year	*Mobula thurstoni*, smoothtail manta	*Mobula mobular*, spinetail manta	*Mobula munkiana*, munk's devil ray	*Mobula tarapacana*, Chilean devil ray	*Mobula birostris*, giant manta
2019	7	35	9	24	2
2020	9	19	1	5	7
2021	8	34	10	11	1
2022	5	43	12	23	3
2023	28	25	5	73	2
2024	12	73	2	39	4
Average	11	38	7	29	3

Year	Mobulidae spp., mobulid rays, nei	*Pteroplatytrygon violacea*, pelagic stingray	Dasyatidae spp., stingrays, nei	Other rays
2019	87	255	40	-
2020	62	260	17	-
2021	85	388	46	-
2022	128	422	34	-
2023	112	333	40	1
2024	144	349	42	-
Average	103	334	37	-

TABLE 102. Estimated purse-seine OBJ catches in metric tons (t) of large fishes for size-class 6 vessels with a carrying capacity >363 t (2019–2024). Data for 2023–2024 are considered preliminary. "Other large fishes" include unidentified mackerels (Scombridae), and large fishes nei (not elsewhere identified). Adapted from EB-03-01, table J-6a.

TABLA 12. Capturas OBJ cerqueras estimadas de peces grandes, en toneladas (t), para buques de clase 6 con una capacidad de acarreo >363 t (2019–2024). Los datos de 2023–2024 se consideran preliminares. "Otros peces grandes" incluyen caballas (Scombridae) no identificadas, y peces grandes nep (no identificados en otra parte). Adaptada de EB-03-01, tabla J-6a.

Year	Coryphaenidae spp., dorado	*Acanthocybium solandri*, wahoo	*Elagatis bipinnulata,* rainbow runner	*Seriola* spp., amberjacks, nei	*Caranx* spp., jacks, crevalles, nei
2019	1,208	201	21	12	5
2020	783	130	23	9	3
2021	2,183	132	28	81	3
2022	2,325	164	35	25	6
2023	1,457	264	45	9	3
2024	865	232	86	16	7
Average	1,470	187	40	25	5

Year	*Seriola, Caranx* spp., amberjacks, jacks, crevalles, nei	Molidae spp., molas, nei	*Lobotes surinamensis,* tripletail	*Sphyraenidae* spp., barracudas	*Lampris* spp., opahs
2019	3	2	2	<1	-
2020	<1	1	2	<1	-
2021	2	<1	1	1	-
2022	4	2	4	<1	-
2023	1	2	2	2	-
2024	9	<1	3	<1	-
Average	3	1	2	1	-

Year	Gempylidae spp., snake mackerels, nei	Bramidae spp., pomfrets, nei	Other large fishes	Unidentified fishes
2019	-	-	<1	<1
2020	-	-	<1	<1
2021	-	-	<1	<1
2022	-	<1	<1	<1
2023	-	<1	<1	-
2024	-	-	<1	<1
Average	-	<1	<1	<1

TABLE 113. Estimated purse-seine OBJ catches in metric tons (t) of small forage fishes for size-class 6 vessels with a carrying capacity >363 t (2019–2024). Data for 2023–2024 are considered preliminary. “Epipelagic forage fishes” include various mackerels and scad (*Decapterus* spp., *Trachurus* spp., *Selar crumenophthalmus*). “Other small fishes” include various Tetraodontiformes, driftfishes (Nomeidae), Pacific chub mackerel (*Scomber japonicus*), Pacific tripletail (*Lobotes pacificus*), remoras (Echeneidae), longfin batfish (*Platax teira*), and small fishes not elsewhere identified (nei). Adapted from EB-03-01, Table J-7.
TABLA 13. Capturas OBJ cerqueras estimadas de peces forrajeros pequeños, en toneladas (t), para buques de clase 6 con una capacidad de acarreo >363 t (2019–2024). Los datos de 2023–2024 se consideran preliminares. “Peces epipelágicos de forraje” incluyen varias caballas y jureles (*Decapterus* spp., *Trachurus* spp., *Selar crumenophthalmus*). “Otros peces pequeños” incluyen varios Tetraodontiformes, derivantes (Nomeidae), estornino del Pacífico (*Scomber japonicus*), dormilona del Pacífico (*Lobotes pacificus*), remoras (Echeneidae), pez murciélago teira (*Platax teira*), y peces pequeños (nep) no identificados en otra parte. Adaptada de EB-03-01, tabla J-7.

Year	*Auxis* spp., bullet and frigate tunas	Balistidae, Monacanthidae spp., triggerfishes and filefishes	Kyphosidae, sea chubs	Epipelagic forage fishes	Small Carangidae spp., carangids, nei	Other small fishes
2019	182	57	7	5	<1	<1
2020	435	47	2	4	<1	<1
2021	423	50	6	15	<1	<1
2022	687	543	21	15	<1	1
2023	588	518	12	10	3	1
2024	446	513	7	11	2	<1
Average	460	288	9	10	1	1