Comparative Analysis of Tuna Fisheries in Madagascar Using ERS Data: Longline and Purse Seine Fleets, 2024–2025

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Abstract

This study presents a comparative analysis of tropical tuna catches by the longline and purse seine fleets operating in Madagascar waters during 2024 and the first half of 2025. The analysis focuses on the temporal distribution of catches, species-specific catch rates, and the overall contribution of tropical tuna to total catches, using data from the Electronic Reporting System (ERS), which was introduced in Madagascar in 2024 as part of the implementation of the EU-Madagascar Sustainable Fisheries Partnership Agreement (SFPA).

The results reveal distinct dynamics between the two fleets. The purse seine fleet primarily targets skipjack tuna (SKJ), with fishing activity concentrated in the first half of the year and peak catches in early months, reflecting strong seasonality. The longline fleet mainly exploits bigeye tuna (BET) and yellowfin tuna (YFT), with a more evenly distributed activity pattern and a seasonal peak in the second quarter, indicating greater operational flexibility.

Interannual comparison shows an increase in longline catches in 2025, particularly for BET, while purse seine performance slightly declined, possibly due to environmental conditions or reduced fishing effort. Tropical tunas dominate total catches, representing over 98% for purse seiners and a majority for longliners, with clear differentiation in species composition between fleets.

These findings highlight the importance of integrating fleet-specific dynamics, seasonality, and species composition in the management and conservation of tuna stocks in Madagascar. The study provides key information for optimizing fishery management, promoting sustainable exploitation of tropical tuna resources, and supporting evidence-based decision-making for industrial tuna fisheries in the region.

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1. Introduction

Tuna fishing plays a predominant role in the maritime waters of Madagascar and constitutes one of the country's main fisheries activities. It represents a source of foreign exchange for the state and contributes to the socio-economic development of coastal regions, particularly in Antsiranana, where a tuna canning plant was established around the 1990s, generating local economic benefits.

However, the national capacity of the Malagasy fleet remains limited and does not allow for optimal exploitation of tuna resources. This structural constraint has led Malagasy authorities to establish fishing agreements with foreign companies. Among these, the Sustainable Fisheries Partnership Agreement (SFPA) concluded with the European Union is of particular importance. The new agreement, signed in 2023, notably includes the requirement to use the Electronic Reporting System (ERS), reflecting the government's commitment to strengthen the national system for monitoring, control, and fisheries data collection.

The implementation of the ERS required substantial investments, both in terms of equipment acquisition and development of technical infrastructure. This system, now fully operational, allows for the near real-time collection and transmission of catch data, representing a significant step forward for the sustainable management of fisheries.

This study is conducted within this framework and aims to utilize ERS data to perform a comparative analysis of tuna fishing activities in Madagascar, distinguishing between longline and purse-seine operations over the 2024–2025 period. The temporal distribution of catches, the catch rate by tropical tuna species, and the overall catch rate of tropical tunas are the three main parameters examined in the comparative analyses presented in this study.

2. Methodology

2.1. Study Area and Data Sources

The study area covered by this analysis corresponds to the fishing zone of Madagascar. The study focuses primarily on tuna fisheries, particularly those conducted by European Union vessels under the Sustainable Fisheries Partnership Agreement (SFPA), using the Electronic Reporting System (ERS).

The main data used come from the ERS database, managed by the Fisheries Monitoring Center (CSP). These data include information on catches and fishing effort, extracted through specific queries.

Tuna catches consist of several large pelagic fish species. However, this study focuses primarily on the three main tropical tuna species: yellowfin tuna (YFT), skipjack tuna (SKJ), and bigeye tuna (BET). Other species or species groups are not entirely excluded from the analysis but are not the main focus of this study.

2.2. Analysis Methodology

- *Temporal Distribution of Catches*

The temporal distribution of catches by purse-seiners and longliners was calculated for 2024 and the first semester of 2025.

The data were aggregated on a monthly basis using the following formula:

Catch weight=∑(catch weight by species and month)

This approach allows for observing the monthly variation in catch volume over the study period.

- *Catch Rate by Tropical Tuna Species*

The catch rate of each tropical tuna species, expressed as a percentage, was calculated using the formula:

$$\textbf{Catch rate per tropical tuna species} = \frac{\textbf{catch weight by species and month}}{\textbf{total monthly catch}} \textbf{ x 100}$$

This variable allows determining the relative contribution of each species (yellowfin tuna, skipjack tuna, and bigeye tuna) to the total monthly catch.

- *Catch Rate of All Tropical Tunas*

The overall catch rate of tropical tunas was calculated by aggregating the three main species using the formula:

$$\textbf{Catch rate of tropical tunas} = \frac{\textbf{catch weight of all three species by month}}{\textbf{total monthly catch}} \textbf{ x 100}$$

- *Data Processing Tool*

All data processing and the presentation of results were performed using Microsoft Excel.

3. Results

3.1. Distribution of Tropical Tuna Catches in 2024

A monthly comparison of tropical tuna catches by purse-seiners and longliners during 2024, expressed in tonnes, is presented below. The catches are broken down by the main target species, namely bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

3.1.1. Distribution of Longline Catches in 2024

Figure 1 shows the monthly distribution of tropical tuna catches by the longline fleet in 2024. The figure includes the main target species — bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ) — along with the total monthly catch across all species.

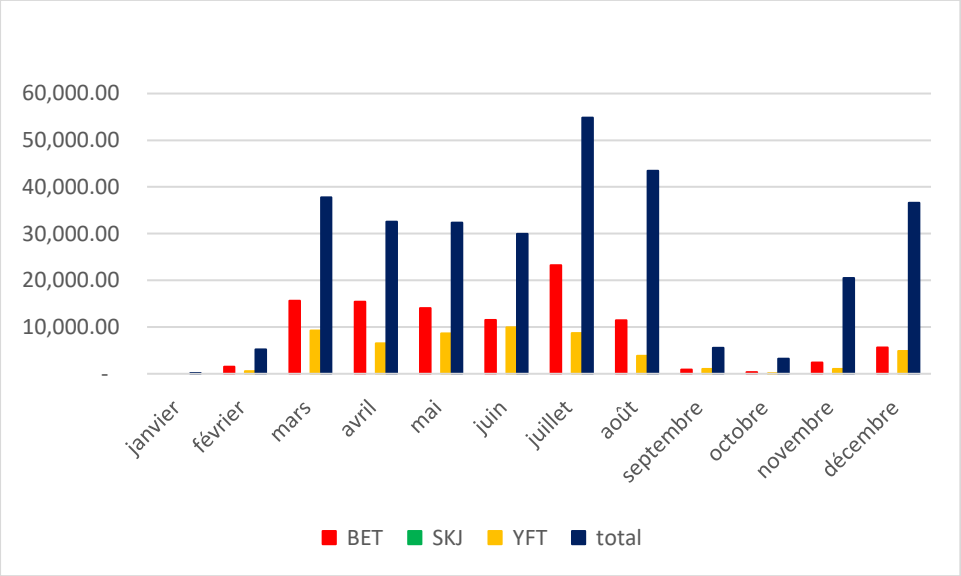

Figure 1 : Monthly distribution of tropical tuna catches by the longline fleet in 2024, showing the main target species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) and the total monthly catch across all species.

The results reveal a strong seasonal variability in catches. They remain low at the beginning and end of the year, then increase gradually from March, stabilizing at a plateau between 30 and 40 tons per month until June. A peak in activity occurs in July, with catches exceeding 55 tons, followed by a gradual decline through September.

In terms of species composition, bigeye tuna (BET) clearly dominates the catches, followed by yellowfin tuna (YFT), while skipjack tuna (SKJ) is nearly absent.

These findings indicate that the longline fishery relies mainly on these two species, with an intensification of fishing activity during the second and third quarters of the year.

3.1.2. Distribution of Purse Seine Catches in 2024

Figure 2 illustrates the monthly distribution of tropical tuna catches by the purse seine fleet during 2024. The graph distinguishes the main target species — bigeye tuna (BET), skipjack tuna (SKJ), and yellowfin tuna (YFT) — as well as the total monthly catch across all species.

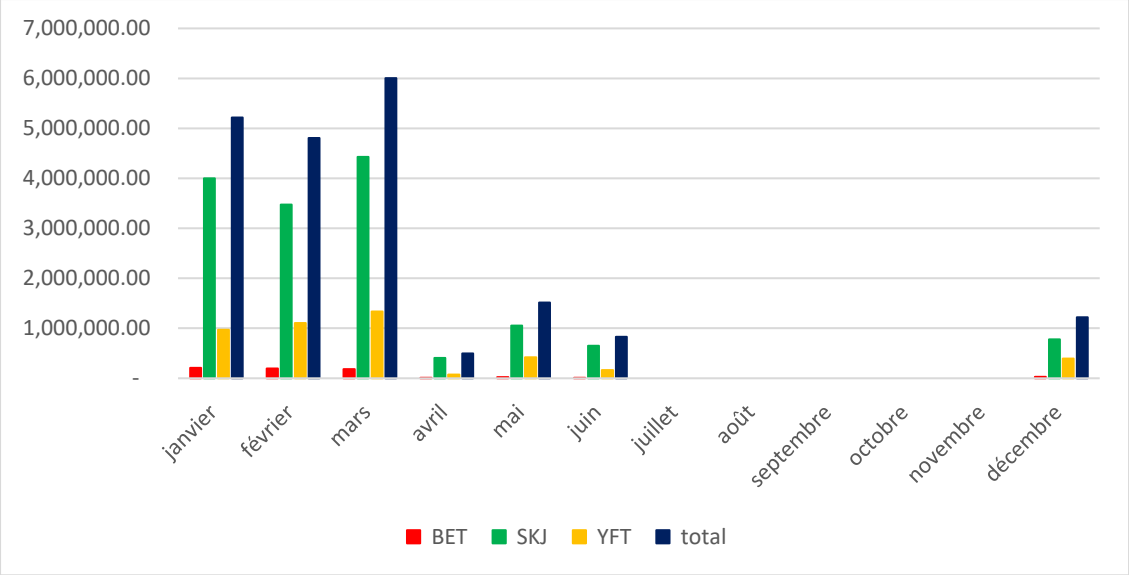

Figure 2 : Monthly distribution of tropical tuna catches by the purse-seine fleet in 2024, showing the main target species (skipjack tuna [SKJ], yellowfin tuna [YFT], bigeye tuna [BET]) and the total monthly catch.

The results show a highly seasonal pattern of catches, concentrated mainly during the first quarter of the year, with a peak in April exceeding 6,000 tons. From May onward, catches drop sharply and remain almost negligible between August and November, before showing a modest recovery in December.

In terms of species composition, skipjack tuna (SKJ) overwhelmingly dominates the catches, particularly between February and March, while yellowfin tuna (YFT) ranks second but remains relatively steady throughout the period. Bigeye tuna (BET) contributes only marginally. This dynamic highlights the highly seasonal nature of the purse seine fishery, which is largely dependent on skipjack tuna and concentrated in the first four months of the year.

3.2. Catch Rates by Tropical Tuna Species

This section presents the monthly variation in catch rates of the main tropical tuna species caught by both purse seine and longline fleets during 2024. The catch rates, expressed as percentages, illustrate the relative contribution of each species—bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ)—to the total monthly catches.

3.2.1. Catch Rates by Species – Longline Fleet in 2024

Figure 3 illustrates the monthly evolution of catch rates for the main tropical tuna species exploited by the longline fleet during 2024. The figure distinguishes the three major species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

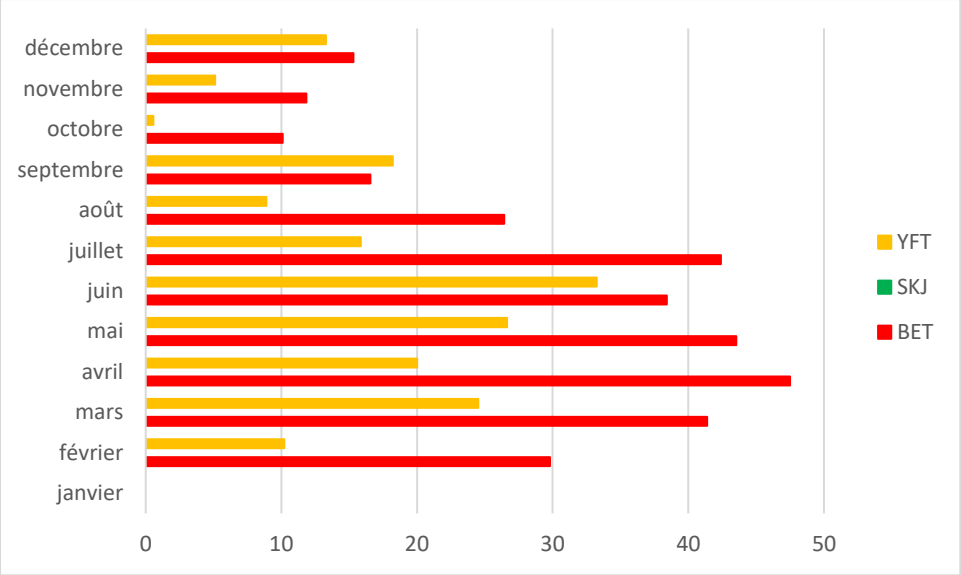

Figure 3 : Monthly catch rates of the main tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) by the longline fleet in 2024.

The results indicate that bigeye tuna (BET) clearly dominates the catches, with catch rates exceeding 30% from March to July and reaching a peak of more than 45% in April. Yellowfin tuna (YFT) represents the second most important species, showing its highest proportion in June, while skipjack tuna (SKJ) remains negligible throughout the year.

The seasonal pattern of the longline fishery shows maximum activity during the first half of the year, followed by a gradual decline from August onward, reaching a minimum in October–November, and then a slight recovery in December, mainly driven by BET and YFT.

3.2.2. Catch Rates by Species – Purse Seine Fleet in 2024

Figure 4 presents the monthly distribution of catch rates for the main tropical tuna species exploited by the purse seine fleet during 2024. The figure distinguishes bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

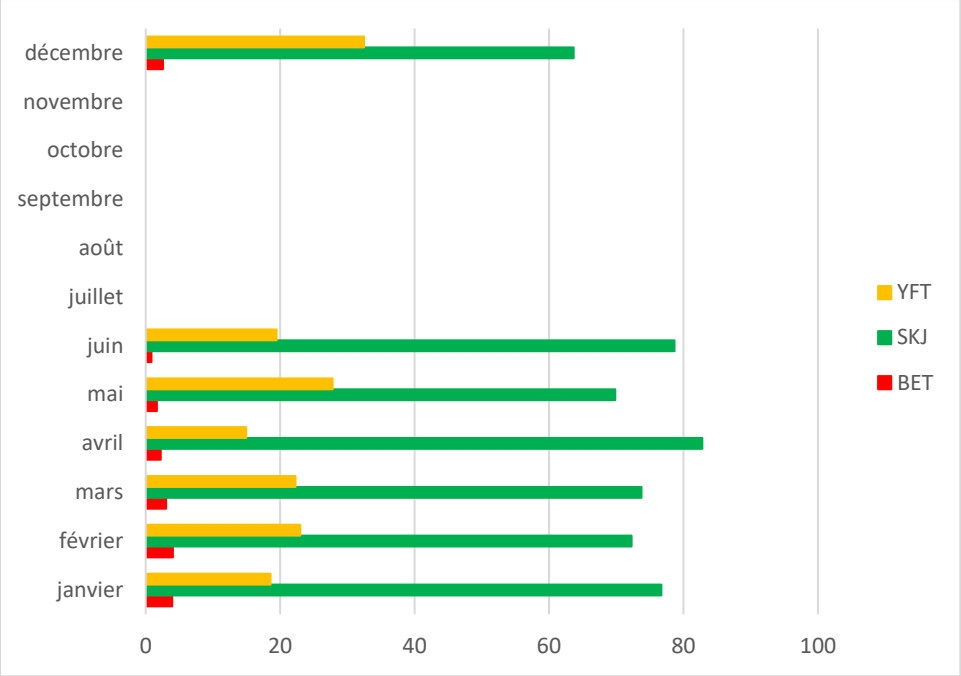

Figure 4 : Monthly catch rates of the main tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) by the purse-seine fleet in 2024.

The results show that skipjack tuna (SKJ) overwhelmingly dominates the catches of the purse seine fleet throughout the year, with rates exceeding 70% from January to June and peaking at over 80% in April. Yellowfin tuna (YFT) ranks second, contributing between 15% and 30%, with a slight increase observed in December. Bigeye tuna (BET) remains marginal, accounting for less than 5% of the monthly catches.
This distribution highlights the high specialization of the purse seine fleet on SKJ, while YFT plays a secondary role in the species composition of the catches.

3.3. Monthly Evolution of Tropical Tuna Catch Rates in 2024

A comparison of the monthly evolution of catch rates for tropical tuna species recorded by purse seine and longline fleets during 2024, expressed as percentages, is presented below. Catch rates are broken down by the main target species, namely bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

3.3.1. Tropical Tuna Catch Rates – Longline Fleet in 2024

Figure 5 illustrates the monthly distribution of catch rates for tropical tuna species recorded by the longline fleet during 2024. The figure distinguishes the main target species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

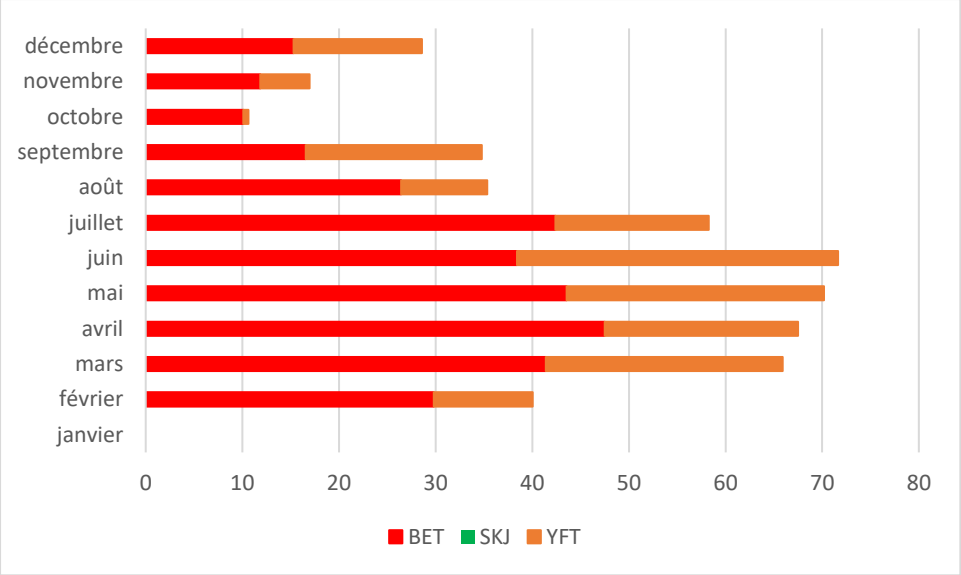

Figure 5 : Monthly catch rates by species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) for the longline fleet in 2024

The results reveal a strong seasonality in the longline fleet catches. A peak in activity is observed from March to July, during which catch rates exceed 40% and reach over 70% in June. Yellowfin tuna (YFT) dominates the catches for most of the year, particularly between May and July, while bigeye tuna (BET) is mainly concentrated in the first half of the year, peaking in March–April. Skipjack tuna (SKJ) is negligible throughout the year.

From August onward, catches gradually decline, reaching a minimum in October–November, followed by a slight recovery in December, mainly driven by YFT.

3.3.2. Tropical Tuna Catch Rates – Purse Seine Fleet in 2024

Figure 6 illustrates the monthly distribution of catch rates for tropical tuna species recorded by the purse seine fleet during 2024, distinguishing the main target species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

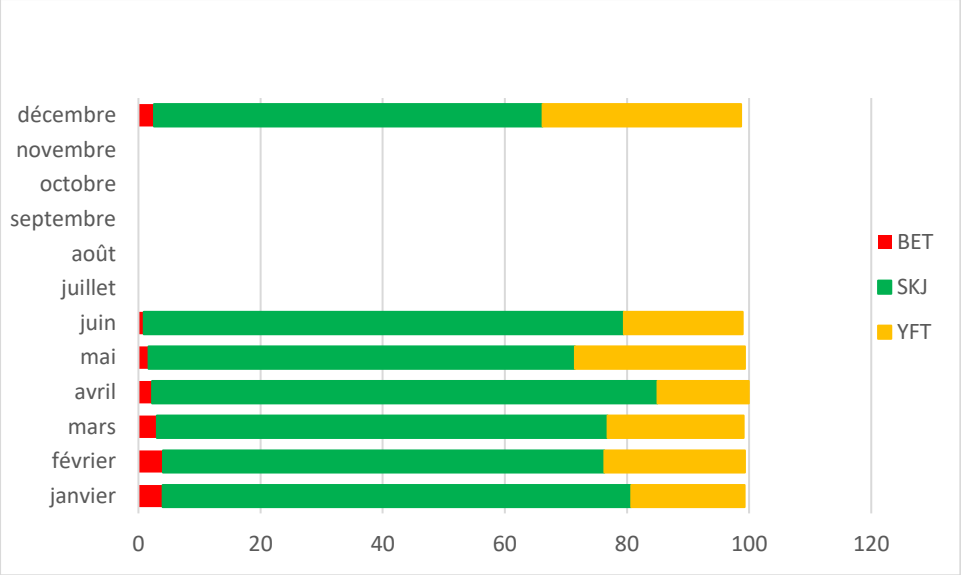

Figure 6 : Monthly catch rates by species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) for the purse-seine fleet in 2024.

The catches exhibit a marked seasonality, occurring primarily from December to June. Purse seine fishing ceases completely in the waters of Madagascar from July onward. Catches are dominated by tropical tunas, accounting for over 98% of the total. Skipjack tuna (SKJ) clearly predominates in the catch composition, followed by yellowfin tuna (YFT), while bigeye tuna (BET) represents a relatively small proportion.

3.4. Distribution of Tropical Tuna Catches in 2025

A monthly comparison of tropical tuna catches by purse seine and longline fleets during the first half of 2025, expressed in tonnes, is presented below. The catches are broken down by the main target species, namely bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

3.4.1. Longline Fleet Catches in 2025

Figure 7 presents the monthly distribution of tropical tuna catches by the longline fleet during the first half of 2025. The figure distinguishes the main target species: yellowfin tuna (YFT), bigeye tuna (BET), skipjack tuna (SKJ), as well as the total monthly catch across all species.

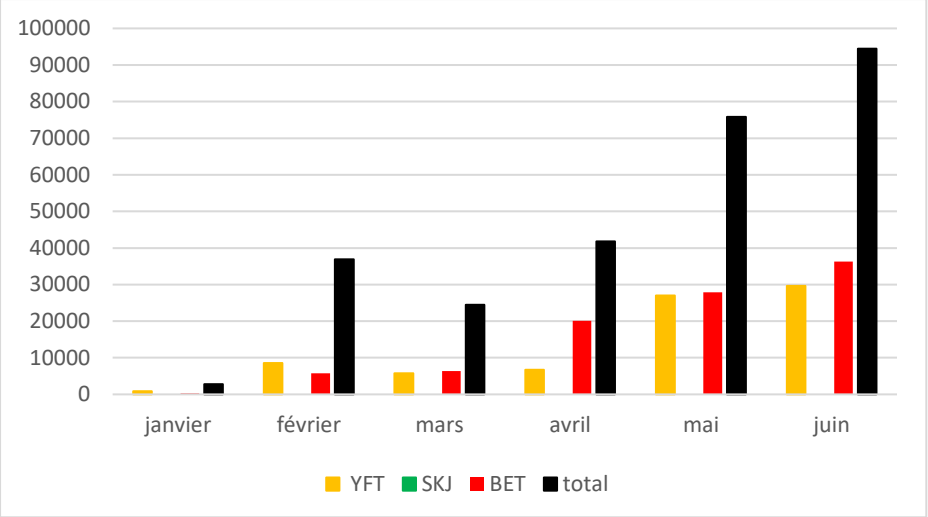

Figure 7 : Monthly distribution of tropical tuna catches by the longline fleet during the first semester of 2025, showing yellowfin tuna [YFT], bigeye tuna [BET], skipjack tuna [SKJ], and the total monthly catch.

Total catches gradually increase from January to June, reaching a peak of over 90 tonnes, reflecting a strong seasonality in longline fleet activity. As in 2024, yellowfin tuna (YFT) and bigeye tuna (BET) dominate the production, while skipjack tuna (SKJ) remains negligible.

The first half of 2025 is thus characterized by a continuous increase in catches, peaking during the second quarter, corresponding to the fleet's seasonal maximum.

3.4.2. Purse Seine Fleet Catches in 2025

Figure 8 illustrates the monthly distribution of tropical tuna catches by the purse seine fleet during the first half of 2025, expressed in tonnes. The catches are presented for the three main target species: skipjack tuna (SKJ), yellowfin tuna (YFT), and bigeye tuna (BET), with the total monthly catch indicated by black bars.

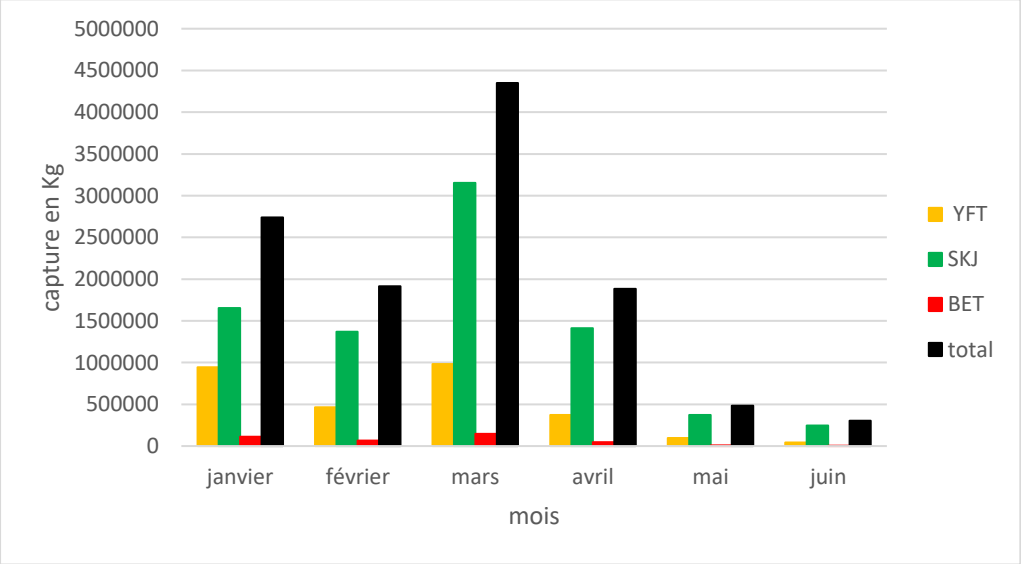

Figure 8 : Monthly distribution of tropical tuna catches by the purse-seine fleet during the first semester of 2025, expressed in tonnes, showing the three main species (skipjack tuna [SKJ], yellowfin tuna [YFT], bigeye tuna [BET]) and the total monthly catch.

Catches exhibit a strong seasonality, concentrated between January and April, with a peak in March exceeding 4,000 tonnes. They decline sharply in May and June, reflecting a slowdown in fishing activity, likely due to a reduction in tuna availability. Skipjack tuna (SKJ) overwhelmingly dominates the catches, particularly in March, while yellowfin tuna (YFT) contributes consistently but to a lesser extent, and bigeye tuna (BET) remains marginal. This pattern highlights the purse seine fleet's reliance on SKJ and the high seasonal variability of the fishery.

3.5. Tropical Tuna Catch Rates by Species

A comparison of the monthly evolution of catch rates by tropical tuna species recorded by the purse seine and longline fleets during the first half of 2025, expressed as percentages, is presented below. Catch rates are broken down by the main target species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

3.5.1. Tropical Tuna Catch Rates – Longline Fleet in 2025

Figure 9 illustrates the monthly catch rates of the main tropical tuna species recorded by the longline fleet in 2025, namely bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

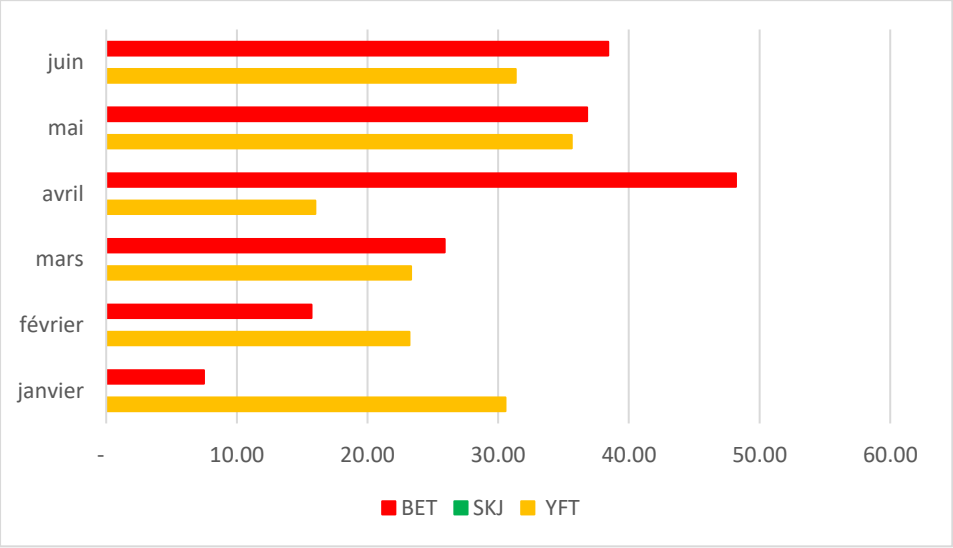

Figure 9 : Monthly catch rates of the main tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], skipjack tuna [SKJ]) by the longline fleet during the first semester of 2025.

The results show that bigeye tuna (BET) dominates the catches of the longline fleet in the first half of 2025, with catch rates exceeding 30% from April to June and a pronounced peak in April surpassing 45%. Yellowfin tuna (YFT) is the second most important species, reaching its maximum in May, while skipjack tuna (SKJ) is negligible.

3.5.2. Tropical Tuna Catch Rates – Purse Seine Fleet in 2025

Figure 10 presents the monthly distribution of catch rates for the main tropical tuna species recorded by the purse seine fleet during the first half of 2025. The figure distinguishes bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

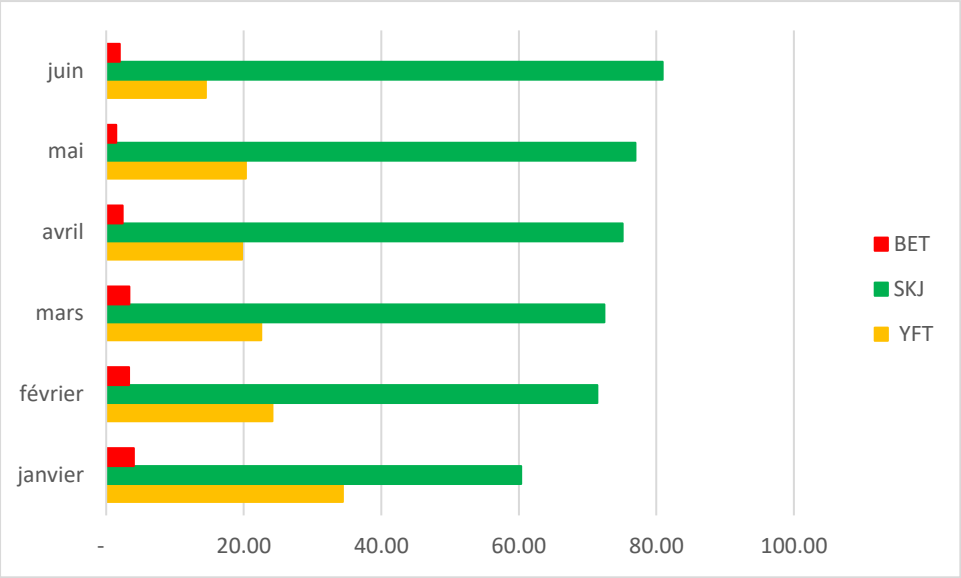

Figure 10 : Monthly catch rates of the main tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], and skipjack tuna [SKJ]) by the purse-seine fleet during the first semester of 2025

The results show that skipjack tuna (SKJ) overwhelmingly dominates the catches of the purse seine fleet, with catch rates exceeding 60% between January and June. Yellowfin tuna (YFT) occupies the second position, with contributions ranging from 15% to 30%, while bigeye tuna (BET) remains marginal, representing less than 5% of the monthly catch.

This distribution highlights the strong specialization of the purse seine fleet on SKJ, while yellowfin tuna plays a secondary role in the species composition of the catches.

3.6. Monthly Evolution of Tropical Tuna Catch Rates in 2025

A comparison of the monthly evolution of catch rates of tropical tuna recorded by the purse seine and longline fleets during the first half of 2025, expressed as percentages, is presented below. Catch rates are broken down by the main target species, namely bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

3.6.1. Tropical Tuna Catch Rates – Longline Fleet in 2025

Figure 11 presents the monthly distribution of tropical tuna catch rates by the longline fleet during the first half of 2025, broken down by species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

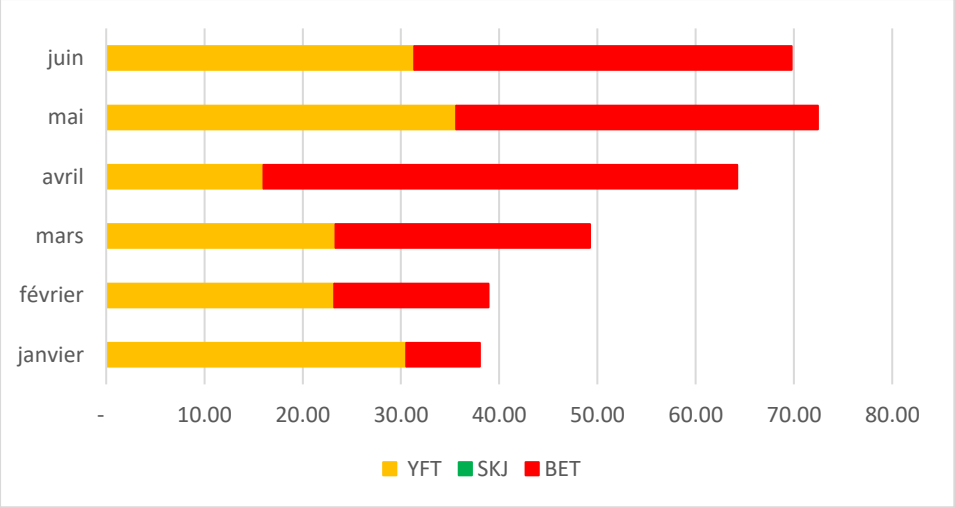

Figure 11 : Monthly catch rates of tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], and skipjack tuna [SKJ]) by the longline fleet during the first semester of 2025.

The results reveal a strong seasonality in the catches of the longline fleet. Catch rates exceed 40% from March and reach over 70% in May. Yellowfin tuna (YFT) and bigeye tuna (BET) dominate the catches, while skipjack tuna (SKJ) is negligible.

3.6.2. Tropical Tuna Catch Rates – Purse Seine Fleet in 2025

Figure 12 presents the monthly distribution of tropical tuna catch rates by the purse seine fleet during the first half of 2025, broken down by species: bigeye tuna (BET), yellowfin tuna (YFT), and skipjack tuna (SKJ).

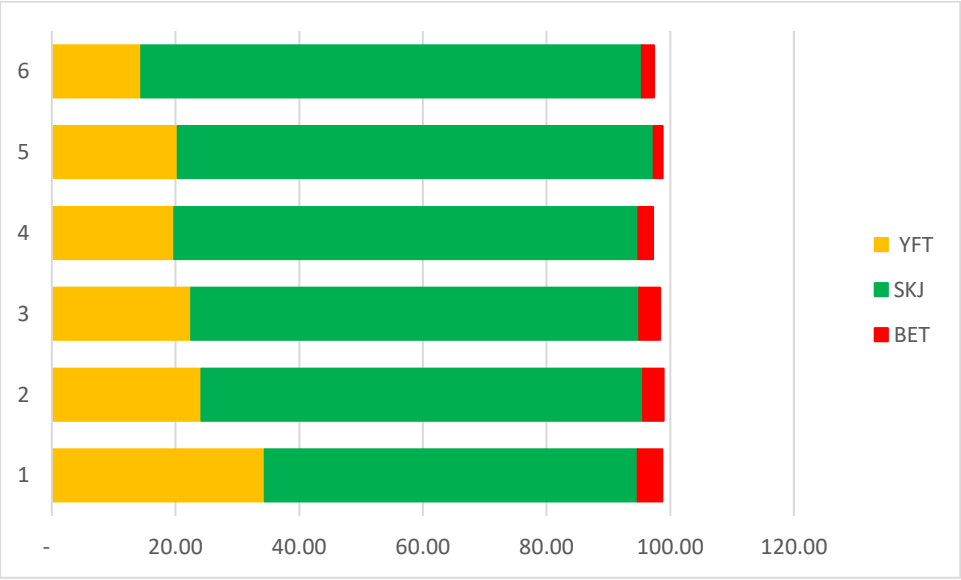

Figure 12 : Monthly catch rates of tropical tuna species (bigeye tuna [BET], yellowfin tuna [YFT], and skipjack tuna [SKJ]) by the purse seine fleet during the first semester of 2025.

The catches are dominated by tropical tunas, accounting for over 98% of the total. Skipjack tuna (SKJ) clearly predominates in the species composition, followed by yellowfin tuna (YFT), while bigeye tuna (BET) represents a relatively small proportion.

4. Discussion and Conclusion

The comparative analysis of tropical tuna catches by the longline and purse seine fleets operating in Madagascar waters during 2024 and 2025 highlights distinct dynamics in terms of fleet specialization, seasonality, and species composition.

The purse seine fleet primarily targets skipjack tuna (SKJ), with fishing activity strongly concentrated in the first half of the year and peak catches occurring early in the year. This seasonality reflects the fleet's dependence on the availability of SKJ, likely influenced by environmental and biological factors. The near-total cessation of activity from July onwards emphasizes the fleet's adaptation to tuna migration cycles or changes in species availability.

In contrast, the longline fleet mainly targets bigeye tuna (BET) and yellowfin tuna (YFT), with a more evenly distributed activity pattern and a seasonal peak in the second quarter. This distribution indicates greater operational flexibility, allowing stable fishing levels over a longer period. The minimal contribution of SKJ in this fleet confirms the clear differentiation in target species between fleets.

The interannual comparison shows that the trends observed in 2025 largely mirror those of 2024, with an increase in longline catches, particularly of BET, and a slight decline in purse seine performance, likely linked to less favorable environmental conditions or reduced fishing effort.

These results emphasize the importance of considering seasonality, species composition, and fleet type when designing management and conservation strategies for tuna stocks in Madagascar. The differentiation between fleets implies that regulatory measures must be tailored to each fleet to ensure sustainable and balanced exploitation of tropical tuna resources.

In conclusion, this study demonstrates that industrial tuna fisheries in Madagascar are characterized by strong fleet specialization, pronounced seasonality, and interannual variability. These insights provide a critical foundation for optimizing fishery management and enhancing the sustainability of tropical tuna catches in the region.