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CONSIDERATIONS ON THE USE OF THE JACK MACKEREL ACOUSTIC INDEX IN PERUVIAN NATIONAL JURISDICTIONAL WATERS

by

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This report contains information on the jack mackerel fish stock and fishery in Peruvian jurisdictional waters that, we reiterate, the delegation of Peru, in use of its discretionary powers, voluntarily provides for the purpose of information and support to the scientific research work within the Scientific Committee of the SPRFMO. In doing so, while referring to Article 5 of the Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean and reiterating that Peru has not given the express consent contemplated in Article 20 (4) (a) (iii) of the Convention, Peru reaffirms that the decisions and conservation and management measures adopted by the SPRFMO Commission are not applicable within Peruvian jurisdictional waters.

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ABSTRACT

This study evaluates some limitations of the jack mackerel acoustic index obtained from pelagic hydroacoustic surveys conducted by IMARPE in Peruvian waters between 2020 and 2025. Although these surveys allow the estimation of biomass and distribution of pelagic resources, they are primarily designed for anchovy assessments and therefore have predominantly coastal coverage, whereas jack mackerel exhibits a broader and more oceanic distribution. The analysis used data from summer and spring hydroacoustic surveys, as well as information from the industrial and artisanal jack mackerel fisheries. The results show that fishing sets were conducted outside or at the edge of the survey coverage, suggesting that a significant fraction of the resource biomass may not have been detected. In addition, acoustic estimates showed high variability and weak correspondence with annual jack mackerel catches, which remained relatively stable even in years with low estimated biomass. The study concludes that the acoustic index should be interpreted with caution and not as an absolute indicator of jack mackerel stock abundance in Peruvian waters. Therefore, it is recommended that stock assessments be complemented with other indicators, such as standardized CPUE, biological and environmental variables, and the development of hydroacoustic surveys specifically designed for jack mackerel, with broader spatial coverage and a stronger focus on oceanic areas while considering the seasonal dynamics of the resource.

1. Introduction

The assessment of pelagic resources using hydroacoustic methods constitutes one of the main technical tools used to estimate observed biomass and the spatial distribution of pelagic fish in marine ecosystems (Castillo et al., 2021; Castillo et al., 2023). These methods use scientific echosounders to detect fish aggregations along previously defined transects, allowing the estimation of relative abundance or biomass of the resources at the time of the survey.

In Peru, pelagic hydroacoustic surveys conducted by the Instituto del Mar del Perú (IMARPE) have historically been oriented toward the assessment of anchovy and other pelagic resources, constituting one of the main sources of scientific information for national fisheries management (IMARPE, 2022; IMARPE, 2025). However, during these surveys, species as jack mackerel, chub mackerel, and other transboundary resources are also recorded. Nevertheless, the methodological design employed is not specifically intended to quantify the total biomass of these species in a representative manner, as they exhibit a broader spatial distribution.

Unlike anchoveta, jack mackerel is a transboundary resource that may move toward oceanic areas beyond the regular coverage of hydroacoustic surveys (Ñiquen et al., 2013; Dioses, 2013). Consequently, the acoustic information obtained during these assessments may not adequately represent the total available stock of the resource.

In this context, the present document aims to evaluate some methodological considerations associated with the use of the jack mackerel acoustic index derived from hydroacoustic surveys conducted in Peruvian jurisdictional waters, considering the spatial coverage of the surveys and its relationship with the distribution of the fishery.

2. Methodology

2.1. Data sources

2.1.1. Pelagic hydroacoustic surveys

Information from the “Hydroacoustic Assessment of Anchovy and Other Pelagic Resources” surveys conducted by the IMARPE during the summer and spring seasons between 2020 and 2025 was used in this study.

The main objective of these surveys is to estimate the abundance, spatial distribution, and biological characteristics of anchovy and other associated pelagic resources. To achieve this, a hydroacoustic methodology based on the use of scientific echosounders installed aboard research vessels is employed. These systems allow the detection and recording of fish aggregations along previously defined survey transects (Castillo et al., 2021; Castillo et al., 2023).

The sampling design considers systematic transects distributed perpendicular to the coastline and generally conducted within the first 80–100 nautical miles, depending on the area and the oceanographic conditions during each survey. In addition, oceanographic stations and validation fishing sets are carried out during the surveys in order to identify acoustically detected species and obtain complementary biological information, such as size composition, population structure, and species composition of the catches (IMARPE, 2022; IMARPE, 2025).

During these surveys, other pelagic species as jack mackerel, chub mackerel, and bonito are also recorded. However, the spatial coverage and methodological design are primarily focused on coastal-distributed resources, particularly anchovy. Consequently, hydroacoustic surveys do not necessarily cover the entire distribution area of jack mackerel, especially in more oceanic zones.

2.1.2. Fisheries data

Information from the industrial and artisanal jack mackerel fisheries during the period 2020–2025 was used. The information included records of fishing sets associated with extractive operations carried out by both fleets, as well as annual landing data for the resource corresponding to the evaluated period.

2.2. Analysis of hydroacoustic survey coverage and the spatial distribution of the jack mackerel fishery

To evaluate the spatial representativeness of the jack mackerel acoustic index, a comparative analysis was conducted between the coverage of hydroacoustic surveys and the spatial distribution of the jack mackerel fishery during the period 2020–2025.

For this purpose, information corresponding to the hydroacoustic surveys transects carried out during IMARPE research was used, together with information of the fishing sets industrial and artisanal jack mackerel fleets

Based on this information, maps of the spatial distribution of areas where jack mackerel catches were recorded were created. Subsequently, these records were overlaid with the hydroacoustic transects to identify sectors where the fleet recorded catches outside or at the edge of the transect coverage. This analysis allowed for the evaluation of the spatial correspondence between the acoustically surveyed areas and the main operating areas of the jack mackerel fishery.

Additionally, information on acoustic biomass estimates for jack mackerel obtained during the summer and spring hydroacoustic surveys between 2020 and 2025 was compiled. These estimates were temporally compared with annual jack mackerel landings in order to evaluate the relationship between acoustic biomass and the catch dynamics recorded by the fishery.

Finally, the combined analysis of hydroacoustic coverage, the spatial distribution of the fishery, and biomass estimates allowed the evaluation of the main methodological limitations associated with the use of the jack mackerel acoustic index derived from national pelagic surveys.

3. Results

Figure 1 shows the spatial coverage of the hydroacoustic surveys conducted between 2020 and 2025, as well as the spatial distribution of fishing sets by the industrial and artisanal fleets that recorded jack mackerel catches during the same period.

The results show that the hydroacoustic transects had predominantly coastal coverage, consistent with the methodology applied in surveys mainly designed for anchovy assessment. However, the spatial distribution of the fishery indicates that jack mackerel was frequently located outside or at the edge of the survey coverage, particularly toward more oceanic areas in southern Peru (16°S – southernmost area).

Likewise, during several periods, fishing sets of the fleet industrial and artisanal fishing sets were recorded in sectors where no acoustic transects were conducted, suggesting that part of the available biomass of the resource may not have been detected during the hydroacoustic surveys.

On the other hand, Figure 2 shows the relationship between the acoustic biomass estimates of jack mackerel obtained during the summer and spring hydroacoustic surveys, as well as the annual catches recorded by the fishery between 2020 and 2025.

In general, high interannual variability was observed in the acoustic biomass estimates. During 2020 and 2022, high biomass values were recorded in the summer surveys, exceeding 300 thousand tons, whereas in 2021, 2023, and 2024 the estimates were considerably lower. Similarly, the spring surveys showed relatively high biomass in 2021 and 2022, and lower values during 2020, 2023, 2024, and 2025.

In contrast, annual jack mackerel catches showed a relatively more stable pattern, remaining between approximately 120 and 220 thousand tons per year, even in years when acoustic biomass estimates were low. The 2023–2024 period is particularly noteworthy, as catches remained relatively important despite low biomass estimates recorded during both surveys. This suggests that the fishery continued to find significant jack mackerel aggregations in areas that were not adequately during the survey.

The comparison between both sources of information reveals a low correspondence between acoustic estimates and catches recorded by the fishery. This suggests that the low biomass estimates observed during some surveys do not necessarily reflect an actual decline in the jack mackerel stock, but rather possible limitations associated with the spatial coverage and representativeness of the hydroacoustic surveys.

These results indicate that the acoustic index derived from surveys should be interpreted with caution and not necessarily as an absolute indicator of resource abundance. This is because jack mackerel exhibits a more complex spatial dynamic than anchovy, characterized by oceanic displacements, high mobility, and spatial variability associated with environmental and oceanographic conditions.

Consequently, it is necessary to complement resource assessment with other sources of information, as standardized Catch Per Unit Effort (CPUE), biological indicators, and environmental variables, in order to reduce uncertainty in the population assessment of jack mackerel.

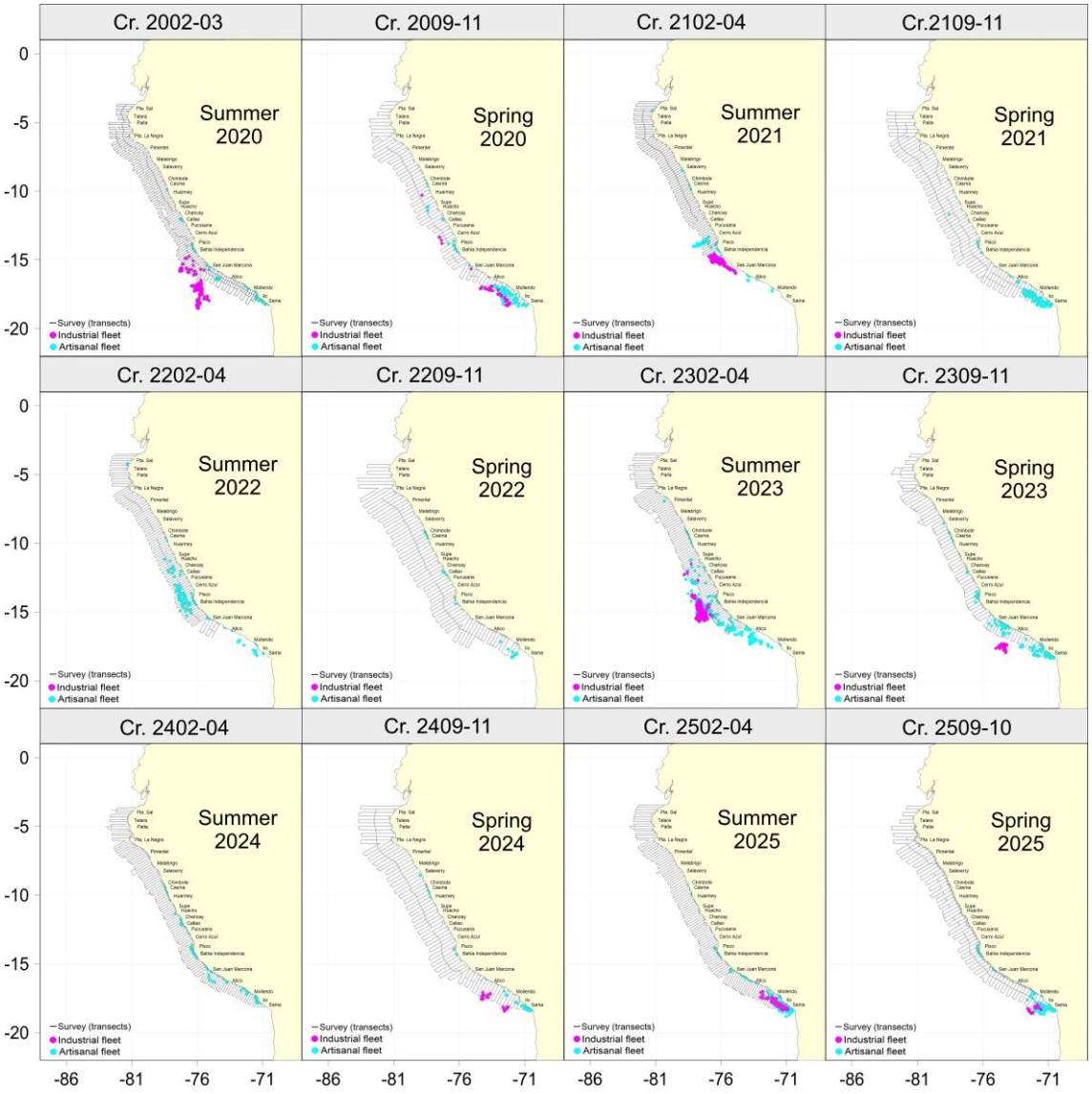

Figure 1. Spatial distribution of catch for jack mackerel by the fishing fleet and the hydroacoustic survey transects in Peruvian waters during the period 2020–2025. The colored points represent the locations of fishing sets by the industrial fleet (magenta) and the artisanal fleet (cyan), while the gray lines represent the transects of the pelagic hydroacoustic surveys by IMARPE.

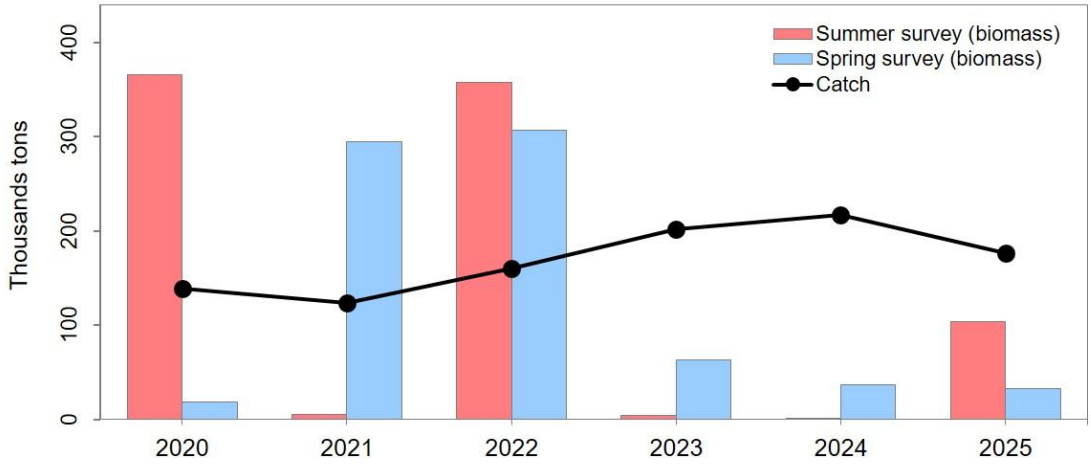

Figure 2. Estimated jack mackerel biomass from hydroacoustic surveys and annual jack mackerel landings in Peru during the period 2020–2025. Colored bars represent biomass estimates obtained from summer (red) and spring (light blue) hydroacoustic surveys, while the black line represents annual jack mackerel landings.

4. Conclusions

- Pelagic hydroacoustic surveys conducted in the Peruvian sea present a predominantly coastal spatial coverage, as they were primarily designed for anchovy assessment.

- The spatial distribution of the jack mackerel fishery shows that an important portion of the resource is frequently located outside or at the limit of the hydroacoustic transect coverage.

- Acoustic biomass estimates of jack mackerel showed high interannual variability and low correspondence with catches recorded by the fishery between 2020 and 2025.

- The stability of catches, even in years with low acoustic estimates, suggests that the fishery continued finding important jack mackerel aggregations in areas that were not adequately during the surveys.

- The acoustic index derived from hydroacoustic surveys conducted in the Peruvian sea should be interpreted with caution and not necessarily as an absolute indicator of the abundance of the jack mackerel stock in Peruvian jurisdictional waters.

5. Recommendations

- Strengthen the use of complementary indicators, as standardized Catch Per Unit Effort (CPUE), for the population assessment of jack mackerel in the Peruvian sea.

- Evaluate the possibility of developing hydroacoustic surveys specifically designed for jack mackerel, with broader spatial coverage and oriented toward oceanic areas, considering the seasonality of the resource.

- Continue developing spatial analyses between survey coverage and fishery distribution.

6. References

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