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**SC9-HM05**

**Classification of Fleet by Acoustic Data Collection Capabilities**

*Peru*

South Pacific Regional Fisheries Management Organisation  
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**Preliminary classification of the Peruvian fleet operating in the Jack mackerel and chub mackerel fishery based on its acoustic data collection capabilities and proposal for its application to vessels operating in the Convention area**

by

**SNP, SCIENTIFIC RESEARCH COMMITTEE**

This report contains information on the Jack mackerel and chub mackerel fish stocks and fisheries 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.

## SUMMARY

Last year, the Peruvian delegation submitted to the SPRFMO Scientific Committee the document “Guidelines for acoustic data collection aboard fishing vessels operating in waters under national jurisdiction and the SPRFMO area”. Some recommendations were made, including the one to assign priority to establishing a classification of fishing vessels operating in national jurisdictional zones and in high seas in the South Pacific, in order to further determine capabilities to perform studies of different ecological niches depending on the available instruments and devices deployed by the fleets. In the present case a preliminary classification has been adopted by the SNP in Peru. Which, among others, permitted to establish the number of vessels in each class, with the indication of the possible uses of the data every vessel can contribute, including the collection of biological information and data on the interactions between top predator species and the fleet.

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## 1. Introduction

Last year, the Peruvian delegation submitted to the SPRFMO Scientific Committee the document “**Guidelines for acoustic data collection aboard fishing vessels operating in waters under national jurisdiction and the SPRFMO area**” (Gutierrez *et al.* 2020). It was preliminary based on the ICES Cooperative Research Report on “**Collection of acoustic data from fishing vessels**” (ICES 2007) in order to approach the need of data and analysis of scientific quality in order to provide advice for the management of species being exploited. Also, last year it was created a sub-Working Group of the Habitat Monitoring Working Group (HMWG) to approach the need to develop a common protocol for collecting acoustic data on habitat characterization in the SPRFMO area.

This report is a second contribution toward that goal by proposing a preliminary classification of the Peruvian fleet operating in the Jack mackerel and chub mackerel fishery based on its acoustic data collection capabilities and proposal for its application to vessels operating in the Convention area

## 2. Preliminary fishing vessels classification

Acoustic data from fishing vessels provide a valuable source of information, mainly from the echosounders; new analysis methods are being developed for the routine use of acoustic data from sonars in the future. To maximize the utility of the fishing vessels’ acoustic data, objectives on the use of that data must be clearly defined in the context of the needs for habitat monitoring. This can be achieved through a qualitative or quantitative evaluation of all monitoring needs within the fisheries. Therefore, it is necessary to explore the available technologies aboard fishing vessels authorized to operate in the SPRFMO convention area considering the preliminary classification adopted by SNP in Peru in the Jack mackerel and chub mackerel fisheries.

The first approach for implementing a protocol is to determine the amount and quality of available platforms of observation (fishing vessels).

- 2.1. The need of an inventory of acoustic systems on board fishing vessels operating in the SPRFMO area. All vessels should be able to contribute information regardless of its technical sophistication.
- 2.2. To classify the vessels according to ‘levels of equipment’ (Table 1):
  - 2.2.1. Level 1, vessels equipped with digital systems (digital echosounders of at least 2 frequencies deploying split beam transducers, scientific sounders or equivalent; and a sonar). “Level 1+” will be assigned if the sonar is of a digital grade.
  - 2.2.2. Level 2, vessels equipped with digital systems (digital echosounders of 1 frequency deploying split beam transducers, scientific sounders or equivalent; and a sonar). “Level 2+” will be assigned if the sonar is of a digital grade.
  - 2.2.3. Level 3, vessels equipped with digital systems (digital echosounders of 1 frequency deploying single beam transducer; and a sonar). “Level 3+” will be assigned if the sonar is of a digital grade.
  - 2.2.4. Level 4, vessels with digital systems (analogue echosounders of 1 frequency single beam transducer; and a sonar).

## 2.2.5. Level 5, all other possible combination.

- 2.3. To establish minimum conditions for every level (e.g., level 1: need of an annual calibration and noise measurement, need of using a datalogger etc) and possibilities of use (e.g., fish stock biomass, habitat characterization etc).
- 2.4. To adopt a procedure for gathering data from vessels. To perform annual workshops for data exchange and joint analysis.
- 2.5. To propose data analysis methods based on experiences of other cooperative researches (e.g., CCAMLR).
- 2.6. To adopt a protocol for data collection on interactions of the fishery with top predator species.

Table 1. Classification criteria of fishing vessels by levels adopted in Peru, based on their acoustic systems and potential uses as observation platforms

Item	Systems / Levels	Fishing Vessels classification according to their acoustic systems				
		Level 1	Level 2	Level 3	Level 4	Level 5
Equipment	Digital echosounders of at least 2 frequencies split beam, scientific sounders or similar					
	Digital echosounders of 1 frequencies split beam or similar					
	Digital echosounders of 1 frequencies single beam					
	Analogue echosounders of 1 frequencies single beam					
	All other possible combination					
Calibration	Calibration using spheres					
	Calibration using hydrophones					
	Noise measurement					
	Target Strength measurements					
Fish	Accurate fish biomass estimation and classification					
	Fish biomass estimation					
	Relative abundance estimations					
	Fish typology					
Zooplankton	Accurate zooplankton abundance estimation and classification					
	Zooplankton abundance estimation					
	Relative zooplankton abundance estimations from visual contact					
Habitat	Depth of oxycline					
	Depth of thermocline					
	Depth of thermocline from visual contact					
	Carbon and CO <sub>2</sub> relative measurements					
	Prey-predator interactions observations					
Other	Seabird observations					
	Marine mammals observations					
	Big pelagics and highly migratory fish observations					
	Fishing devices for providing biological sampling					

### 3. SNP classified fishing vessels

The Peruvian fishing vessels owned by companies associated to the SNP, operating in the combined jack and chub mackerel industrial fishery, are 70. All of them deploy a main echosounder, which can be of different types and configurations; these vessels are also equipped with one additional spare analogue echosounder, besides one or two omnidirectional sonars. From all of the main echosounders, 59 are digital type and 11 are analogue (Figure 1). The “digital” categorization is not only defined by the type of processor but also by being possible to record acoustic raw data in internal hard disks of the echosounder.

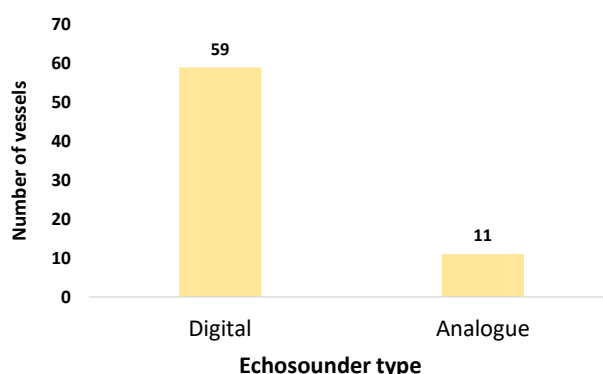


Figure 1. Echosounders types deployed by the Peruvian fishing vessels associated to SNP

Just three manufacturers have been identified for the main echosounders deployed by the fleet: 22 Furuno (Japan), 2 Kaijo (Japan) and 46 Simrad (Norway), Figure 2.

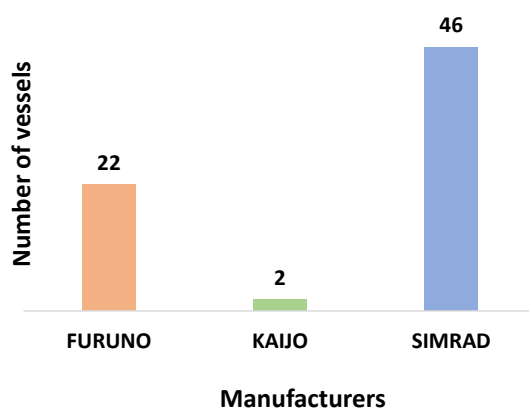


Figure 2. Echosounders manufacturers deployed by the Peruvian fishing vessels associated to SNP.

For the Furuno systems there have been identified five different models: 1 FCV-1000, 13 FCV-30, 1 FCV-582L, 1 FCV-585 and 6 FCV-588. All the Furuno systems are equipped with a single frequency of 38 kHz, the FCV-30 transducers are split beam type, model CV-303; all the others are single beam model CA-50. Figure 3.

For the Kaijo systems two models have been identified: 1 KSE-100 and 1 KSE-200. Two of them are single beam 38 kHz, the transducer type is split beam T-178 transducer. Figure 3.

For the Simrad system, there have been identified four different models: 1 EK60, 7 ES60, 33 ES70 and 5 ES80. The only EK60 and one of the ES70 are equipped with two frequencies (38 and 120 kHz); all the others are single frequency 120 kHz. All the 120 kHz transducers

are model ES120-7C split beam type, the two 38 kHz transducers are model ES38B split beam type. Figure 3.

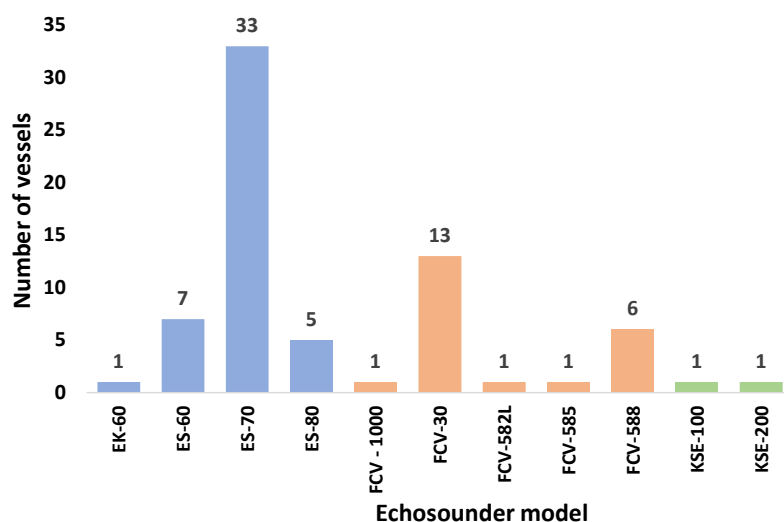


Figure 3. Echosounders models deployed by the Peruvian fishing vessels associated to SNP.

Following the definition shown in Table 1, they have been found 2 vessels Level 1+, 44 vessels Level 2+ (the suffix “+” refers to the deployment of a digital sonar), 13 vessels Level 3, 11 vessels Level 4 and none Level 5. Figure 4.

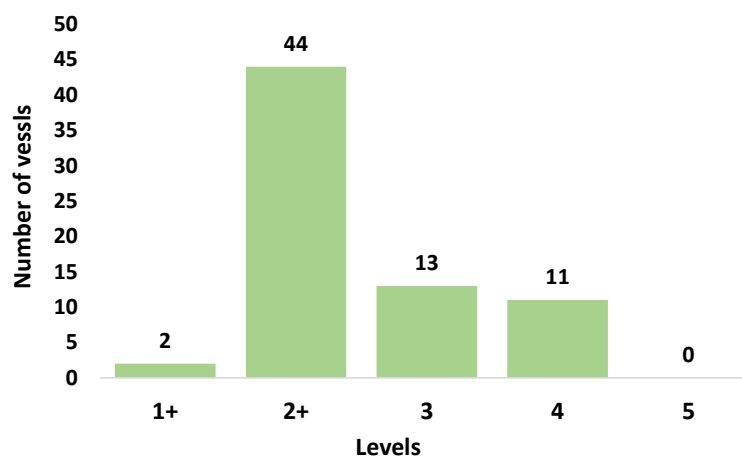


Figure 4. Peruvian fishing vessels associated to SNP by Levels according to its current capacities to collect acoustic, oceanographic and biological data, including the interactions of the fleet with top predators.

#### 4. Conclusions

In Peru, the SNP has adopted a preliminary classification of industrial fishing vessels operating in the jack mackerel and chub mackerel fishery in Peruvian jurisdictional waters. The adopted classification might be considered as a reference by the SPRFMO for the vessels operating in the Convention area.

There are 70 Peruvian industrial purse-seine fishing vessels owned by companies associated to the SNP that operate in the combined Jack-chub mackerel fishery:

- Two of them are able to produce accurate quantitative indexes both for fish and macrozooplankton;
- 44 of them are able to produce accurate quantitative indexes for fish and relative abundance indexes for zooplankton;
- 13 of them are able to produce relative abundance indexes for both fish and zooplankton;
- 11 of them are able to produce qualitative indexes for fish and zooplankton; and,
- All of them are collecting biometry data as well as data on interactions of seabird and mammal species with the fishery (SNP Salvamares Program).

## 5. Recommendations

- To consider the preliminary classification adopted by SNP in Peru as a reference for the classification of fishing vessel authorized to operate in the SPRFMO area according to its capacities to collect acoustics and other sources data of scientific quality;
- To produce calibration reports for the vessels classified with Levels 1 and 2;
- To create a repository of acoustic data at SPRFMO, where Scientific Committee members can contribute data samples to be used in the different quantitative exercises oriented to test different assessment methods to be reviewed by the HMWG;
- To adopt the ICES metadata convention system (ICES 2016) in order to properly identify the collected acoustic data and its use for quantitative purposes; and,
- Start the discussion of the possibility to produce cooperative field experiments on the comparison of jack mackerel habitat characteristics:
  - Scientists should communicate clearly the objectives of the proposed research and the potential benefits to industry participants and other stakeholders;
  - Written protocols for all sampling and related operations should be drafted and agreed by the HMWG members upon well in advance of the first cooperative experiment;
  - Industry participants must be assured that proprietary information they provide will not be released without consent;
  - Cooperative research agreements should encourage evaluation of performance by industry and scientific participants with a focus on the development and implementation of future projects;
  - Every survey plan defines the survey goals and objectives and details protocols associated with all aspects of the study;
  - Storage of digital data collected during prolonged surveys can be problematic. Researchers should consider carefully the trade-offs between quantity and resolution of data collected and the ability to meet research objectives. Large quantities of data may be collected, and this may require the establishment of special procedures for storage and archiving of data. It may be advisable to collect



raw data and low-resolution data simultaneously. Low-resolution data can be reviewed rapidly to assist in identifying sequences of high-resolution data for detailed analysis;

- Metadata requirements and recording protocols should be established and documented. Metadata will be especially useful in the identification of subsets of data for detailed analysis;
- Calibration of acoustic systems is required for the quantitative use of acoustic data and is recommended for all studies. Calibration should be conducted as it is described in Demer *et al.* (2015);
- Ping synchronization is also critical to acoustic instruments. In general, the master synchronization pulse should be provided by the scientific echosounder, and all other acoustic instruments should be set up as slaves. Custom electronics may be required to address specific timing or pulse form needs. It may be necessary to turn off some vessel acoustic instruments during scientific data collection; and,
- Biological sampling must be consistent with survey objectives. Gear selectivity and temporal and spatial resolution will be of particular concern in this regard. It is important to ensure that sampling gear and protocols for fishing are consistent with the research/survey information needs.

## 6. References

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