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Monitoring programs in Peru

Peru

PO Box 3797, Wellington 6140, New Zealand
P: +64 4 499 9889 – F: +64 4 473 9579 – E: secretariat@sprfmo.int
www.sprfmo.int

NATIONAL SOCIETY OF FISHERIES
HUMBOLDT INSTITUTE OF MARINE AND AQUACULTURE RESEARCH

South Pacific Regional Fisheries Management Organization
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Marine research and monitoring programs currently developed in Peru by scientific entities and fishing companies

SCIENTIFIC RESEARCH COMMITEE - SNP

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Introduction

For the monitoring and study of marine habitats it is convenient to identify the programs and related research projects in each country, in order to promote cooperation among the largest possible number of entities. This document presents a summary of marine research and monitoring programs currently executed in Peru by the Peruvian Sea Research Institute (IMARPE), The Ministry of Production (PRODUCE) and the National Fisheries Society.

1. **Study and monitoring of the effects of El Niño Phenomenon in the marine ecosystem off Peru.** (www.imarpe.gob.pe)

The Peruvian Sea Research Institute (IMARPE), along with some other institutions of the Multisectoral Committee for the National Study of the El Niño Phenomenon (ENFEN), has participated since 2014 in the Program 'Reduction of Vulnerability and Attention to Emergencies', with the product "Entities permanently informed and with forecasts related to El Niño Phenomenon", which consists of the timely delivery of scientific information (monthly technical reports) that are the result of monitoring and forecasting of El Niño-Southern Oscillation (ENSO) to contribute towards an effective management of the risks associated with this type of event.

Within this framework, IMARPE is executing the activity 'Study and monitoring of the effects of the El Niño phenomenon in the marine ecosystem off Peru', which includes four Tasks: i) Bio-oceanographic monitoring in the northern zone of the Peruvian coast on board scientific vessels; ii) Daily monitoring of biological indicators from the Fishery Monitoring and Fishing Logbook Program; iii) Study of the effects of the Kelvin waves trapped on the coast on the fertility and biological productivity of the marine ecosystem off Peru; and iv) Product dissemination.

Regarding the first task, IMARPE executes monthly surveys on oceanographic lines off Paita and Chicama, including the detection of abnormal physical, hydrochemical and productivity conditions, as well as indicators of plankton and other species associated to El Niño / La Niña events. In addition to the oceanographic lines, IMARPE also carries out operations every two weeks at fixed coastal points off Paita, Chicama and Ilo. In the case of Paita the collected time series began during April 2014, while the last two have started in February 2015.

In the second task, IMARPE carries out daily monitoring of fishing landings (on land and on board the fleet) and assessment surveys along the coast, which provide information on the distribution by species, growth, reproductive, condition and growth indices used in the assessment of the main species. In the case of anchovy, special attention is given to the spatial distribution of the stock, both on the surface and in the water column.

The third task is aimed at improving the knowledge of the effects of waves trapped on the coast, which are generated by the arrival of Kelvin waves to the South American coast, which has effects on the fertility and biological productivity of the marine ecosystem off Peru. This task is carried out by analyzing the interrelationship between sea level anomalies (modelled from satellite information) as a proxy for the waves trapped on the coast with chlorophyll-a as well as the depth of the thermocline, oxycline and nutritional content estimated from the outputs of a regional circulation model (ROMS-PISCES).

Finally, the dissemination of these studies includes the delivery of the technical reports to the ENFEN Committee, which corresponds to the analysis of the conditions of the marine ecosystem off Peru.

2. Pelagic Resources Acoustic Assessment Program

In 1983 the Sea Research Institute (IMARPE) founded the Pelagic Resources Acoustic Assessment Program, which consists on the use of scientific vessels deploying scientific echo sounders. Between 1983 and 1996 between 1 and 2 surveys per year along the entire Peruvian marine jurisdiction were carried out; from 1997 to 2001 there were 4 surveys per year; and from 2002 onwards, 3 surveys have been carried out. Between 1983 and 1996, 4 species were monitored (anchovy, sardine, jack mackerel and chub mackerel). Since 1997, 12 species are being monitored (the above mentioned besides red squat lobster, catfish, white anchovy, sea robin, ribbon fish, flying fish, jumbo squid, vinciguerria and eventually others that due to their abundance can be assessed by acoustic methods (hake, mytophids, euphausiids).

Oceanographic studies are carried out in each survey. The most commonly used information is temperature, salinity and surface oxygen. Also information on nutrients are collected at sea surface level, such as nitrates, nitrates and silicates. Oceanographic sampling also implies the execution of oceanographic stations in selected profiles (generally in Puerto Pizarro, Paita, Punta Falsa, Chicama, Chimbote, Bermejo, Callao, Pisco, San Juan, Mollendo and Ilo) at distancea of 1, 5, 15, 25, 50, 75 and 100 nm from the coast. During the ship's journey, surface stations are carried out, without stopping the ship every 30 minutes of travel, to collect water samples for temperature and salinity measurements. The total number of oceanographic stations fluctuates between 70 and 90 in every survey.

During these assessment surveys, biometric and biological samplings are carried out through fishing trawls to contribute to identify the species that are acoustically detected, as well as to determine certain population parameters (sizes, reproductive stagea, etc.). The obtained data related to fish sizes and weights by species are used in estimating abundance or biomass. On each survey, as an average one fishing set is carried out every 40 surveyed nautical miles, which represents between 150 and 200 sets per survey.

The biomass calculations are carried out through several stratification methods, e.g. by isoparalittoral areas that result from the intersection of the parallels of latitude every 30 minutes with the projection of the coastline at intervals of 10 nautical miles. The acoustic reflectivity (TS) information is specific for each species according to its size, and is used to estimate the biomass. From 1966 to 1982 only anchovy biomass is available as derived from qualitative observations made from the Eureka Program; from 1983 to 1996, anchovy, sardine, jack mackerel and chub mackerel are available. From 1997 onwards it is also available biomass for 12 regularly assessed species.

3. Biological and ceanographic surveys on jack mackerel and chub mackerel (www.imarpe.gob.pe)

The Peruvian Sea Research Institute (IMARPE) carries out the program “Bioceanic surveys on jack mackerel and chub mackerel”. Jack and chub mackerel have a wide geographical distribution off the Peruvian coast. They perform latitudinal and longitudinal migrations, associated with variations in oceanographic conditions.

Historical information on the availability of jack mackerel off the Peruvian coast until 1998 indicated a wide distribution and a large abundance, with biomass levels that peaked 8.5 million tons in 1983, being the annual peak catch slightly over 700 thousand tons during 2001.

Information updated on jack mackerel after 1998 indicates a distribution restricted to the south-central zone of the Peruvian sea, with biomass levels that do not exceed two million tons and annual catches, except for 2001, of less than 300 thousand tons.

An important aspect in the development of the combined jack mackerel and chub mackerel fishery was the approval of supreme decree DS 001-2002 (09-06-2002), which established the exclusive use of these species for direct human consumption, which supported the modernization of the industrial RSW fleet. Likewise, on April 12, 2007 the specific regulation of the jack mackerel and chub mackerel was established, as approved by Supreme Decree No. 011-2007-PRODUCE, which promotes the sustainable exploitation of these species.

The Pelagic Fishery Monitoring Plan and the Pelagic Resources Acoustic Assessment Surveys, mainly focused in anchovy, also allow the quantification of the fishing effort and main biological aspects of jack mackerel and chub mackerel. However, more information on migratory behavior is needed about these species outside the 100 miles off the Peruvian coast. In that context, IMARPE is conducting research surveys aimed exclusively at jack mackerel and chub mackerel, focusing on different aspects of their biology, ecology, habitat and fishery. Therefore, this specific activity allows the obtaining of more elements to advise the national fishery management of those fishing resources.

This Program is supported by an interdisciplinary group of specialists, which includes the participation of specialists from IMARPE, the Vice-Ministry of Fisheries, the private sector and international consultants. The main activities of the Program include the recovery of historical data from the jack mackerel fishery and the execution of at least one survey per year, usually during autumn and spring, in order to track areas beyond 100 nautical miles with the objective of quantifying their biomass given the closest approach to the coast of these species during those seasons. Another important objective is to monitor the biological aspects, such as the reproductive process, growth, recruitment and trophic relationships.

4. **Fisheries monitoring program** (www.imarpe.pe)

The Peruvian Sea Research Institute (IMARPE) develops a fisheries monitoring program through records and samplings at both at landing points along the coast and aboard industry vessels. The information collected is registered in the IMARSIS platform, and is used in the monitoring and assessment of exploited populations. The specific activities that are carried out are the following:

4.1. Monitoring of the anchovy fishery and other pelagic resources.

They are being monitored the biological and fishing parameters of anchovy and other pelagic fish, such as landing volumes, fishing effort, species composition, distribution and concentration, biometric and biological aspects, etc., in order to carry out the permanent assessment and diagnosis oriented to advise the sustainable management of fisheries.

4.2. Monitoring of the coastal demersal fishery.

They are being monitored the biological and fishery parameters of the main coastal demersal resources, which includes the measurement of their distribution, concentration, spawning, recruitment, space-time variability and composition of the catches by age besides the study of the relationship of the resources with the changing oceanographic conditions.

4.3. Monitoring of the marine invertebrate fishery.

They are being monitored the biological and fishing parameters of the main marine invertebrate resources, which includes their distribution, concentration, recruitment, reproductive aspects, spatio-temporal variability of catches and the relationship of the resources with the changing oceanographic parameters.

4.4. Monitoring of the extraction of marine macroalgae.

They are being monitored the biological and fishing parameters of the main marine macroalgae species, which included their distribution, concentration and reproductive aspects, the recording of the extracted volumes by areas daily, and the relationship of the resources with the changing oceanographic parameters.

4.5. Monitoring of the artisanal fishery.

Through this study they are assessed daily the main species, landing volumes, fishing effort, fishing areas and the prices of the species that support the artisanal fishery. Furhtermore, the spatio-temporal variability of catches is derived to estimate the catch per unit of effort from landing statistics of the artisanal fishery in the harbourd of Pacasmayo, Malabrigo, Caleta Huanchaco, Puerto Salaverry and Caleta Puerto Morín.

5. Satellite tracking system (SISESAT)

The Satellite Tracking System (SISESAT) was founded in 1998 by the Ministry of Production (formerly Ministry of Fisheries) to prevent the entry of fishing vessels into the 5-nautical-mile protected zone, as well as to avoid fishing in closed seasons and zones. SISESAT has undergone reforms in order to improve the surveillance and control of fishing operations.

This vessel monitoring system (Vessel Monitoring System or VMS) is key for the control and surveillance of the different activities carried out at sea (Monitoring Control & Surveillance or MCS). The type of electronic equipment that is used in a VMS depends on the country and the use that will be given to it, although there are two main categories: for use in local or regional fisheries such as the anchovy fishery in Peru.

The Ministry of Production (PRODUCE) has been immersed in the redesign of SISESAT. A state-of-the-art system has been adopted, with higher frequency of emissions and bi-directionality to allow interaction between vessels and fisheries managers and the fishing companies themselves in real time.

6. Industry monitoring programs

6.1. **SALVAMARES Program** (www.snp.org.pe)

The National Fisheries Society (SNP) created the Salvamares Program in 2017, it is the first initiative of a private association worldwide that aims to contribute to the

sustainability of the marine ecosystem, by collecting data on the interactions of top predators species (birds and marine mammals, sea turtles, sharks, etc.) with the industrial fishing fleet. Likewise, a record is being kept on the liberations of individuals of these species that are eventually and accidentally captured during fishing operations. With this information SNP is contributing to the development of a large database on the marine ecosystem to be used by the scientific community. Being aware of the important role that top predators play in the marine ecosystem, and also considering their current status according to the International Union for Conservation of Nature (IUCN), the SNP saw the need to create this Program.

The Salvamares Program included the training of observers, who are also crew members on board the fishing vessels of the fishing companies associated to SNP. Thus, they are periodically trained by experts of the Peruvian Sea Research Institute (IMARPE) regarding the identification and correct liberation procedure of birds, mammals, turtles, sharks etc.

Furthermore, within the framework of the Salvamares Program, some fishing vessels have been specially selected for their high technological standards to participate in the collection of scientific information during the IMARPE's acoustic assessment surveys in order to contribute to increase the resolution of the fishery and acoustic sampling. The Salvamares Program also includes periodic public conferences with national and international experts on sustainability issues, the oceans and ecosystems, as well as experiences in fisheries management.

6.2. **PESCADATA System** (www.snp.org.pe)

The acoustic information that is collected by the fishing fleet can be used to estimate the density of fish and zooplankton in each navigated interval. It is also possible to detect the upper limit of the minimum oxygen zone and the morphological characteristics of the schools of fish. This information is being integrated into the PESCADATA System, which is oriented to make publicly available all the information collected by the fleet associated to SNP, including biological data derived from catches, like fish size structure in each fishing set during anchovy and jack and chub mackerel fisheries.

PESCADATA also includes data from the Satellite Tracking System (SISESAT) of the fleet associated to SNP. The information is collected by the Scientific Research Committee (CIC) of the National Fisheries Society (SNP), which is integrated by researchers from the member companies. The information collected by the Salvamares Program is ordered, classified and made available to the public through the website of the Humboldt Institute for Marine and Aquatic Research (IHMA, http://ihma.org.pe/category/data/). SNP's PESCADATA System constitutes a reliable example of the commitment made by SNP to the United Nations (UN) Sustainable Development Goal 14 on the care of submarine life.

6.3. **CUIDAMAR Program: Sustainable Fisheries Management Model** (www.tasa.com.pe)

Sustainability is one of the main challenges for governments, companies and citizens. The private sector has been increasingly adopting sustainable practices seeking to positively influence its environment. However, these initiatives require demonstrating concrete results to encourage others to follow a good innatiative.

In the Peruvian industrial fishing sector there is an emblematic case that has already done that task: it is Cuidamar Program ©, the sustainable fishing model promoted since 2008 by TASA, the world leading Peruvian company of marine ingredients. The

Cuidamar Program's main objective is to contribute to the development of sustainable fishing, minimizing the impact of fishing activity on the ecosystem, seeking its replicability in the fishing sector at the national level. The Cuidamar model has four lines of action: (1) Generation of capacities and marine culture, (2) Continuous monitoring of the marine ecosystem, (3) Management and conservation of marine biodiversity and (4) Information management. TASA owns 48 fishing vessels also operating as platforms of opportunity to observe the marine ecosystem and collect data with the participation of over 1,000 trained and sensitized fishermen-observers. Fishermen are the most important agents for the development of marine conservation plans.

For that reason, the Cuidamar model includes the generation of capacities as a key element to implementing: a continuous training plan with support of specialized NGO; a kit with different tools and instruments that allowed the observers quantitatively and qualitatively improve the collected information in addition to achieving a high level of awareness in the conservation and care of the marine ecosystem; making use of correct techniques for handling and liberating different marine species, especially ETP species.

Indeed, the Cuidamar Program demonstrate that crew members can be agents of change in society, and ambassadors of good practices in the industry.

Another positive aspect in the Cuidamar model is its approach to the methodology and practice of responsible fishing. The program was conceived in accordance with the principles of the Fisheries Ecosystem Approach (EEP) and the Code of Conduct for Responsible Fisheries of the Food and Agriculture Organization of the United Nations (FAO), which includes that fisheries management must be developed in an integrated and sustainable manner; as well as to observe international agreements for the protection of marine fauna such as the lists of species of IUCN, CITES and current national regulations.

The development of the four axes of the Cuidamar Program has managed to incorporate to date a continuous monitoring system of the marine ecosystem in 48 vessels, in 500,000 km2 along the Peruvian coast and during 300 days per year. Registering included over 100,000 sightings of different species of marine fauna; over 17,000 liberation of individuals of seabirds, sea lions, cetaceans, sea turtles and elasmobranchs, where 94% were released alive. In addition, there is continuous monitoring of each fishing set including the recording of biometric information regarding size structure of species such as anchovy, jack mackerel and chub mackerel. Furthermore, a permanent digital record is made of the information collected by scientific-grade digital echo sounders in 16 vessels. There is also a daily collection of satellite oceanography data for several variables that geographically extends further the national maritime jurisdiction of Peru (temperature, thermal anomalies, chlorophyll, salinity, altimetry, etc). It is also collected continuously the satellite monitoring of TASA's fleet. All this information was collected in previous years in paper logbooks. During 2020 the registering will migrate to the digital registry through the Cuidamar App.

All these actions have allowed the *Cuidamares* and the model to lead the fishing sector to promote its replicability in other companies of the fishing sector. The commitment of the Cuidamar model was included during 2017 in the platform of the United States for Sustainable Development Goals. In addition, all the designed material, such as handbooks, guides, and educational videos are available on the official web page www.tasa.com.pe so that they are available to be used by another organizations.

6.4. **SIMAR program** (www.copeinca.com.pe)

The SIMAR Sustainability Program was launched in March 2018 by CFG-COPEINCA in alliance with the NGO World Wildlife Fund (WWF). Its objective is to contribute to the preservation of exploited marine resources and the components of its ecosystem (in particular, its top predators) through good practices on board the industrial fleet that is dedicated to the catch of anchovy, jack mackerel and chub mackerel.

The problem that the SIMAR Program seeks to address is the following: the feeding or transit areas of endangered or protected species (ETP) sometimes matches the fishing zones of the industrial fleet. During their interaction with the industrial fleet, top predators are often trapped in purse seines. If these individuals are not released correctly, they can be injured or die, which will have a negative impact on the ecosystem.

The objectives of the SIMAR Program are: to reduce the environmental impact and incidental capture of ETP species in the anchovy, jack mackerel and chub mackerel fisheries; sensitize the CFG-COPEINCA crew members on the importance of top predator species for the ecosystem; monitor bycatch and sightings of ETP species through a continuous monitoring system implemented in the industrial fleet; implement measures on board to reduce bycatch and mortality of ETP species; develop research topics based on the records made on board in order to contribute to the management of fisheries through an ecosystem approach; to become a model for other national and international fishing companies to replicate this type of program.

The training of crew members has been carried out on board the company's 47 vessels, and involves all the personnel on board. During the closed season, the training is performed on land. The trainings were developed by personnel from CFG-COPEINCA and specialists from WWF Peru (World Wildlife Fund), who through dynamic talks made the crews aware of the importance of conserving marine species, especially those protected and in danger of extinction. Thanks to thath, to date, the release of specimens is being recorded on board the 47 ships in which the Program is carried out. Besides, conversations with crew members have been maintained in order to enhance the perspective and participation of the crew members in relation to the SIMAR Program.

Complementing the program, logging has been implemented to document interactions with species. Currently, SIMAR is in the stage of implementing electronic logs on CFG-COPEINCA fishing vesseles. The information collected by these logbooks will be useful for scientific research. Finally, an analysis of the incidence of juveniles in catches in the anchovy fishery is being carried out in order to establish mitigation measures.