SPRFMO
South Pacific Regional Fisheries Management Organisation

9th MEETING OF THE SCIENTIFIC COMMITTEE

Held virtually, 27 September to 2 October 2021

SC9-SQ03

Alternative Observer Programme for Peruvian Artisanal Vessels

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

IMARPE

South Pacific Regional Fisheries Management Organisation
9th Meeting of the Scientific Committee
Held virtually, 27 September - 2 October 2021

IMARPE OBSERVERS PROGRAM FOR THE ON BOARD AND IN PORT MONITORING OF THE CATCHES AND FISHING ACTIVITIES OF PERUVIAN ARTISANAL VESSELS AUTHORIZED TO FISH JUMBO FLYING SQUID *Dosidicus gigas* IN THE HIGH SEAS, IN THE AREA OF APPLICATION OF THE SPRFMO CONVENTION (Proposed to be used as the alternative scientific monitoring mechanism to satisfy the requirements of paragraph 4 of CMM 16 2021 of the SPRFMO Observer Program)

by

Luis Mariátegui†, Jimena Mendoza*, Ericka Espinoza, Maria Nelly Sanjinez, Ricardo Tafur, Anatolio Taipe, Jorge Csirke & Juan Arguelles

Instituto del Mar del Perú (IMARPE)
Esquina Gamarra y General Valle s/n, Callao, Perú

† Posthumous author
* Corresponding author, e-mail: jimendoza@imarpe.gob.pe

2021

SUMMARY

This document describes the methods and procedures applied by the Instituto del Mar del Perú (IMARPE) to obtain biological and fisheries information and data on the jumbo flying squid *Dosidicus gigas* in the Peruvian waters. Which, in cooperation with other institutions, is in the process of being expanded in order to strengthen the systematic collection, sampling and recording of information and data on the fishery, the biology and population dynamics of this species, both on board artisanal fishing vessels and in the main landing sites and coastal research laboratories of IMARPE. This IMARPE observers programme already provides a standardized tool for collecting, sampling and recording information and data that contributes to generating of reliable and comparable information from the jumbo flying squid fishery in Peruvian jurisdictional waters and, with the necessary adjustments, it will be strengthened and expanded to meet the requirements of the SPRFMO Observer Program (CMM 16-2021) and CMM 18-2020 (Squid) with respect to Peruvian artisanal vessels less than 15 m in length that will be authorized and participate in jumbo flying squid fishery in the high seas, in the area of application of the SPRFMO Convention. The current measures and those that will be expanded for those artisanal vessels fishing in the Convention area are described.

TABLE OF CONTENT

1. INTRODUCTION

The Observer Program of the Instituto del Mar del Perú (IMARPE) described in this document is intended to satisfy the requirement of having an alternative scientific monitoring mechanism that collects data equivalent to those specified in the SPRFMO Observer Program (CMM 16-2021) and in the CMM 18-2020 (Squid), to be applied in the case of Peruvian artisanal vessels of less than 15 meters in length that participate in the jumbo flying squid (*Dosidicus gigas*) fishery in the high seas, in the area of application of the SPRFMO Convention, according to the arrangements established in paragraph 4 of the SPRFMO CMM 16-2021.

This IMARPE program includes observers on board and in port, and is based on and designed as part of the monitoring system described by Yamashiro *et al.* (2018, 2019), which is regularly used by IMARPE to obtain biological and fisheries data and information on the jumbo flying squid, both in port and on board the national fishing fleet, as well as on board scientific research vessels that operate in Peruvian waters. This monitoring system includes the standardized sampling and recording of data, which contributes to the generation of reliable and comparable information in support of scientific research and decision-making regarding the assessment and management of the jumbo flying squid stock and fishery in Peru.

This document reproduces relevant parts of the monitoring system for the jumbo flying squid fishery described by Yamashiro *et al.* (2018, 2019), with some adaptations to the specific case of artisanal vessels of less than 15 meters in length that fish for jumbo flying squid in Peruvian waters and that, taking advantage of the exceptions and arrangements specified in paragraph 4 of the SPRFMO CMM 16-2021 (Observer Program), will be authorized to also fish for jumbo flying squid in the high seas, in the area of application of the SPRFMO Convention.

2. BACKGROUND

The jumbo flying squid *Dosidicus gigas* is the most important marine invertebrate in the Southeast Pacific. Where, with some fluctuations, it has had an average total catch of more than 900 thousand tons per year in the last decade (2010-2019). Peru has captured, on average, almost 49% of this total in its jurisdictional waters, Chile 17%, and up to 34% has been captured by China, Korea and others on the high seas, in the area of application of the SPRFMO Convention.

The jumbo flying squid fishery in Peruvian waters began in 1991, with the participation of the artisanal fleet and, in particular, with the participation of foreign industrial jigger vessels that, through fishing licenses granted by the Peruvian Government, operated in Peruvian waters until 2011. During this 1991-2011 period, on board each of these industrial vessels IMARPE organizes a daily monitoring and recording of the catch, fishing operations and fishing effort, as well as the systematic sampling to determine the size structure and biological characteristics the squids being captured, which was made by on board observers who also were responsible for the collection of specimens and biological samples (*e.g.*, stomachs, statoliths, plumes, gonads, parasites, parasites) for further analyses in laboratory. This monitoring and daily sampling and recording of the catch and on-board fishing activities was undertaken by IMARPE observers that were embarked on each industrial vessel. And it is noted that the information and data collected during this 20-year period through this monitoring and sampling by on board IMARPE observers was one of the key sources of

information that has made it possible to dramatically expand biology and fisheries aspects of this species.

Since 2000, the participation of the artisanal fleet in the jumbo flying squid fishery in Peruvian waters rapidly increased, and gradually displaced the foreign industrial jigger vessels. And, since 2012 all fishing for jumbo flying squid in Peruvian waters is carried out with this type of artisanal vessels. Due to the small size of these artisanal vessels (<15 m in length), it was not possible to have the same information or to collect the same type and volume of samples as it used to be collected by the observers on board the industrial vessels (who carried out biometric and biological sampling of the squid catches in addition to keeping accurate daily records of catch and on-board fishing). For this reason, when the operations of the industrial fleet ceased, since 2012 IMARPE implemented the jumbo flying squid biological and fishery monitoring system (Yamashiro *et al*. 2018, 2019), through which information and data on the daily catch, fishing effort and sizes-frequency distributions, as well as biological samples are collected by IMARPE observers on board and at all main landing sites, with the support of IMARPE main and coastal research laboratories. Examples of the main information and data that has been obtained though this biological and fishery monitoring on board the artisanal fleet between 2015 and 2019 is presented in Mariátegui *et al.* (2021).

The SPRFMO Commission has recently adopted conservation and management measure CMM 18-2020 that is specific for the jumbo flying squid fishery in the high seas, in the area of application of the SPRFMO Convention. In addition, other more general SPRFMO measures also apply to this fishery, such as CMM 05-2021 on the establishment of the Commission record of vessels authorized to fish in the Convention area and CMM 16-2021 on the establishment of the SPRFMO Observer Program, which apply to all vessels flying the flag of Members and Cooperating Non-Contracting Parties (CNCP) that intend to fish or are fishing for jumbo flying squid within the Convention area. Among other aspects, these CMMs establish that these vessels must be duly authorized by their governments and be included in the SPRFMO record of vessels authorized to fish in the Convention area, in addition to having SPRFMO accredited observers on board part of the vessels and collect, verify and provide to the SPRFMO Secretariat all the data and reports on all fishing activities as specified in these CMMs.

However, in consideration of the small size and limited space and facilities on board the Peruvian artisanal fishing vessels that fish for jumbo flying squid in Peruvian jurisdictional waters and also intend to fish for squid in the high seas, within the Convention area, Peru submitted a proposal to amend the CMM 16-2019 on the SPRFMO Observer Program in order to exempt artisanal fishing vessels of no more than 15 meters in length from having to comply with the requirement of having a SPRFMO certified observer on board. The Peru proposed amendment was adopted and incorporated in the revised CMM 16-2021, in which, in its new paragraph 4, artisanal fishing vessels less than 15 meters fishing for jumbo flying squid are exempted from having to deploy an onboard observer in accordance with the SPRFMO Observer Programme and, instead, "*will employ an alternative scientific monitoring approach that will collect data equivalent to that specified in CMM 16-2021 (Observer Programme) and in CMM 18-2020 (Squid), in a manner that ensures comparable coverage"*.

The same paragraph 4 of CMM 16-2021 indicates that the Member or CNCP wishing to avail itself of such alternative approach *"must present the details of the approach to the Scientific*

Committee for evaluation" and that such approach *"shall be subject to the approval of the Commission at the annual meeting prior to implementation".*

This document presents the alternative scientific monitoring approach that Peru will apply to collect data equivalent to that specified in CMM 16-2021 (Observer Programme) and in CMM 18-2020 (Squid), in a manner that ensures comparable coverage, for evaluation during the 9th meeting of the Scientific Committee and approval during the 10th meeting of the SPRFMO Commission.

3. COVERAGE OF THE OBSERVER PROGRAM

It is foreseen that the IMARPE Observer Program will have the following levels of coverage of the jumbo flying squid fishing trips in the Convention area (high seas) carried out by Peruvian artisanal fishing vessels of less than 15 meters that are authorized and set sail to fish for jumbo flying squid in the Convention area (high seas):

(a) a coverage of 5% or more of the trips of the artisanal fishing vessels involved, through observers on board, who will provide detailed information on the catch, fishing areas, fishing effort and biometric and biological data of what is caught. This level of coverage is equivalent to the level of coverage established in paragraph 10 of CMM 18-2020 (Squid), and may be adjusted to other coverage levels that could be specified in further revisions of this CMM;

(b) an approximate coverage of 80% or more of the landings (and trips) of the artisanal fishing vessels involved, through observers in port from IMARPE and/or from the Ministry of Production (PRODUCE), who will provide information on the catch, the fishing areas and fishing effort;

(c) coverage of 90% or more of the trips of the artisanal fishing vessels involved, through an information system using a traceability application[1] running on portable smartphones, with which fishermen will provide in real-time all relevant information on their fishing trip, including on their catch, fishing areas and fishing effort;

(d) it is expected that 100% coverage can be achieved by combining ***(b)*** and ***(c)*** above, with regards to the information on catch, fishing areas and fishing effort by trip of the artisanal fishing vessels involved.

3.1. Extent and scope of the Observer Program

The extent, scope and requirements of personnel and means of this Observer Program will largely depend on the number of Peruvian artisanal fishing vessels of less than 15 meters that will be authorized to fish for jumbo flying squid in the high seas, in the area of application of the SPRFMO Convention, and of the number of trips (per month, year, etc.) that the skippers of these vessels decide to undertake to go fishing for jumbo flying squid in said area. The number of authorized vessels will be known shortly and early enough for planning purposes, but the percentage of these vessels that will actually be engaged in fishing for jumbo flying squid in the Convention area will largely be conditioned by the prevailing environmental conditions and the inshore-offshore distribution of squid and other fish concentrations off Peru, which may vary greatly seasonally and from year to year. Therefore, there will be the

[1] Negotiations are well underway to adapt and formalize the adoption and use of the traceability application "TrazApp" (https://www.trazapp.org) that has been developed by the non-governmental organization World Wildlife Foundation (WWF).

need to have and maintain some flexibility in the extend and scope of this programme, especially with regards to the availability and readiness of on-board observers.

In principle, the coverage levels indicated in paragraphs 3*(a)* (observers on board) and 3*(b)* (observers in port) above can be achieved with the personnel and means already at the disposal of IMARPE. But it might be necessary to expand this availability of personnel and means if the number of vessels involved in fishing jumbo flying squid in the Convention area were to increase significantly. And this will only be known once a list of authorized vessels is available, and their activities begin to be monitored.

3.1.1. List of artisanal fishing vessels authorized to fish for jumbo flying squid in the high seas, in the Convention area

The Ministry of Production (PRODUCE) shall prepare and keep updated a list of artisanal fishing vessels that have been formalized and are authorized by the Government to fish for jumbo flying squid in the high seas, in the Convention area, and have been registered or are in the process of being registered in the SPRFMO Record of Vessels Authorised to Fish in the Convention Area. Only based on this information will it be possible to determine the extent and scope of the monitoring system to be established, particularly with regards to the onboard observer's component of it in order to achieve the desired coverage of 5% or more of the vessels involved.

4. THE IMARPE OBSERVERS

IMARPE already relies on trained and experienced port and on-board observers as part of its regular monitoring system for the jumbo flying squid in Peru and for informational purposes, a brief reference is made below to their employment status, professional profile, training offered, as well as their main rights and responsibilities.

4.1. Observers' employment status

The observers are professionals in the areas of biology, fisheries engineering, fisheries technicians and fishermen. The port observers are IMARPE personnel with an Administrative Service Contract (Contrato Administrativo de Servicios, CAS), while the on-board observers are temporal workers. In both cases they receive a monthly remuneration.

4.1.1. Requirements to be an on-board observer

Training level: fishing technologist, bachelor or professional in areas of fisheries engineering or biology;

Experience: minimum of 3 months in the performance of similar jobs and/or in the performance of equivalent functions;

Specialization program: have successfully completed a survival at sea couse;

Required knowledge: knowledge of general biology and taxonomy of hydrobiological resources and preferably of jumbo flying squid-squid, and knowledge of fisheries data collection techniques and basic computer software (*e.g.*, Excel, Word, others); and,

Insurance: have processed and have a Complementary Work and Risk Insurance (health insurance) and a Complementary Work and Risk Insurance (pension insurance) as a temporary worker.

4.1.2. Requirements to be a port observer

Training level: fisheries engineers, biologists, fisheries technician or local fisherman (who will be previously trained and shall already have a good knowledge of the local fishing activities and enjoy a good stand within the local fishing community);

Experience: minimum 1 year in the performance of similar jobs and/or in the performance of equivalent functions;

Specialization program: have successfully completed a survival at sea course;

Required knowledge: general knowledge of the common local fish species, knowledge of fisheries data collection techniques and basic computer software (*e.g.*, Excel, Word, others).

4.2. Observer training

IMARPE will be responsible for the training of the port and on-board observers for the the monitoring of the artisanal jumbo flying squid fishery. The training will include aspects related to the rights and duties of the observers on board and at the landing sites, the type and method of collecting data from the fishery on board and in port, the carrying out of biometric and biological samples of the catches on board, and of the landings in port.

4.3. Observer rights on board and at landing sites

- Right to be issued and carry an identification document that certifies him/her as an IMARPE observer;
- Right to have all the materials that are needed to perform their work on board or at the landing sites;
- Right to be granted access to all the port facilities through which catch landings takes place and, on board, the right to take biological samples;
- Right not to perform tasks assigned to the crew, such as handling of fishing gear (for fishing purposes) or unloading of fish;
- Right that the data, records, documents, equipment and belongings of the observer are not be manipulated, damaged or destroyed;
- Right to be treated with respect by the skippers and crew of the fishing vessels as well as by the managers and personnel in charge of the landing sites, who will be provided with a copy of these rights; and,
- Right to receive periodical training.

4.4. Observer duties

- Always carry their identification documents while working on board and/or at landing sites;
- Maintain independence and impartiality at all times while on duty;
- Prepare a report of the activities carried out on board at the end of each fishing trip and deliver it together with the forms, information and samples collected to the designated coordinator of the closest IMARPE Coastal Laboratory; and,
- Maintain the confidentiality and reserve of the information accessed by virtue of the contract as observer.

5. STANDARD DATA TO BE COLLECTED FROM FISHING ACTIVITIES

When an IMARPE observer is on board the fisheries data will be collected for each set or each fishing operation.

When there is no IMARPE observer on board, the catch data, fishing areas and number of fishermen by trip will be collected arrival to port by the IMARPE observer in the landing site or by a designated representative of the Peruvian Government (from IMARPE or PRODUCE). when the vessel arrives at port. disembarkation.

Serious consideration is being given and negotiations are well under way to adapt and use the mobile traceability application "TrazApp"[1] developed by the non-governmental organization World Wildlife Foundation (WWF), through which fishermen can provide detailed fishing information (including geographical position, catch and effort per set or fishing operation). This application is already in use by some artisanal fishermen in the Peru and it is hoped that through an IMARPE-WWF agreement, its use can be extended and generalized at least amongst those artisanal vessels seeking authorization to fish for jumbo flying squid in the Convention area. The data obtained with the use of this application will expand and complement the information and data obtained through the observers on board and in port, allowing for detailed information to be collected on the duration, geographical position, catch and effort per set or fishing operation even when there are no observers on board or in port.

The fishermen and skippers of the artisanal vessels being authorized to fish for jumbo flying squid in the Convention area will be instructed that, when they plan to go out fishing for jumbo flying squid more than 200 nm away from the coast, they will notify the local IMARPE representative in advance, so that priority may be given to assigning an IMARPE observers aboard one or more of these vessels.

The fishermen and skippers of the artisanal fishing vessels being authorized to fish for jumbo flying squid in the Convention area will be instructed that, whenever they have carried out fishing operations for jumbo flying squid more than 200 nm away from the coast without having brought an IMARPE observer on board, they will proceed to report to the IMARPE port observer as soon as they arrive to port, in order to proceed with the data collection and sampling of the catch of said vessel as a matter of priority.

The type of information and data to be collected from each vessel and trip will depend on whether the vessel has an IMARPE observer on board, whether there is an IMARPE or PRODUCE observer at the port, and whether the skipper of the boat has access to the mobile traceability application "TrazApp".

5.1. When an IMARPE observer is on board

The data to collected will be:

- Vessel flag,
- Name of the vessel,
- Vessel registration number,
- Date of fishing activity (UTC format),
- Position at the start of each set or fishing operation, with resolution of 1/10th degree, decimal format, of latitude and longitude,

- Position at the end of each set or fishing operation, with resolution of 1/10th degree, decimal format, of latitude and longitude,
- Target species (FAO species code),
- Number of crew,
- Number of jigs and number of hand lines,
- Total fishing hours per set or fishing operation,
- Estimated total catch (kg) of jumbo flying squid per set or fishing operation,
- Identification and estimated total catch (kg) of any other species caught, if any, per set or fishing operation,
- Size-frequency sampling of squid caught in each set or fishing operation (see Annex 1, section 3),
- Biological sampling of squid specimens per set or fishing operation (see Annex 1, section 4).

5.2. When there is no IMARPE observer on board and there is a port observer from IMARPE or from PRODUCE

The data to be collected will be:

- Vessel flag,
- Name of the vessel,
- Vessel registration number,
- Date of fishing activity (UTC format)
- Referential position of the fishing area, with resolution of 1/10th degree, decimal format, of latitude and longitude, as declared by the skipper or master fisherman,
- Target species (FAO species code),
- Number of crew,
- Number of jigs and number of hand lines,
- Total catch (kg),
- If it is possible to identify and separate the specimens caught in the Convention area, a length-frequency sampling of the squid caught in the Convention area will be carried out,
- In coordination with and subject to acceptance of the skipper or master fisherman, samples of non-gutted squid specimens caught in the Convention properly selected and preserved will be purchased for biological sampling in the laboratory.

5.3. When there are or are no IMARPE or PRODUCE observers, and the fishing pattern has the mobile traceability application "TrazApp"

The data to be collected will be:

- Vessel flag,
- Name of the vessel
- Vessel registration number
- Position at the start of each set or fishing operation, with resolution of 1/10th degree, decimal format, of latitude and longitude,
- Position at the end of each set or fishing operation, with resolution of 1/10th degree, decimal format, of latitude and longitude,
- Target species (FAO species code),
- Number of crew,

- Number of jigs and number of hand lines,
- Total fishing hours per set or fishing operation, and
- Estimated total catch (kg) of jumbo flying squid per set or fishing operation.

6. SAMPLING ON BOARD BY IMARPE ON-BOARD OBSERVER

On trips where there is an IMARPE observer on board, the IMARPE observer will carry out daily biometric (size) and biological samplings of the jumbo flying squid being caught, as described in Annex 1. This sampling will include:

6.1. Biometric sampling (of size frequency)

A simple random sample of maximum 120 squids will be collected and measured per fishing day (distributed among the different sets or fishing operations of that day), measuring and recording the dorsal mantle lengths as described in Annex 1.

6.2. Biological sampling

To obtain biological data, from the large daily sample above, 10 female and 10 male squids will be set aside by means of a stratified random sampling, so that the specimens cover the entire range of sizes in the large daily sample. Then, for each specimen, the following data will be determined and recorded, as described in Annex 1:

- Mantle length (mm)
- Total weight (g)
- Eviscerated weight (g)
- Sex
- Maturity stage
- Evidence of copulation (females only)

7. SAMPLING IN PORT

In ports where there is an IMARPE Coastal Laboratory (*i.e.*: Tumbes, Paita, San José, Chicama, Huanchaco, Chimbote, Huacho, Callao, Pisco, Atico, Matarani and Ilo) arrangements will be made to buy part of the catch of those vessels that have caught jumbo flying squid more than 200 nm from the coast (in the Convention area) without having an IMARPE observer on board, for the purpose of carrying out biological sampling in the laboratory. This will be done only if it will be possible to differentiate what has been caught in the Convention area, and those squids are landed whole (not gutted). For this, the master fisherman and/or crew fishermen of the artisanal vessels participating in the program will be instructed to bring to port samples of complete specimens, selected and conserved under certain criteria, and a fair price will be paid for that part of the catch delivered to IMARPE.

8. BIBLIOGRAPHIC REFERENCIAS

MARIÁTEGUI L., MENDOZA J., ESPINOZA E., TORRES E., CHAMBILLA J., ARGUELLES J. & CSIRKE J. 2021. Main results of the biological and fisheries monitoring of the jumbo flying squid *Dosidicus gigas* on board the artisanal fleet dedicated to its capture in Peruvian jurisdictional waters, which could also be extended to the area of application of the SPRFMO Convention. Meeting document of the 9th Meeting of the SPRFMO Scientific Committee, Held virtually, 27 September - 3 October 2021. Doc. SPRFMO SC9-XXXX (TBA)

MARKAIDA U. 2001. Biología del calamar gigante *Dosidicus gigas* Orbigny, 1835 (Cephalopoda: Ommastrepphidae) en el Golfo de California, México. Tesis doctoral. Centro de Investigación Científica y de Educación Superior Ensenada Baja California, México: 387p.

PEREA A, SANCHEZ J, BUITRON B. 2018. Escala de madurez gonadal del calamar gigante *Dosidicus gigas* (d'Orbigny, 1835) (Cephalopoda: Ommastrephidae). Bol. Inst. Mar Perú.33(2):137-152. (https://revistas.imarpe.gob.pe/index.php/boletin/article/view/36/33)

ROPER C.F.E, SWEENEY M.J. NAUEN C.E. 1984. FAO species catalogue. Vol. 3. Cephalopods of the world. An annotated and illustrated catalogue of species of interest to fisheries. FAO Fish. Synopsis., 125(3): 277p.

TAFUR R, MARIÁTEGUI L, CONDORI W, BUITRÓN B. 2016. Protocolo para muestreo biológico y biométrico de cefalópodos. Inf. Inst. Mar Perú 43(4): 375-401. https://repositorio.imarpe.gob.pe/bitstream/20.500.12958/3125/1/Informe%2043%284%29-4.pdf

TAFUR R, MARIÁTEGUI L, YAMASHIRO C, SANJINEZ M & MENDOZA J. 2019. Protocol for biological and biometric sampling of jumbo flying squid *Dosidicus gigas* (d'Orbignyi) in use in Peru. Meeting document of the 7th Meeting of the SPRFMO Scientific Committee, La Havana, Cuba, 7-12 October 2019. Doc. SPRFMO SC7-SQ04: 15p. (https://www.sprfmo.int/assets/2019-SC7/Meeting-Docs/SC7-SQ04-Protocol-for-biological-and-biometric-sampling-of-Jumbo-Flying-Squid-in-Peru.pdf)

YAMASHIRO C, MARIÁTEGUI L, TAFUR R, CASTILLO R, ARGUELLES J, GOICOCHEA C, ALEGRE A, SÁNCHEZ J, TAIPE A, SANJINEZ M. 2018. Sistema de monitoreo de la pesquería del calamar gigante *Dosidicus gigas* en el Perú. Monitoring system for the jumbo flying squid *Dosidicus gigas* fishery in Peru. Bol. Inst. Mar Perú. 33(2): 212-221 (https://repositorio.imarpe.gob.pe/bitstream/20.500.12958/3243/1/Boletin%2033%282%298.pdf)

YAMASHIRO C, MARIÁTEGUI L, TAFUR R, CASTILLO R, ARGUELLES J, GOICOCHEA C, ALEGRE A, SÁNCHEZ J, TAIPE A, SANJINEZ M. 2018. Monitoring system for the jumbo flying squid *Dosidicus gigas* fishery in Peru. Meeting document of the 7th Meeting of the SPRFMO Scientific Committee, La Havana, Cuba, 7-12 October 2019. Doc. SPRFMO SC7-SQ09: 32p. (http://www.sprfmo.int/assets/2019-SC7/Meeting-Docs/SC7-SQ09-Monitoring-system-for-the-Jumbo-flying-squid-fishery-in-Peru.pdf)

ANNEX 1

PROTOCOL FOR BIOLOGICAL AND BIOMETRIC SAMPLING OF JUMBO FLYING SQUID *Dosidicus gigas* (from Tafur *et al.* 2016, 2019)

1. MATERIALS USED

The materials to use in this process should include:

- Acrylic board,
- Measuring tape with 1 mm accuracy,
- Electronic scale with 0.01 g accuracy (for laboratory sampling),
- Dynamometer or "Roman" scale with 0.25 kg accuracy (for on-board sampling),
- Dissecting equipment: scissors, watchmaker's tweezers, straight tweezers, stainless steel knife,
- Vernier caliper or square caliper (for laboratory sampling, to measure the length of the testis, etc),
- Plastic trays,
- Stationery: pens, pencil, eraser, correction fluid, notepad,
- Biometric sampling form,
- Biological sampling form.

2. SAMPLING TYPE

The sampling type being used is the one considered for cephalopods, and is carried out as follows:

To obtain biometric data, it will be by taking a simple random sample of maximum of 120 specimens per fishing day (distributed among the different fishing sets or fishing operations of the day); and,

To obtain biological data, 10 female and 10 male specimens from the above sample will be set aside per day by means of a stratified random sampling, so that the specimens cover the entire range of sizes in the large daily sample.

3. BIOMETRIC SAMPLING

The dimension to be measured is the dorsal mantle length (LM) in mm with a measuring tape, from the proximal edge of the mantle to the distal edge following the gladius in a straight line.

The size frequency of the specimens in the daily sample must be recorded with vertical bars forming groups of 5 (with the 5^{th} bar crossing over previous four) in the biometric sampling form ("Formato de muestreo - 01" del IMARPE, or IMARPE's "Sampling format - 01"), together with the date, fishing area, catch weight (kg), sample weight (kg), name of the vessel and names of those who carried out the biometric sampling.

4. BIOLOGICAL SAMPLING

The biological sampling wil be different and will collect different sets of data depending on whether is conducted on board an artisanal vessel or in land, in a coastal laboratory, as follows:

Biological sampling on board. In this case, the on board observer will only be recording the mantle length (mm), total weight (g), gutted weight (g), sex, gonadal maturity stage and (in the case of females) evidence of copulation.

Biological sampling in coastal laboratories. In this case the port observers and/or the coastal laboratory personnel will do a more complete processing of the samples of whole squid specimens that have been purchased for sampling and research purposes from selected vessels participating in, or cooperating with the observers' programme. And for this laboratory sampling:

- The mantle length (ML) of each specimen is measured to the nearest mm with measuring,
- The total weight of each specimen weighed to the nearest g with an electronic scale,
- The specimens placed in the ventral position are dissected and the sex and gonadal stage of maturity is determined using the scale proposed by PEREA *et al.* (2018),
- In the case of female specimens, the length of the nidamental gland (mm) is measured and the reproductive structures (*i.e.,* nidamental glands, oviducts, oviductal gland and ovary) are removed and set aside to be weighted. In the case of male specimens, the spermatophoric complex (sac and organ) and the testis are removed set aside to be weighted after measuring the length of the testis (mm). The reproductive structures of each male and female specimen are weighed with a precision scale to the nearest 0.01 g,
- The digestive gland is removed and weighed,
- The degree of fullness of the stomach is determined according to a 4-stage empirical scale (0 = empty, 1 = half full, 2 = full and 3 = completely full). The stomach is removed for dissection and qualitative analysis of items in the food content, which are classified into fish (F), crustaceans (C), squid (Sq), others (O) and red liquid (LR). Samples of stomachs are also collected for analysis at the IMARPE Trophic Ecology Laboratory, according to the established protocol,
- In females, evidence of copulation is determined by observing and recording the presence or absence of spermatophores in the oral veil,
- The statoliths, which are found in the nuchal region (under the siphon), are collected by using a scalpel blade to make a transverse cut, and with the help of a watchmaker's tweezers, it is extracted, cleaned and the pair of statoliths is placed in statolith boxes or cartons (the label will be the serial number or the length and sex).
- The mantle is weighed.

5. ANATOMY OF THE JUMBO FLYING SQUID

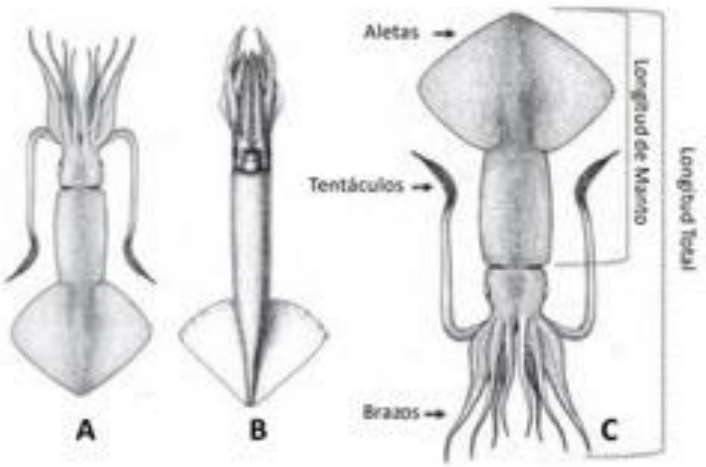

Figure 1.- Jumbo flying squid *Dosidicus gigas* in (A) dorsal view (taken from ROPER *et al.* 1984, in MARKAIDA 2001); (B) ventral view (taken from WORMUTH 1976, in MARKAIDA 2001); and, (C) dorsal view (modified from ROPER *et al.* 1984)

6. GONADAL MATURITY SCALE FOR FEMALES OF JUMBO FLYING SQUID

The description and macroscopic view of the four (4) stages of gonadal maturity of female jumbo flying squid (*Dosidicus gigas*) as described by PEREA *et al.* (2018) are summarized in the following chart.

STAGES	DESCRIPTION	PICTURES
I - Immature	The ovary is shaped like a pyriform sac, which is elongated, not granular and clear in appearance; being translucent in the initial phase of this stage. The wall of the ovary is very thin.	
II - Maturing	The vary looks grainy, opaque, creamy or slightly yellowish.	
III - Mature	Larger and turgid, more piriform in appearance, yellowish-cream to amber in color, due to the presence of a large number of mature oocytes. The wall of the ovary is thin. Oviduct of great size for being full of advanced mature oocytes. The nidamental gland is developed and turgid. It presents immature, maturing, and mature oocytes.	

IV – Spawning or Expelling	Less turgid, granular, with lots of cream-colored and amber oocytes, with a predominance of the latter, giving an orange hue to the ovary. The wall of the ovary is very thin. Flaccid nidamental gland. The oviducts may be compact and large because they are full of advanced mature oocytes or somewhat flaccid due to their evacuation. In addition, in the external part of the oviductal gland some advanced mature oocytes are observed, a sign of spawning in the squid. Immature, maturing, and mature oocytes are observed. In the oviducts, these are full of oocytes at maximum maturity and ovulated. In the ovary, at microscopic level, the presence of post-ovulatory follicles is observed	

7. GONADAL MATURITY SCALE FOR MALES OF JUMBO FLYING SQUID

The description and macroscopic view of the three (3) stages of gonadal maturity of males of jumbo flying squid (*Dosidicus gigas*) as described by PEREA *et al.* (2018) are summarized in the following chart.

STAGES	DESCRIPTION	PICTURES
I - Immature	Small, flaccid, elongated, white-colored and translucent testicle.	

II - Maturing	A larger, somewhat consistent, whitish to creamy, but not translucent testicle. Whitish spermatophore sack.	
III - Mature	A testicle of a more developed size with respect to the previous stages, turgid, white-colored and milky in appearance. Spermatophore sac is full of spermatophores; free spermatophores are observed in the abdominal cavity..