SPRFMO
South Pacific Regional Fisheries Management Organisation
SCIENTIFIC COMMITTEE MEETING
11TH
PANAMA 2023

11TH SCIENTIFIC COMMITTEE MEETING REPORT

11 to 16 September 2023

Panama City, Panama

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The publication also benefited from contributions by the SC11 invited experts Ms Lee Qi and Dr Irina Chemshirova.

Report location: https://www.sprfmo.int/meetings/meeting-reports/

SPRFMO SC11-REPORT EXECUTIVE SUMMARY

The 11th Scientific Committee Meeting (SC11) of the South Pacific Regional Fisheries Management Organisation (SPRFMO) took place from 11 to 16 September 2023 as an in-person meeting, in Panama City, Panama, and chaired by Dr Jim Ianelli (USA). There were 90 participants from 14 SPRFMO Members, representatives from one IGOs and eight NGOs, two invited experts, and the Secretariat. The Scientific Committee (SC) reviewed and assessed 93 meeting documents and provided 38 recommendations (including requests and advice) on a wide diversity of issues.

Technical work on the different subjects the SC covers was largely progressed through intersessional work.

Annual Reports were received from Australia, Belize, Chile, China, Cook Islands, Cuba, Ecuador, European Union, Faroe Islands, Korea, New Zealand, Panama, Peru, Russian Federation, Chinese Taipei, and United States of America.

The SC recommended a 15% increase of the Jack mackerel TAC, throughout the range of jack mackerel, at or below 1,242 kt. The SC strongly supported Member activities in conducting acoustic and other surveys as they are critical for the stock assessments and potentially in developing simulation-tested management procedures. Concerning Jack mackerel MSE, the SC recommended that catch entitlement banking and borrowing be evaluated within the MSE to test the impact on long-term management of this resource, as well as recommending that Members engage with the work of the MSE technical group. The SC agreed that further work needs to be done with the Commission and agreed that a MSE workshop should be held immediately prior to the upcoming Commission meeting. In terms of connectivity research, the SC recommended that the Commission consider funding a research project, proposed by the Connectivity task group. Research on the spatial distribution of jack mackerel in relation to climate change and annual temperature anomalies such as El Niño and La Niña was recommended to continue.

In terms of Deepwater, the SC accepted the cumulative Bottom Fishing Impact Assessment (BFIA) submitted by Australia and New Zealand in accordance with CMM 03 Bottom Fishing, albeit with a recommendation to update the BFIA in 2024. Regarding Vulnerable Marine Ecosystems (VME), the SC recommended that the Commission modify the Bottom trawl Management Areas (as per SC11-DW05) to ensure a minimum of 70% protection of suitable habitat for each modelled VME indicator taxa, within each Fisheries Management Area. The SC advised the Commission that orange roughy stock status is very unlikely to be impacted by taking accumulated catches in alternating years.

In terms of Squid, the SC recommended that the Commission maintain the current fishing effort levels. The SC also created a task group to focus on Squid assessment, created terms of reference for the group and recommended that information on the assessment progress be posted to the SC GitHub site to make it more available for other Members. The SC advised that the Commission review observer coverage considering the percentage of vessels sampled and consider the feasibility for the future development of Electronic Monitoring to monitor the squid fishery bycatch in the Convention Area. Members were also advised to continue its efforts to improve methods used to derive abundance indices from Catch per Unit Effort.

The SC reviewed the habitat monitoring intersessional activities and recommended adopting the ICES metadata convention developed by the "FAST" working group for data management. The SC also supported periodic large-scale synoptic ecosystem surveys using fishing vessels from Peru and Chile, as survey platforms. The habitat monitoring working group is also focused on the preparations of the upcoming symposium in November 2023. The SC acknowledged the work on acoustic data analysis and recommended it continue with a view towards integrating this information with the assessment

modeling, as well as recommending that the HMWG develops an inventory of available climate-related data and existing models applicable for SPRFMO fisheries and identify any gaps.

On the subject of Exploratory Fisheries, the Members with current exploratory fisheries presented progress reports (Cook Islands, European Union and New Zealand); and the SC advised that the proposed new exploratory fisheries (by Cook Islands, European Union and Australia) met the required standards. In catch composition research the SC recommended that stocks affected by current fishing practices should be considered for future stock assessments, even if data-limited (with a specific focus on chub mackerel). Under assessment development the SC recommended that any future targeted fishery for redbait should be undertaken as part of an agreed exploratory fishery.

The SC addressed Climate Change and has included the subject as a permanent agenda item, pursuant to the SPRFMO Commission Decision 13-2023 on Climate Change; the SC also included climate change items in its multiannual workplan.

In other matters, the SC supported the continuation of the data working group and recommended that the Commission consider hiring staff dedicated to supporting the SC in its functions. The SC made three suggestions for the Commission to consider in order to resolve the issue of the vacancy of the SC Chairperson.

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SPRFMO SC11-REPORT

Report of the 11th Meeting of the Scientific Committee

11 to 16 September 2023
Panama City, Republic of Panama

Adopted 16 September 2023, 17:12 hrs.

1 Opening of the Meeting

1. Ms Yarelis Martínez, from the Authority for Aquatic Resources of Panama (ARAP, for its name in Spanish) made an opening statement and welcomed meeting participants. The SPRFMO Executive Secretary, Mr Craig Loveridge, thanked Panama for hosting the 11th meeting of the SPRFMO Scientific Committee (SC11).

2. The Chairperson of the Scientific Committee (SC), Dr Jim Ianelli (USA), then opened the meeting and proceedings. Heads of Delegations (HoDs) were asked to introduce themselves and their delegations. A list of participants is available in Annex 2 of this report.

1.1 Adoption of Agenda

3. The SC Chairperson sought proposed changes to the provisional agenda (SC11-Doc01_rev1). After discussion, the final agenda was adopted (available as Annex 3).

1.2 Meeting Documents

4. Meeting documentation, location and access was presented. The posted list of meeting documents (SC11-Doc03_rev6) and annotated agenda (SC11-Doc02_rev1) were made available and referred to throughout the meeting. Five documents were submitted late; the SC agreed to accept them and ensured that they would be considered.

1.3 Nomination of Rapporteurs

5. Reporting was supported by Lara Ainley (Australia), Jose Zenteno (Chile), Niels Hintzen and Jan Geert Hiddink (European Union), Jordi Tablada (New Zealand), Emily Reynolds (USA), the Secretariat, and Working Group chairpersons.

1.4 Meeting Programme and Timetable

6. The indicative meeting schedule was introduced (SC11-Doc04_rev1) and made available to the meeting; minor modifications were made to the schedule throughout the meeting. The final schedule is shown in Annex 4 to this report.

2 Annual Reports

7. Annual reports were received from Australia, Belize, Chile, China, Cook Islands, Cuba, Curaçao, Ecuador, European Union, Faroe Islands, Korea, New Zealand, Panama, Peru, Russian Federation, Chinese Taipei, and United States of America (SC11-Doc13 to SC11-Doc33). A live collaboration document on Microsoft Teams was provided for questions and answers about the different annual reports. All reports, including questions, responses, and final report text, were expected to be finalised by the close of day on 9 September. No questions were asked via this live document.

2.1 Australia

8. Document SC11-Doc21 presents the Australian fishing activity in 2022 in the South Pacific Regional Fisheries Management Organisation (SPRFMO) Convention Area. Two Australian-flagged vessels fished in the SPRFMO Area in 2022 using demersal longline gears with 637,909 hooks deployed. No Australian-flagged vessel fished using trawl gears. The total retained catch reported in logbooks was 132.4 t, comprised primarily of yellowtail kingfish (*Seriola lalandi*), sweetlips spp. (*Plectorhinchus* spp.), morwong (*Nemadactylus* spp.), blue-eye trevalla (*Hyperoglyphe antarctica*) and other species. Australia achieved 13% observer coverage in 2022. Observers did not report any bycatch of marine mammals, marine reptiles or other species of concern in non-trawl operations in the SPRFMO area in 2022. In the bottom longline fishery, observers reported one interaction with bycatch of seabirds, southern giant petrel (*Macronectes giganteus*; dead). There was one interaction reported by observers with a short fin mako (*Isurus oxyrinchus*; dead). Observers reported 59 kg of non-living 'benthos' in 13 separate fishing operations in 2022, however the discarded benthos was not identified to lower classification. The required annual data were submitted to the SPRFMO Secretariat in accordance with Australian's data confidentially policies and the relevant CMMs.

2.2 Belize

9. Document SC11-Doc33 presents a nil report from Belize.

2.3 Chile

10. Document SC11-Doc25 reports that since 2020, the fishing operations on Chilean jack mackerel have been conducted exclusively within the Chilean EEZ. During the first half of 2023, the industrial fleet targeting this resource was made up of 44 fishing vessels using purse seines.

11. A progressive increase in the jack mackerel catches has been observed in the 2013 - 2022 period, with a maximum reached in 2022. This trend is explained by the increase in the quota allocated to Chile plus quota transfers from other SPRFMO members to Chile along with the completeness of its extraction. Thus, until May 2023, 554,236 metric tonnes of jack mackerel were caught in the Chilean EEZ, which corresponds to 77% of the national TAC.

12. Since 2016, size-structured jack mackerel catches have shown a wide range of sizes, between 8 and 67 Fork Length (FL) cm, with main modes fluctuating between 26 and 41 FL cm, with higher values towards the end of the series. Thus, during the first semester of 2023, the size range of includes individuals between 8 and 66 cm in FL, with a main mode of 37 cm in FL, due to a low participation of individuals belonging to the immature fraction of the jack mackerel stock.

13. Similarly, since 2011, age-structured jack mackerel catches according to the new age group allocation criteria have shown a wide range of ages, with main modes fluctuating between age groups I to IV in the period 2011-2018. Then, starting in 2019, the main catch mode became represented by age group V.

14. Finally, it is important to reiterate that, as of January 2020, Image Recording Devices (DRI) have been implemented to monitor compliance with Bycatch Reduction Plans and Fishery regulations in the entire fleet. In addition, during 2020, the mandatory use of Electronic Logbooks Systems (SIBE) has also been implemented in the industrial fleet to report total catches, bycatch and discards, the locations of sets and other operational information according to legal requirements on a set-by-set basis and in real time. To this date, the implementation of these Electronic Monitoring Systems (DRI and SIBE) in the Chilean industrial fleets have been focused on monitoring compliance with regulations applying to catches, discards and incidental bycatch of seabirds, marine mammals, sea turtles and chondrichthyes. However, the extension of the use of these tools beyond control, such as the scientific monitoring of fishing activities to gather fisheries dependent data, has begun to be explored recently with the aim complementing it with traditional human observation programs, in a near future.

15. Document SC11-Doc26 reports that the jumbo squid fishery has the participation of both artisanal and industrial vessels. In 2022, the artisanal fleet landed 97,013 tonnes of this resource, representing 99.31% of the national total (97,687 tonnes). The artisanal fleet targeting this resource is made up of 1,787 vessels whose length is equal or less than 18 meters. However, the main fishing operation was carried out by vessels of length equal or less than 12 meters, which represented 96.98% of the total number of artisanal vessels, equivalent to 1,733. This type of vessel (≤ 12m) altogether landed more 99.00 % of the total landings for the artisanal sector. On the other hand, during 2022, the participation of the industrial fleet over this resource was developed as bycatch while targeting other resources, and represented landings of 674 tonnes, representing 0.69% of the total landings for jumbo squid in Chile during 2022 (97,687 tonnes). The industrial landings of jumbo squid involved 2 factory vessels and 40 vessels of which 19 landed more than 3 tonnes per fishing trip. Out of those 19 vessels, no factory vessels were involved: 15 operated with purse seines (78.95%), 3 (15.79%) with trawls and 1 with jigging (5.26%). Regarding the total tonnes landed by the industrial fleets, and its relationship with the fishing gear used, during 2022, 59.00% corresponded to catches performed with trawls, 37.33% with purse seine and only 3.67% with jigging. During 2022, bycatch of marine mammals, seabirds, or sea turtles was not observed for both fleets. Finally, is important to note that all catches of jumbo squid were performed within the Exclusive Economic Zone of Chile (EEZ).

2.4 China

16. Document SC11-Doc29 reports that in 2022, a total of 462 Chinese squid jigging vessels operated in the Convention Area and caught 509,000 tonnes of jumbo flying squid. The number of active fishing vessels varied from 226 (April/May) to 417 (December). The number of fishing days reached to 95,390 days and the catch rate was 5.3 tonnes per fishing day. Five observers and six studying vessels conducted the observer program during the 2021-2022 and 2022-2023 fishing years. A total of 595 fishing days and 23 transshipment activities were observed in 2022, and over 100,000 squids collected by observers and studying vessels were measured.

17. Document SC11-Doc30 reports that five observers as well as six studying vessels conduct the observer program for the Chinese squid during the 2021-2022 and 2022-2023 fishing years, in which a total of 595 fishing days and 23 transshipment activities were observed by the five observers in 2022. One observer departed from Zhoushan port in October 2021 and returned to the port in October 2022. The four observers embarked in late July to early August 2022 and returned to Zhoushan harbor in two batches in May and July 2023, respectively. During this period, the five observers spent an average of 10 months at sea. More than 100,000 squids were measured by observers and the studying fleet, and there are still thousands of samples waiting to be shipped back to the lab for analysis. Samples taken by the observer program covered 12 months of the year and both the northern and southern fishing grounds. No seabirds, reptile or marine mammal were observed to be caught by the jiggers.

2.5 Cook Islands

18. Document SC11-Doc22 provides the Cook Islands Annual Report. The Cook Islands has made significant strides in enhancing its fisheries operations with the introduction of a new fishing vessel named *Akanu*i in 2022. This vessel has successfully completed three trips, contributing to the country's fishing activities. The Cook Islands remains committed to expanding its capabilities in the fisheries sector and strives to ensure sustainable practices. However, the COVID-19 pandemic caused disruptions, leading to an extension of the fishing program until 2024. Despite these challenges, the Cook Islands continues to make progress, with a total 2022 catch of 41.35 t of *J. caveorum* and 6.38 t *Chaceon* sp. in the trap fishery, along with 1 t of bycatch. The Cook Islands remains dedicated to preserving its marine resources and is actively working towards achieving a prosperous and sustainable fishing industry. The *J. caveorum* stock on Kopernik Seamount breached the CPUE limit imposed by the Cook Islands and as such the Cook Islands has temporarily closed the fishery at that Seamount to lobster fishing.

2.6 Cuba

19. Document SC11-Doc20 contains the nil Annual Report from Cuba. Cuba currently has no vessels participating in the fisheries in the Convention Area and that its jack mackerel quota for the year 2023 was transferred to European Union. Therefore, Cuba does not have data or information to report to the SC for this meeting in relation to the sections established for annual reports, according to the relevant guidelines. In particular, since there has been no fishing activity in the last five years, Cuba does not provide information on Fisheries Description. It also does not provide information on the remaining sections on Catches, Effort, and CPUE Summaries; Fisheries Data Collection and Research Activities; Biological Sampling and Length/Age Composition of Catches; ecosystem approach considerations; and observer implementation reports.

2.7 Curaçao

20. Curaçao currently has no vessels participating in the fisheries managed by SPRFMO. As such, Curaçao has no data or information to provide regarding Curaçao fisheries operating under SPRFMO jurisdiction in 2022 or 2023. Similarly, Curaçao has no information to provide regarding 1) catches, effort, and CPUE summaries; 2) fisheries data collection and research activities; 3) biological sampling and length/age composition of catches; 4) ecosystem approach considerations; and 5) observer implementation reports for fishing activities under SPRFMO jurisdiction.

2.8 Ecuador

21. Document SC11-Doc31 covers the details of the jack mackerel fishery. Small pelagic fishery is one of the most important incomes to the country in continental Ecuadorian platform. Thread herring (*Opisthonema spp*.), chub mackerel (*Scomber japonicus*), Pacific anchoveta (*Cetengraulis mysticetus*), Frigatetuna (*Auxis spp.),* Round herring (*Etrumeus teres*), sardine (*Sardinops sagax*), anchovy (*Engraulis ringens)* and jack mackerel (*Trachurus murphyi*) are the species caught by the purse-seine vessels. The product, depending on the species, is mainly intended to produce fishmeal, followed by canning and direct human consumption (fresh – frozen).

22. Between January and July of the year 2023, Ecuador has documented cumulative weight of Jack mackerel unloads for this period has been recorded at 3,012 kilograms. This figure is like the preceding year, 2022, during which jack mackerel unloads amounted to 4,934 kilograms. The report presented by the National Researching Institute for Aquaculture and Fisheries (IPIAP) showed a size structure spectrum spanning from 14 to 66 cm TL, indicative of the delineation of three distinct cohorts of size categories (19 - 31, 32 - 51, and 55 - 65 TL), alongside the pronounced prominence of two robust modal groupings at 28 and 29 cm TL.

23. In order with the studies of biomass, abundance and distribution of the main species of small pelagic fish in the continental Ecuadorian platform, from June 27 to July 12 of 2022 was carried out the 6th hydro acoustic prospecting survey; jack mackerel was reported, as well as biological samples were taken (15 organisms)

24. Document SC11-Doc32 covers the details of the squid fishery in Ecuador. The giant squid *Dosidicus gigas* (d'Orbigny, 1835) fishery in Ecuadorian waters is under development and represents a fishing alternative for the Ecuadorian fishing sector. It is a highly migratory species and is distributed in the Eastern Pacific Ocean (Keyl et al., 2008). It is a short-lived, unstable and variable resource in its annual biomass (Ibañez et al., 2015), its seasonal distribution in Ecuadorian waters is influenced by the Humboldt current, in whose area of influence the giant squid makes vertical nocturnal movements for feeding, where it is caught by the artisanal fishing fleet in directed fishing and incidental fishing, mainly during the new (dark) moon. The report presented the results achieved from the giant squid biological fishing monitoring recorded by the Public Institute for Aquaculture and Fisheries Research (IPIAP) on the Ecuadorian continental coast during 2022. The artisanal fishing fleet caught giant squid in directed fishing, using hand lines with jigs, and bycatch with driftnets or surface gillnets. The captured squid was used mainly as bait for large pelagic fish (PPG) such as tuna, mahi mahi, albacore, billfish, etc. The fishing fleet was made up of fiberglass type vessels (F/V) with outboard motors (40 to 75 HP), and mother ships (with 2 to 10 fiberglass vessels) with stationary motors, established mainly in Manta.

25. On the Ecuadorian continental coast, a total landing of 5,906.7 t was estimated, which represented an increase of 211.4% in relation to 2021. The province of Santa Elena registered the highest landings (56%). A total of 3,995 female organisms were analysed; comprising 15.0% stage I (immature), 84.9% stage II (mature), and 0.1% stage III (mature) (Figure 3). It should be noted that females were more frequent and more numerous (86%) than males (14%) throughout the year.

2.9 European Union

26. Document SC11-Doc24 presents the European Union fishing activity in 2022 in the South Pacific Regional Fisheries Management Organization (SPRFMO) Convention area and the observer program implementation in 2022. The data on catches of jack mackerel (*Trachurus murphyi*) by two EU trawlers in 2022 covers the period from April to November. Total catch in 2022 was just over 63,978 (44,538 CJM) tonnes. Three scientific observers were deployed on two EU fishing vessels in the period from end of March till mid-August 2021. A short section on the PFA self-sampling program has been included in the report, demonstrating the main results of the self-sampling activities that cover all trips by EU vessels in the area. A comparison of the EU observer data on jack mackerel with the PFA self-sampling data has been submitted to the SPRFMO SC (SC11-JM02). The document first assessed the quality and reliability of the self-sampling data in trips where both observer data and self-sampling data were available. Over the years 2015-2022, 21 trips were covered by both self-sampling and scientific observers. In total, the fishery took place during 22 quarters of which 16 had at least some observer coverage and 6 quarters had no observer coverage (but did have self-sampling coverage). The overall number of length measurements between the observer trips (87,323) and the self-sampling trips (10,1732) up to and including 2022 is comparable. The self-sampling program samples fewer fish per trip (1,734 compared to 3,969 in observer trips) but samples more trips than in the observer program (58 vs. 22). The resulting length distributions by trip were found to be comparable and of sufficient quality. A comparison of the overall length compositions by year derived from all self-sampled trips or derived from the raised observer trips, demonstrates that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources. Thus, self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programs while being able to assure a wide coverage of the fishing season. During the Jack mackerel Benchmark Working Group (SCW14) it was decided to develop a protocol for inclusion of self-sampling data for the EU fleet for those quarters

where no observer trips were carried out. This document describes that protocol and the selection of quarters for which the self-sampling data will be used. For SC11, it is proposed to use 2022_Q4, 2023_Q2 and 2023_Q3 from the self-sampling data. Exploratory fishing for toothfish was undertaken by the Spanish vessel Tronio in accordance with CMM 14e-2021. In both 2021 and 2022 the TAC of 75t was reached in 15 days and 17 days respectively. A detailed survey report is presented to the SC.

2.10 Faroe Islands

27. Document SC11-Doc13 reports no activity from this member.

2.11 Korea

28. Document SC11-Doc18 provides the Annual Report for Korea. There was no fishing activity by Korean's fishing fleets in the SPRFMO Convention Area in 2022 or 2023. Therefore, Korea has no update to provide regarding 1) description of fisheries, 2) catches, effort, and CPUE summaries; 3) fisheries data collection and research activities; 4) observer implementation; and 5) ecosystem approach considerations under the SPRFMO Convention Area in this year.

2.12 New Zealand

29. Document SC11-Doc16 provides an update on New Zealand's fishing activities in the SPRFMO Convention Area in 2022. Four New Zealand vessels fished in the SPRFMO Area, all four using bottom line methods. There was no bottom trawl fishing by New Zealand vessels in the SPRFMO Area in 2022. There were 341,000 hooks set using bottom line methods with a total catch of 53 t for non-exploratory fisheries, the majority of which was wreckfish and bluenose (33 t and 8 t respectively), and 40 t for exploratory fisheries, the majority of which was toothfish (39 t). New Zealand met all requirements for observer coverage, as there was no trawl fishing and 21% of hooks were observed in bottom line fisheries. Overall, 88 fish were measured by observers, all of these were wreckfish. Most research activities by New Zealand in 2022 were continuations of previous projects. New Zealand also provides information on a range of ecosystem considerations. These include interactions with seabirds, marine mammals, reptiles, other species of concern, non-target fish and elasmobranch catch, and catch of benthic organisms. Information on abandoned, lost, or discarded fishing gear is also provided. There was one reported seabird capture on New Zealand vessels in 2022 and this bird was released alive and uninjured. There were no reported encounters with potential VMEs pursuant to CMM 03-2023 (Bottom Fishing).

2.13 Panama

30. Document SC11-Doc19 reports no activity from this Member.

2.14 Peru

31. Within the SPRFMO Area, as of July 2023, there are 118 Peruvian vessels authorized and registered in the Commission record of vessels authorized to fish within the SPRFMO Convention area. A maximum annual catch of 40,516 t of *Trachurus murphyi* was reported in 2010 by the Peruvian fleet in the SPRFMO and fishing activities were significantly reduced thereafter. In 2014, up to 5 Peruvian multipurpose purse seine/trawlers caught 2,556.9 t of *T. murphyi* and 1,190.0 t of *Dosidicus gigas* in the SPRFMO Convention area. From 2015 to 2022, no Peruvian vessel fished for *T. murphyi* in the SPRFMO Convention area. However, during the first semester of 2023 (until July) a total catch of 20,056.06 t was reported by 38 Peruvian flagged purse seine vessels. Regarding *Scomber japonicus,* a total of 1,122.3 t was caught by 5 Peruvian purse seiners in 2016. But during this year 2023 (until July 2023), the same Peruvian flagged vessels fished a total of 7,360 t. of *S. japonicus* in the SPRFMO Convention area. Regarding *D. gigas,* two Peruvian scientific research vessels caught a total of 1.6 t in

2015 and one of them caught 1.0 t in 2018, while a variable number of small artisanal jigger vessels were reported to have occasionally fished for *D. gigas* in the SPRFMO Convention area between 2014 and 2018. No catches of jumbo flying squid in this area have been reported from 2019 and the first semester of 2023 (until July 2023). The research activities in the SPRFMO area, and monitored by a Peruvian onboard observer program, provided reliable information on fishing effort, catch volumes, species composition of the catches, fishing areas; and horizontal and vertical distribution of the target species. Part of this information is presented in this report. Finally, there were no registers of top predators bycatch (seabirds, marine mammals and sea turtles) in any observation during the reported fishing activities.

32. The Peruvian Area of National Jurisdiction (ANJ) marine environment is characterised by its high productivity and high variability and is particularly exposed to the effects of the opposed significantly warm (El Niño) and cold (La Niña) climatic patterns in the Pacific Ocean that alternate with relatively short periods of close to neutral conditions. Between 2013 and the first part of 2018, these changing environmental conditions caused a more dispersed distribution, reduced availability, lower abundance indexes and consequently lower catches of jack mackerel. This has been followed by an expanded distribution in denser concentrations farther offshore, much higher abundance indexes, increased availability to the industrial and artisanal purse seine fleet and higher catches of jack mackerel during the second half 2018 and throughout 2019, 2020, 2021 and the first half of 2022. From summer 2023 until June 2023, a Coastal Niño event was registered along the Peruvian coast, as a consequence, during this period, a displacement of Jack mackerel fishing areas to the south of Peruvian coast was observed, as well as a dispersion of its schools. The poor 2018-2019 reproductive cycle has been followed by almost normal 2019-2020, and well above normal 2020-2021, 2021-2022, and 2022-2023 reproductive cycles. The fishery, between January 2022 - June 2023, targeted a wide range of jack mackerel sizes (22 cm to 65 cm total length), but there was a low presence of juveniles (fish smaller than 31 cm of total length), where the highest proportions of juveniles in numbers were observed in November 2022 (8%) and April 2023 (8%). Research surveys in 2022 and 2023 also found the adult modal groups that were caught by commercial fleets during these years and, they also found much younger and smaller juveniles with total lengths as small as 3 cm total length. In late December 2022 IMARPE (Instituto del Mar del Perú) updated the available 2022 jack mackerel assessment made for the Peruvian (far-north) stock with the JJM model using the configuration agreed during the 10th meeting of the Scientific Committee (SC10). This resulted in a range of options for setting the 2023 TAC that were included in its advice to the Government, initially recommending a TAC for 2023 based on the F2022 multiplier of no more than 1.5, which corresponded to a maximum estimated F = 0.137 and a maximum projected TAC = 144,000 t, accepting a risk of 0% risk that the current biomass will be lower than its reference level. Based on this advice, in February 2023, PRODUCE established a catch limit of 65,000 tonnes for the jack mackerel (*Trachurus murphyi*) to be caught in Peruvian jurisdictional waters by the large-scale or industrial fleet during 2023 and a catch limit of 72,500 tonnes to be caught by the artisanal fishing vessels with purse seines and hold capacity equal or greater than 20 m^3 up to 32.6 m^3. Also, based on their regular low catches throughout the year and other socio-economic considerations, no catch limit has been established for the Jack mackerel fishery by artisanal fishing vessels that use passive fishing gear (curtain, hooks, among others), and purse seine vessels with a hold capacity of less than 20 m^3. Then on 10 March 2023, PRODUCE decided to extend only the jack mackerel catch limit to be caught by the industrial fleet, from the first 65 000 tonnes up to 83,958 tonnes for the current year. An updated assessment with the same JJM model has been made by IMARPE on the basis of the most recent information and data available up to June 2023. The recent observations and assessments confirm the increasing trend in the biomass estimates observed from 2016 until last year. The model projection for this 2023 shows a slight decrease in its trend. Despite this, the Peruvian jack mackerel stock is in an overall healthy situation considering the natural low abundance regime through which the stocks appear to have been going through during the last two decades.

2.15 Russian Federation

33. SC11-Doc15 provides the Annual Report for the Russian Federation. Jack mackerel (*Trachurus murphyi*) fishing was conducted by two Russian-flagged trawlers and covered the period from April to December 2022. The total catch of biological resources was 47,505 t, including 29,443 t of jack mackerel and 18,017 t of chub mackerel (*Scomber japonicus*). Scientific observers were deployed on board vessels during the entire period of fishing and the scientific observer coverage in the fishery was 100%.

2.16 Chinese Taipei

34. Document SC11-Doc23 provided an update on fishing activity by Chinese Taipei vessels in the SPRFMO Convention Area. Jumbo flying squid widely distributes in the eastern Pacific Ocean and has been targeted by Chinese Taipei's squid-jigging fleet during 2002-2021. There was no fishing activity in the SPRFMO Convention Area in 2022 fishing season for Chinese Taipei's fishing fleet. The number of fishing vessels varied from 2 to 29 during 2002–2021 with catches of 665 to 39,450 tonnes. The major fishing grounds located around 13°–18°S and 80°–85°W, while several vessels operated in the equatorial waters (around 1°–4° S and 95°–106° W). Data of logbook, observer, transshipment, and landing have been collected entirely and submitted to the Secretariat of SPRFMO. The research on the stock status and spatial dynamics of Jumbo flying squid have been conducted. Using weight category and length frequency of the samples, the monthly length composition of jumbo flying squid was estimated. Based on statolith microstructure analysis, the hatching months of the squid peaked in April and June.

2.17 United States of America

35. The United States currently has no vessels participating in the fisheries managed by SPRFMO (SC11-Doc14). As such, the United States has no data or information to provide regarding U.S. fisheries operating under SPRFMO jurisdiction in 2022 or 2023. Similarly, the United States has no information to provide regarding 1) catches, effort, and CPUE summaries; 2) fisheries data collection and research activities; 3) biological sampling and length/age composition of catches; 4) ecosystem approach considerations; and 5) observer implementation reports for fishing activities under SPRFMO jurisdiction. The United States has a continuing interest in the fisheries managed by SPRFMO and may have vessels that enter these fisheries in the future. If U.S.-flagged vessels enter SPRFMO-managed fisheries, the United States would provide the Commission with all relevant data and information and abide by all relevant measures adopted.

3 Commission guidance and intersessional activities

3.1 SC multi-annual workplan

36. The 2024 workplan was posted as SC11-Doc05 and developed during the meeting sessions. The SC reviewed the tasks and developed a draft 2024 multi-annual workplan (Annex 5). The SC discussed funding prioritisation of workplan items and noted that two items (jack mackerel connectivity research and invited external experts) lacked a funding source. The SC therefore refrained from further prioritisation discussions.

37. Chile reports that of the three subtasks considered in the SC Multi-Annual Plan. The first one has been completed, through the development of a work program on board the CIMAR 26 cruise ship carried out during the year 2022. The Chilean scientific vessel "Cabo de Hornos" conducted an expedition to the Salas y Gómez ridge, including Rapa Nui, in which oceanography, pelagic biodiversity, seabirds, cetaceans and one of the main threats for this area, marine litter, were studied. This information has been processed and we are working on the reports that will be presented as soon as possible to this committee. In October 2023, the CIMAR 28 cruise will be carried out in the Chilean portion of the Nazca ridge and the Juan Fernandez ridge, on board the ship "Cabo de Hornos".

38. In relation to subtask 2, the Center for Ecology and Sustainable Management of Oceanic Islands (ESMOI) has worked during 2023 on the impact of climate change and adaptive capacity in the Rapa Nui fishery, west of the Salas y Gomez ridge, through the Packard Foundation's Climate Impacts in the Oceans-Chile Initiative. The report is being prepared and will be made available to the SPRMFO scientific committee in 2024.

39. In relation to the expedition established as the third subtask, Chile is working on the final planning of the Falkor Too (Schmidt Ocean Institute) cruise to the Nazca Ridge, which will take place in January 2024. This expedition will be a major effort that we will be carried out cooperatively with different actors at national and international level, but the scientific leadership will be the responsibility of the ESMOI Center of Chile.

40. Additionally, a second Falkor Too cruise to the Salas y Gómez Ridge is likely confirmed, to be carried out in February-March 2024, coordinated by ESMOI, but with researchers from all over the world. In this sense, from Chile expresses its strong commitment to inclusive work in this area and invites to interested scientists from this committee to participate in some way in any of these cruises, if they are interested.

41. Chile is committed to the work related to the Nazca and Salas y Gómez ridges and firmly believes that it is necessary to deepen in our knowledge, which is already enormous, and in concrete actions that allow its protection, due to the importance they have, not only for the Pacific Ocean, but globally, in order to be a contribution to the development and strengthening of sustainable fisheries and ensuring the health of the ocean in the long term.

42. Oceana and DSCC expressed support of Chile's research on protection of the Nazca and Salas y Gomez Ridges

3.2 Status of the SC Fund

43. The Executive Secretary presented SC11-Doc08 regarding the status of the Scientific Committee support fund. There remains NZ$ 14,428 for SC activities carried out to June 2024; however, with the addition of Member contributions the projected balance as of 31 December 2023 is NZ$ 78,310. Members were requested to prepare research proposals and appropriate invoicing to the Secretariat to access available funding resources.

44. The SC convened a small group to discuss staffing and budget issues relative to resources available to the SC. The SC noted its appreciation for the support the outgoing Data Manager, Dr Tiffany Vidal, has provided to the SC process, including scheduling, staffing, taking minutes, and producing reports for over twenty Working Group meetings in the most recent intersessional period, and assisting the SC Chair to run the SC meeting and produce the SC report. The SC considered maintaining this level of support to be essential for the SC to continue to fulfil its functions.

45. The SC also noted that these duties fell outside the Data Manager's job description and was concerned that continuing to ask for this level of support from the incoming Data Manager is not sustainable, and risks the Data Manager being unable to fully execute either that role's regular duties or the additional support for the SC. The SC also noted that the workload of supporting the SC contributed to the outgoing Data Manager seeking other employment.

46. The SC also noted with appreciation the long (over 12 years) and exemplary tenure of Dr Jim Ianelli as SC Chair. The SC recognised that Dr Ianelli has supported SC functions beyond the duties elaborated in the Rules of Procedure, in particular, his efforts to produce the jack mackerel assessment and develop the draft harvest advice, and that his departure from the role of Chair will leave a gap in support for this and other SC processes.

47. With these considerations in mind, the SC

> **recommended** that the Commission consider hiring staff dedicated to supporting the SC in its functions as per Article 10 of the SPRFMO Convention to: coordinate intersessional Working Group activities by scheduling, staffing, taking minutes, and producing reports for Working Group meetings; assist the SC Chair to run the SC meeting and produce the SC report; plan, support the SC to conduct and review scientific assessments of the status of fishery resources; encourage and promote cooperation in scientific research and; provide other scientific expertise to the Commission and its subsidiary bodies as they consider appropriate, or as may be requested by the Commission; provide support to Members in the coordination of the Scientific Committee Multiannual Workplan adopted by the Commission; analyse the data collected and exchanged through relevant CMMs.

3.3 Secretariat SC-related activities

48. The Data Manager presented SC11-Doc07, which summarised the activities conducted over the past year by the Secretariat in support of SC work. These activities include external meetings, project inputs and data releases.

49. The SC endorsed continued funding and participation in these activities.

4 Jack Mackerel

4.1 Review of intersessional activities

50. he Jack Mackerel Working Group met twice virtually in preparation for the Scientific Committee meeting on the 18/19th of June (report G107-2023) and 29/30th of August (report G128-2023). The workshops focused on progress made towards organising an age-reading workshop and noted the lack of interest from Members. The Secretariat presented a brief overview of the updated work on catch composition of the jack mackerel fishery for which additional data from the Russian Federation had been provided (2008-2022), as compared to the study in 2022. The Chair of the jack mackerel connectivity task group (Fabrice Stephenson) presented a proposal for a six-year study to investigate stock. The jack mackerel Management Strategy Evaluation (MSE) work was discussed at five technical meetings (report G26-2023, G55-2023, G93-2023, G108-2023 and G124-2023). This work has resulted in a functioning operating model (OM) that is the backbone for testing management procedures while covering plausible hypotheses on stock productivity. Prior to SC11, the JMWG reviewed the documents submitted with a goal to best facilitate discussions. At this last JMWG meeting, the group reviewed the stock assessment results given all the new data in preparation for SC11.

4.2 *Trachurus murphyi* catch history

51. The Secretariat has provided an updated historical catch data series to 2023 as Annex 1_rev2 in document SC11-JM01_rev2. There were no notable changes to the historical catch history. As final annual catch figures are not due until 30 September, in many cases the 2022 data remain estimates. Initial 2023 catch estimates, by fleet, have been provided by calculating the ratio of annual catch figures to the cumulative total catch reported through July of the corresponding year, on an annual basis. These ratios were then averaged to produce a multiplier for the 2023 catch estimates through July, to estimate total annual catches for the 2023 calendar year. The time frame over which these ratios were calculated varied by fleet, due to changes in fishing behaviour through time.

52. Members were asked to either accept these initial estimates or provide adjustments based upon their knowledge of the current fishing season. Several Members provided updates to the catch estimates for 2022 and 2023. Previous estimates for total current catches have always been within about 10% of the final figures. Last year's SC10 2022 estimates for total catch show a relative overestimation of 3.39% overall, with the previous 5 years having initial annual catch estimates deviating from the final figures in the range of -1 to 10.1%, with a mean of 3.9%. Boxplots showing historical monthly catches for each of the major fleets were presented and compared with the current monthly catches from the first half of 2023.

53. The paper also provided a short explanation of the *Trachurus murphyi* (CJM) catch history as used in the SPRFMO jack mackerel stock assessment. Section 6 has been included to show information provided by IATTC on catches of epipelagic forage fishes (including *Trachurus spp*) for the entire IATTC area.

4.3 Assessment data review and evaluation

54. The SC discussed the data inputs and preliminary assessment results and diagnostics, including stock status and reference points.

4.4 Management Strategy Evaluation update

55. The SC reviewed SC11-JM16 on conditioning of operating models and exploratory evaluation of candidate management procedures for SPRFMO jack mackerel. In this study we develop a Management Strategy Evaluation for Chilean jack mackerel. The objective of this study is to lead to the adoption of a management procedure to replace the current rebuilding plan which is currently used to provide catch advice on Chilean jack mackerel (CJM). Here we condition operating models and explore candidate management procedures. The operating models are being conditioned based on the 2022 stock assessment for CJM for both the one and two stock hypotheses and additionally a third OM is designed in which connectivity between a northern and southern stock is simulated. Different sources of uncertainty are included in the OM such as parameter uncertainty as well as uncertainty on stock recruitment dynamics, growth, and weight-at-age as well as effort creep in CPUE fleets. Preliminary long-term projections under three management procedure designs are provided for illustration purposes demonstrating stock status trajectories under constant catch and constant F scenarios. Finally, these scenarios are compared for several performance statistics that allow identifying suitable candidate management procedures.

56. The SC discussed the development and advice from the MSE work that has been carried out intersessionally and planned the next phase of work, which has been incorporated into the multiannual workplan. Related to the MSE developments, the SC Chair invited a presentation from the Marine Stewardship Council (MSC) to discuss MSE requirements. There are fisheries within the SPRFMO management which have obtained certification under MSC and new standards specific to MSE requirements for RFMOs have been developed. The presentation was provided for information and will be made available on the SPRFMO website.

57. Chile, and Peru together with Russia made statements on the progress of the MSE work and these are provided in Annex 9.

4.5 Jack mackerel assessment

58. The EU presented PFA self-sampling report SC11-JM03. A description is presented of the fisheries carried out by vessels belonging to members of the Pelagic Freezer-trawler Association (PFA) within the SPRFMO area from 2016 to 2023. The Pelagic Freezer-trawler Association (PFA) is an association that has nine member companies that together operate 18 (in 2022) freezer trawlers in six European countries (www.pelagicfish.eu). In 2015, the PFA has initiated a self-sampling program that expands the ongoing monitoring programs on board of pelagic freezer-trawlers aimed at assessing the quality of fish. The expansion in the self-sampling program consists of recording of haul information, recording the species compositions by haul and regularly taking length measurements from the catch. The self-sampling is carried out by the vessel quality managers on board of the vessels, who have a long experience in assessing the quality of fish, and by the skippers/officers with respect to the haul information. During the fisheries in the Pacific, the self-sampling program has been carried out during all trips and all hauls.

59. The self-sampling program delivers information on spatial and temporal evolution of the fishery, species and length compositions and ambient fishing conditions (temperature and depth). Catch distributions and length compositions by quarter and division are presented for jack mackerel (CJM), chub mackerel (MAS) and southern rays bream (BRU). No PFA fisheries was carried in the SPRFMO area in 2020, due to the global Corona crisis. As such, no results can be reported for 2020. In the first half of 2023, three PFA vessels have been active in the SPRFMO Convention Area, although they arrived later than in previous years.

60. The jack mackerel fishery takes place from March through to November. Overall, the self-sampling activities for the jack mackerel fisheries during the years 2016 - 2023 (up to 12/07/2023) covered 50 fishing trips with 2,112 hauls, a total catch of 140,216 tonnes and 77,105 individual length measurements. Compared to the previous years, jack mackerel in the catch in 2021-2023 have been taken much more northernly. Median length of 23.7 cm compared to 27-36cm in the preceding years. The highest catch rates (catch/day) of jack mackerel have been recorded in 2021 (222 ton/day) and is at 165 ton/day in 2022.

61. Bycatches of chub mackerel (MAS), Southern rays bream (BRU) and blue fathead (UBA) are being taken in the fishery for jack mackerel. During the years, reported here, 1,699 hauls with chub mackerel (MAS), 377 hauls with Southern rays bream (BRU) and 321 hauls with blue fathead (UBA) have been analysed as part of the program.

62. In this 2023 self-sampling report, a standardised CPUE calculation has been included. The standardised CPUE is based on a generalised linear model (GLM) model with a negative binomial distribution. The response variable was catch by week and vessel, with an offset of the log effort (number of fishing days per week) and explanatory variables including year, gross tonnage (GT) category, month, division and depth category. An assumed technical efficiency increase of 2.5% per year has been included in the fitting of the model (Rousseau et al 2019).

63. A comparison of the self-sampling program and the EU observer program has been presented in a separate working document (SC11-JM01 Comparison and protocol for including EU self-sampling data).

64. The EU presented SC11-JM04 on comparison of EU self-sampling and observer data. This working document provides a comparison of the EU observer trips in the Jack mackerel fishery with the EU self-sampling data to assess the quality and reliability of the self-sampling data in trips where both observer data and self-sampling data are available. Provided that the quality and reliability of the self-sampling data is satisfactory, then those data could be used to supplement the observer data for quarters where no observer trips have been realised.

65. The EU pelagic freezer-trawler fleet has been carrying out a self-sampling program on the freezer-trawler fleet since 2015.Within the fishery for jack mackerel in the South Pacific, the self-sampling program has been carried out on all trips.

66. The EU scientific observer program for that fishery is targeted to cover at least 10% of the effort. Over the years 2015-2022 the analysis has shown that around 34% of the catch has been covered by scientific observers. Over these years, 22 trips were covered by both self-sampling and scientific observers. In total, the fishery took place during 19 quarters of which 15 had at least some observer coverage and 4 quarters had no observer coverage (but did have self-sampling coverage). The overall number of length measurements between the observer trips (87,323) and the self-sampling trips (100,589) up to and including 2022 is comparable. The self-sampling program samples fewer fish per trip (1,734 compared to 3,969 in observer trips) but samples more trips than in the observer program (58 vs. 22).

67. In addition, self-sampling data is available for the 2 quarters in the current year (2023) for which no observer data is yet available.

68. A comparison of the overall length compositions by year derived from all self-sampled trips or derived from the raised observer trips, demonstrates that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources. Thus, self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programs while being able to assure a wide coverage of the fishing season.

69. During the Jack Mackerel Benchmark Workshop (SCW14) it was decided to develop a protocol for inclusion of self-sampling data for the EU fleet for those quarters where no observer trips were carried out. This document describes that protocol and the selection of quarters for which the self-sampling data will be used. For SC11, it is proposed to use 2022_Q4, 2023_Q2 and 2023_Q3 from the self-sampling data.

70. Chile presented SC11-JM06 on effort creep in the jack mackerel south central fleet in Chile. The central-southern fleet for the jack mackerel fishery in Chile has experienced technological changes over time, which may not be reflected by other variables already considered in the CPUE standardisation process. To account for these changes the SPRFMO Scientific Committee agreed to apply a factor of 1% per year to correct the CPUE abundance indices of jack mackerel for the Chilean and Peruvian fleets. However, there are concerns over the technical implications of a fixed rate, and the exploration of alternative efficiency correction factors was recommended. In this study we compiled and organised available qualitative and quantitative information related to technological, operative and normative changes in the Chilean central southern fleet, and an informed effort creep time series was developed. The proposed correction is composed of time varying blocks of efficiency factors, providing an alternative for the correction of effort or CPUE. Chile presented the benefits and limitations of this approach and propose next steps for adjusting and improving its reliability.

71. The SC noted that the time series of estimated effort creep is a bit misleading because there is an absence of data relating to factors affecting catchability prior to 1998. The SC:

> recommended that the time series be truncated to reflect only the time series over which there is information on changes in efficiency for future analyses.

72. Chile presented SC11-JM07 on a Bayesian spatio-temporal approach for the standardisation of CPUE in the *Trachurus murphyi* fishery of central-southern Chile. The spatial distribution and habitat selection are key factors in population dynamics of pelagic fish stocks, but are often not explicitly included in ecological studies or age- or size-structured stock assessment models (SAMs). The main types of data commonly used in SAMs are catch, composition (e.g., age/length, sex and weight) and indices of relative abundance. Fishery-independent indices from standardised surveys are often difficult to obtain for logistic and funding reasons or occur during a specific season. Therefore, many SAMs rely on indices of relative abundance based on fishery catch-per-unit-of-effort (CPUE) which can be influenced by several factors that promote its spatial variation challenging its standardisation (e.g., environmental-

conditions, fishing methods, season/area fished and vessel-size). This study standardised the data of Chilean jack mackerel fishery-dependent CPUE from central-southern Chile for the period 1994-2023 using Bayesian hierarchical spatio-temporal models with the integrated nested Laplace approximation (INLA). Jack mackerel CPUE was best explained by vessel hold-capacity, days at the sea, quarter, year, the spatio-temporal component and environmental conditions (here sea surface temperature and chlorophyll-a). In terms of spatio-temporal distribution, jack mackerel biomass prediction maps showed a variable interannual pattern with two periods of coastal concentration (1995-2001 and 2012-2023) and one of offshore expansion (2002-2011). The standardised series of CPUE suggested a stable period of high biomass that reached its maximum in 2006, from when it declined steadily. Then, since 2015, an increase in the CPUE is observed, which was associated with a greater availability of fishing close to the main fishing ports. In addition, the included environmental variables showed an improvement in the goodness-of-fit of the standardisation model, suggesting a habitat-based aggregation of jack mackerel biomass. This approach provides a new spatio-temporal standardised jack mackerel CPUE series that could be used in the Joint-Jack-Mackerel-SAM.

73. Peru presented SC11-JM08 on Instructions for sampling jack mackerel for population study. The population structure and connectivity of jack mackerel (JM) throughout its distribution range are important aspects to take into account in its stock assessment and management. Due to its complexity and limited understanding (given its wide distribution, uncertain migration patterns, different spawning and fishing areas, in addition to varying responses to the influence of environmental changes), JM population structure and connectivity should be evaluated along the whole species range following the same criteria, where sampling design plays an important role for ensuring a subsequent holistic analysis. In this sense, a JM sampling protocol is proposed for the study of JM population structure and connectivity, focused on the population analysis with a multidisciplinary approach. Thus, guidelines for collecting, storing specimens and processing biological samples for the multidisciplinary study are proposed, including a temporal and spatial sampling criteria, different types of sampling (on board vessels and in ports, terminals and fishing factories), and conditions for their transport to laboratories. The subsequent processing of the specimens for their population study is also covered, including sampling protocols for studies of: reproductive biology, parasites, genetics, trophic ecology, and age and growth. All these steps are also presented in a schematic workflow to facilitate their easier implementation in laboratories of decentralised sites, as well as headquarters. Finally, we consider that information in this document may be a useful contribution to the Scientific Committee and the JM Connectivity Task Group, for the development of a regional sampling design and protocol.

74. The SC discussed the paper and **agreed** that the outcomes of the paper provide a useful starting place for further discussion within the Connectivity Task Group.

75. Peru presented SC11-JM09 on the reproductive aspects of Jack mackerel in the Peruvian waters. Despite the diverse literature on Jack mackerel reproductive cycle there is still a lack of information on the reproductively active schools distribution of this species. This work aims to identify the areas of reproductively active schools by calculating the gonadosomatic index (GSI) during the months of greatest reproductive importance of this species along the Peruvian coast from 2019 to 2022. In addition, fecundity estimations of this species are also presented. The fecundity estimated was carried out with specimens of sizes between 41 and 56 cm TL off the Casma and Atico areas, calculating batch fecundity as 158 538 ± 84 006 hydrated oocytes per spawning batch and relative fecundity as 134 ± 54 hydrated oocytes/gram of fish. The results obtained in this study shows that Jack mackerel develop their entire reproductive cycle in waters under Peruvian jurisdiction, mainly off the central-southern zone of the coast.

76. The **SC noted** that genetic samples be taken during the spawning season on the spawning ground.

77. Chile presented SC11-JM10 Update up to June 2022 of Chilean jack mackerel abundance index based on catch per fishing set. The CPUE index of the Central-South Chile purse seiner fleet is one of the most important indices of the Chilean jack mackerel stock assessment model. The CPUE is calculated as the

catch divided by the days out of the port multiply by the vessel holding capacity. An alternative index based on catch by fishing set was estimated by Caballero et al. (2020) for the 1994-2020 period. The aim of this document was to update this index up to June 2022. The data combined the scientific observations collected by observers on board from IFOP and the fishing industry. CPUE index was estimated using a statistic model that includes a distribution of compound probability that describes the joint probability of success and a catch per fishing set. The updated index was significantly different from the nominal data, and it was equal to the index estimated by Caballero et al. (2020). During the 2006-2022 period, the updated CPUE index trend was similar to the CPUE index used in the stock assessment model. During 1994-2005, these CPUE indices had different trends. The updated model explained 10.2% total deviance and the sample size was low in some of the early years. Further analyses were identified as GAM and geostatic analysis and ?me-space models.

78. Chile presented SC11-JM11 on an update of Chilean jack mackerel CPUE abundance index based on catch by fishing trip in south-central Chile. The abundance index based on the CPUE model of the south-central Chilean purse seiner fleet is one of the main indices used in the jack mackerel stock assessment model. This index was updated up to June 2023. The CPUE model uses vessel hold capacity both in independent and dependent variables. To evaluate the effect of the use of vessel hold capacity in the CPUE model, an alternative model based on the catch with vessel hold capacity as covariable was fitted. The two models estimated a similar abundance index, which had a decreasing trend from 1983 to 2011, an increasing trend up to 2020, and a stabilisation in the last three years. The current index level is similar to one in the year 2001.

79. The relationships between the CPUE index and hydro-acoustic survey results in the south-central area were analysed, including acoustic biomass, acoustic density, and fish distribution area. For the years 2000, 2021, and 2023, the acoustic surveys estimated decreasing trends in the biomass and in the area occupied by the fish, and a high increase in the density. A ramp model was fitted between the CPUE index and biomass. CPUE index tends to increase with acoustic density until an asymptotic level. A linear model was fitted between the CPUE index and area (excluding the last three years), which is proposed to correct the CPUE index. This correction reduced the recovery rate in the last three years. It is recommended to have a precautionary approach because the CPUE index seems to overestimate stock recovery.

80. Chile presented SC11-JM12 on jack mackerel abundance index estimated by spatiotemporal SPDE-based GLM and comparison with other CPUE indices. The CPUE index of the Central-South Chile purse seiner fleet is one of the most important indices of the Chilean jack mackerel stock assessment model. The CPUE is calculated as the catch divided by the days off port multiply by the vessel holding capacity. An alternative index based on catch by fishing set was estimated by GLM using a statistic model that included a distribution of compound probability that describes the joint probability of success and a catch per fishing set (Caballero et al., 2020 and Payá, 2023a). However, this model explained 10.2% of total deviance and had small sample sizes in some years, therefore, further analyses were identified. This document reports CPUE index estimates done using spatiotemporal stochastic partial differential equation generalised linear mixed models (SPDE-Based GLMMs) with template model builder (sdmTMB). Two models were fitted to the data, a spatiotemporal model and a spatio-temporal GLM. The estimated abundance indices were not significantly different between the two models. In relation to the CPUE index estimated by GLM using catch per fishing set (Caballero et al., 2020 and Payá, 2023a), the indices had similar trends. In relation to the CPUE abundance index used in the stock assessment model, the indices had a similar trend for the 2006-2022 period, but not for the 1994-2005 period. For the 2006-2022 period all indices showed a “V” type trend with the minimal figure at year 2011, but the rate of decrease before this year and the rate of increase after this year was greater in the abundance index based on days off port. These results are part of a work in progress and further analyses were identified.

81. The SC:

> noted the paper on modelling CPUEs of the Chilean fleet and recommended these models to be further analysed in the next jack mackerel benchmark.

82. Chile presented SC11-JM13 on the spatio-temporal dynamics of Chilean jack mackerel fishery off south-central Chile in 2023 In 2023 (January-June), all the fishing activity for Chilean jack mackerel (*Trachurus murphyi*) took place within the coastal strip delimited by the 60 nm offshore, continuing a trend established since 2020. This condition was favoured by the high level of aggregation, commercial abundance, and recurrent sighting zones presented by the schools of *Trachurus murphyi* near the coast. Few incursions were recorded in the oceanic sector, which did not yield positive results in locating fishing zones, similar to what has been observed in the last 4 years.

83. Monthly size structure showed a higher presence of adults, with a low presence of specimens below the legal minimum size (<26 cm FL), which did not exceed 0.13% (March). Notably, there was a progressively decreasing record of the size fraction of *Trachurus murphyi* in the range of 31-40 cm FL from February to June 2023, concurrently with a increase in the older fraction of 41-50 cm FL.

84. Chile presented SC11-JM14 on the population genomics and environmental associations in *Trachurus murphyi* in the South Pacific Ocean. The assessment of the genetic structuring of biodiversity is crucial for management and conservation. For species with large population sizes and migratory behaviour, a low number of molecular markers may fail to identify population structure. A solution for this shortcoming can be high-throughput sequencing that allows genotyping thousands of markers on a genome approach while facilitating the detection of genetic structuring shaped by selection. This is the case of Chilean jack mackerel, *Trachurus murphyi*, which is a pelagic fish widely distributed in the South Pacific Ocean and one of the commercially most relevant resources for Chile. In this study, we used high-quality biallelic single nucleotide polymorphisms (SNPs) and mitochondrial haplotypes from 376 samples collected from 35 localities, to investigate its genetic population structure across the South Pacific Ocean. We found low population structure at neutral loci, but high differentiation at adaptive loci distinguishing a location at New Zealand from the other locations of the Pacific Ocean. Associations between adaptive and neutral genetic distance with environmental distance were evaluated. Our results reveal a pattern of spatial genetic divergence between adaptive loci, probably reflecting adaptations to local environments such as turbulence and mesoscale activity and secondarily with aspects of biological productivity such as chlorophyll-a, and no evidence for differences related to sea surface temperature. Overall, the results obtained suggest that Chilean jack mackerel shows population structure and adaptation despite considerable gene flow in the South Pacific Ocean. The connectivity (i.e., gene flow) and environmental variables play a key role for the contrasting patterns of spatial structure found for neutral and adaptive loci.

85. Peru expressed concern about the sampling design and the interpretation of the statistical analysis.

86. The SC noted this paper and agreed that, after a brief discussion on the methodology, the outcomes of the paper make a useful start for further discussion within the connectivity task group.

87. Chile presented SC11-JM15 Hydroacoustic assessment of Chilean jack mackerel carried out in the north and south-central area of Chile The results of the jack mackerel assessments carried out in 2023 in Chile, show a biomass of 2,508,883 tonnes in the northern zone, which represented a significant increase of 68.8%, 45.1% and 31.7% compared to what was evaluated in 2019, 2020 and 2021, respectively, while the central-south zone, a biomass of 837,349 tonnes, shows a decrease of 45.9% and 31.0%, compared to what was registered in the zone in 2020 and 2021, respectively. The continuity of a greater availability of the resource in the central-south zone (2020 and 2021), compared to what was registered in 2008 (520,934 t) and 2009 (534,538 t), the strong variation in the availability of jack mackerel since 2018 (375,662 t) to 2023 (2,508,883 t) in the northern zone, together with the operation of the international fleet to the west of this zone, suggests a possible redistribution of the resource off

the coast of Chile. Likewise, the strong increase in biomass of the resource, the record of smaller specimens (12 to 20 cm) until 2022, the strengthening this year of larger specimens (28 to 44 cm) observed in 2021 and 2023, show an improvement of the conditions of the resource, associated with the strengthening of the size structure of the jack mackerel stock off the north coast of Chile.

88. The SC discussed the paper, also in reflection of preliminary analyses within the assessment model and:

> **recommended** these data series to be further analysed within the assessment model at the next jack mackerel benchmark.

89. Noting the importance of data collection on understanding Jack mackerel stock trends, the SC:

> **recommended** that the Commission highlight this and strongly support Members activities in conducting acoustic and other surveys. These are critical for the stock assessments and potentially in developing simulation-tested management procedures.

4.6 Jack mackerel 2023 stock assessment

90. From the preparatory SC web meetings, and recognising that the benchmark assessment occurred in July 2022, the **SC agreed** that the assessment would be carried out in line with the results of the benchmark workshop. The usual incremental analyses of adding each new data component were completed. This preliminary assessment was presented at the second preparatory Jack Mackerel Working Group (JMWG) web meeting. Members were invited review the assessment data prior to SC11. Given that the SCW14 benchmark was held recently (in 2022), it was **agreed** that limited sensitivity runs should be done.

91. The input data was scrutinised by SC scientists prior to SC11 and noted no marked differences compared to previous years. Although weight-at-age for age 12 fish in the Northern Chilean fishery is estimated to be very high (and likely based on few samples), this had negligible impact on the stock assessment. The catch-at-age data prepared by Chile and offshore fishing Members showed that the age distribution is shifting towards slightly older fish, comparable to the period prior to 2010 and after 1990. Also, the Peruvian catches showed an increase in average length. Clear signs of large incoming year classes are not apparent from the Northern Chilean fishery where in previous years this was the case. Peru indicated that year specific weight-at-age data was also available for 2015-2025 and the SC accepted these data to be used within the assessment.

92. The SC discussed best approaches to allocate Peruvian high seas catches to a specific fleet in the JJM model. It was noted that the Peruvian fleet consists mainly of purse seiners where the offshore fleet targets Jack mackerel with pelagic trawl. The SC therefore decided to incorporate those catches to Fleet 3 due to two factors, namely that 1) the fishery composition data were not separated by area, and 2) the fleet characteristics (e.g., gear) are that of the far-north fleet rather than that of the offshore fleet, and therefore may lead to selectivity misspecification. The **SC noted** that in those years where Chilean vessels had fished in the high seas, these catches would be attributed to fleet 2, representing the fishery within the Chilean EEZ. The SC decided to adopt a similar approach and allocate the Peruvian catches to fleet 3 (i.e., the Far North fishery) and that a sensitivity analysis would be presented to illustrate the impact on stock biomass if these catches were considered under fleet 4 (i.e., the offshore fleet). An analysis was undertaken to estimate the change in perception of stock biomass when the Peruvian catches in the high seas would be allocated to the offshore fleet (fleet 4) which showed a negligible impact.

93. During the second preparatory meeting of the JMWG, the WG noted that the offshore fleet CPUE was increasing substantially which was largely driven by the fleet commencing fishing activities later in the year as compared to previous years, as well as a northerly distribution of the fleet, breaking with the time-series prior to 2020 in which the fleet focussed on fishing grounds off south-central Chile. The SC decided to downweigh the 2022 observation.

94. The SC investigated why the value of F_{MSY} as estimated in the stock assessment model increases in recent years. The selection pattern in both the South Central Chile as well as the Offshore fleet has shifted towards older fish. Fishing pressure can be sustained at higher levels on older fish, hence leading to an increase in estimated F_{MSY}. This change in selection is apparent from around 2015 onwards.

95. The SC further **agreed** to use a 10-year average of the dynamically estimated B_{MSY} as the B_{MSY} value to be taken forward in the forecast. This B_{MSY} is estimated as 8,088 kt in 2023 for the single stock hypothesis.

96. The 1-stock and 2-stock models have some differences in the specifications of certain processes (e.g., on selectivity). In the current formulations, the single stock model performs better than the two-stock model with respect to retrospective patterns. Regarding the retrospective pattern, it was suggested that the two-stock model may be unable to reconcile the recent increases in the Peruvian CPUE data. The assessment model fits the catch-at-age and catch-at-length data well although fits to the offshore fleet are somewhat skewed towards older fish. The model furthermore fits the CPUE indices from Peru, Chile and offshore reasonably well although the model predicts more of an increase than Chilean CPUE demonstrates while it underestimates the Offshore CPUE in 2022. The Northern Chilean acoustic survey, although noisy, is fitted within its range of expectation. The selection pattern of especially the South-central Chilean fishery shows a continuous increase with age where in previous years selection flattened at around the age of 5.

97. The spawning stock biomass of the jack mackerel stock is estimated at around 16.4 million tonnes, well above the BMSY value (of 8.09 million tonnes). Fishing mortality in 2023 is estimated at 0.13, well below long term estimates of F_{MSY}. Recruitment is estimated lower compared to the previous years in which very large year classes were born. Recruitment still sits well above the low productivity period at around 2010.

98. Comparing the 2023 assessment with the 2022 assessment (Figure 4.5.1) shows an increase in recent estimates of SSB, mainly driven by updates to the 2023 updates in the indices of abundance. Estimates of F and recruitment have remained largely the same.

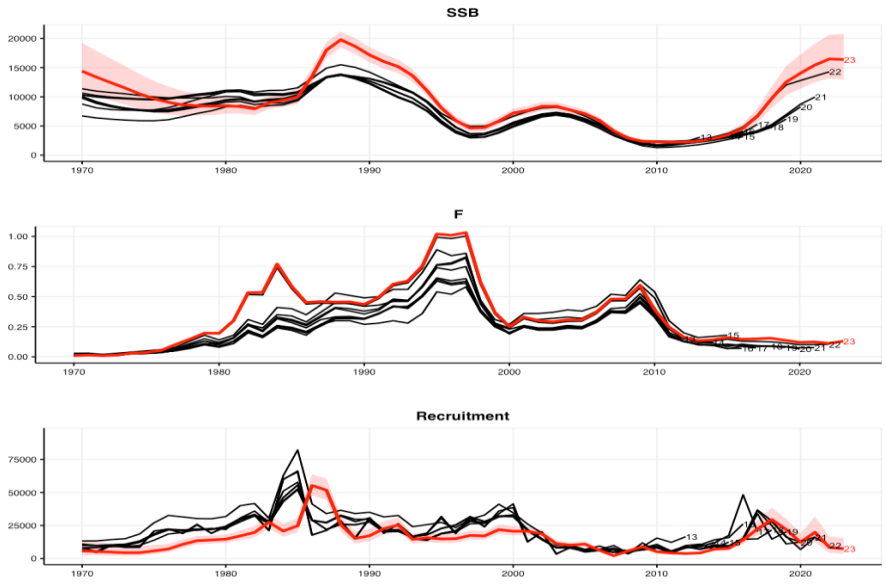

Figure 4.5.1 Historical retrospective of the 1-stock jjm assessment outcomes for SSB, F and Recruitment.

4.7 Connectivity research

99. Document SC11-JM02 details an application for SPRFMO funding to carry out research relating to jack mackerel stock structure and connectivity.

100. To date, one of the sources of uncertainty for the assessment and management of Chilean jack mackerel (CJM) *Trachurus murphyi* relates to its stock identity, as up to five stock structure hypotheses have been proposed, from a single population up to several discrete populations (SPRFMO, 2008; Gerlotto et al., 2012; Bertrand et al., 2016). Clarifying these aspects is of relevance for the assessment and management of the stock(s) and fisheries. A regional multidisciplinary analysis of the different aspects of the life-history of the CJM is proposed, including a scientifically robust sampling scheme, and the integration of factors that may affect changes in CJM abundance, distribution and genetic variability. Furthermore, the estimation of connectivity among possible populations units is critical for assessing the dynamics that occur within the species distribution range, including genetic divergence and adaptation, and improved knowledge of connectivity. To better understand the population structure and variability of CJM for the identification of stocks or population units, three main tasks are proposed: (1) Building on Gerlotto et al. (2012), Hintzen et al. (2014) and Cadrin et al. (2023), carry out a desk study in order to compile all available existing knowledge and data on the species and the stock identity issue, in order to identify the sources of information related to population structure and connectivity; (2) Develop a genetic research program, in accordance to what a genetic workshop could discuss and more specifically propose, including the analysis on NGS (Next Generation Sequencing) techniques like whole genome sequencing; and, (3) Develop a multidisciplinary research approach to tackle the gaps identified in the desk study.

101. This multidisciplinary project may include the analysis of different aspects, including genetic analyses, life-history, age and growth, habitat, migration, parasitology, trophic ecology, amongst others, for the interpretation of the population structure in a holistic approach, as well as through uniform sample sizes, protocols, analysis criteria along the species distribution. The expected duration of the project is 5 years, and the estimated total cost is NZ$ 1,567,428, of which the equivalent of NZ$ 967,428 (equally provided by Peru and Chile) would be in-kind contributions from participating members and NZ$ 600,000 are being proposed for SPRFMO funding. The task group on CJM connectivity updated the SC and sought endorsement of its research proposal (SC11-JM02).

102. The SC supported the proposal and:

> **recommended** the Commission consider funding this research, in the amount of NZ$ 600K.

4.8 Ageing research

103. Document SC11-JM05 *Ageing update of CJM and estimation of age error Matrix* was presented by Chile. Catch-at-age data is crucial for Chilean jack mackerel (*Trachurus murphyi*) stock assessment. Chilean Jack mackerel age estimation have proven to be a difficult task, which has led to many studies in order to establish and validate otolith reading protocols (FIPA 2014-32, FIPA 2017-61, FIPA 2021-21). As a result, a new otolith reading protocol has been proposed, based in micro-increment readings and bomb radiocarbon to validate annuli interpretation (Cerna et al. 2022). Age estimation errors can lead to errors in the estimation of catch and stock weights at age, maturity at age, and any age-structured catch-per-unit-effort (CPUE) indices. Hence, age-reading problems may influence virtually all the assessment inputs (Reeves 2003). To address this issue, an age error matrix is used in stock assessment to weigh the probability that a fish of “true age” is wrongly assigned to one of the observed classes (Vitale et al 2019). As consequence of the change in the otolith reading protocol, the jack mackerel age error matrix has been updated.

104. The SC discussed the need for an age-reading workshop. One was tentatively scheduled for November 2023. However, Members indicated being unable to make funds available to support this workshop. A new date will be sought for 2024. Many Members indicated interest in this workshop and the **SC noted** that Terms of Reference need to be developed. Meanwhile, online meetings should be organised to develop the ToR. Working with invited external experts, the **SC noted** that the project should focus on a unified protocol and establish agreements regarding the methodology for this species. Then based on unified protocol, further workshops should be organised.

4.9 Advice to the Commission on jack mackerel

105. The SC prepared the 2023 advice to the Commission including updates to the workplan.

106. Advice on jack mackerel stock status at this meeting was based on stock assessments conducted using the Joint Jack Mackerel (JJM) statistical catch-at-age model, as developed collaboratively by participants since 2010. The jack mackerel stock(s) in the southeast Pacific show(s) is estimated at approximately the same stock size as in 2022 at around 16.4 million tonnes and is considered to be exploited sustainably (i.e., fishing mortality well below F_{MSY}) and its biomass is estimated to be well above B_{MSY}.

107. In conformity with the approach by the SC since 2012, a comparison was made between the 1-stock and 2-stocks model configurations. Both models showed similar trends with similar overall biomass levels, and a decline in recruitment in recent years. Fishing mortality remains low and below F_{MSY}.

108. The **SC noted** that the stock is estimated to be in the third tier of the harvest control rule. Within the third tier of the harvest control rule, catches should be limited to a fishing mortality of F_{MSY} which would be expected to result in catches in 2024 of 4,934 kt (noting this expected catch is more than 4 times the current catch levels and likely due to inflated F_{MSY} estimates from strong selection on older fish). However, according to the directive of the Commission to the SC (COMM3, Annex C), a maximum change in the catch limit of 15% should be applied relative to the TAC of the current year.

109. In line with the accepted rebuilding plan (i.e., "Adjusted Annex K") and because the jack mackerel biomass is estimated to be above B_{MSY}, the SC:

> **recommended** for 2024 a 15% increase of the 2023 TAC, throughout the range of jack mackerel, at or below 1,242 kt. This advice for catch limits in 2024 does not depend on the stock structure hypothesis that is used.

110. The **SC noted** that under most catch scenarios evaluated, catches are expected to show a decline after 2024 (refer to Annex 7).

111. Other catch scenarios are presented in Table 4.8.1 including among others a TAC increase up to 20%. The SC furthermore discussed the impact of Banking and Borrowing (BaB, i.e., TAC roll-over) quota from one year to the next and:

> **recommended** banking and borrowing to be evaluated within the management strategy evaluation (MSE) to test the impact on long-term risk to overexploitation. It was noted however from international experience that BaB is usually considered riskier when the stock is at or below B_{MSY}. The SC noted that conservation concerns associated with a potential Commission decision to implement BaB for 2024 were considered negligible for jack mackerel if the BaB limit was constrained to be a small percentage of the quota (e.g., up to 10%).

112. The **SC noted** the development of the MSE for jack mackerel and that results presented here should be considered preliminary. Over the course of 2022 and 2023 much progress has been made and preliminary management procedure evaluations show that constant catches at around 750,000 t annually would result in modest decline in stock size and maintain the stock in healthy conditions. Scenarios associated with higher annual catches, such as 1 million tonnes, would result in stock size declines to around 10 million tonnes, still above the 2023 estimate of B_{MSY}.

113. The SC:

> **recommended** that Member scientists:
>
> a. Work closely with the technical group to continue the development of all aspects of the MSE and in specific the operating model (OM) and management procedures (MP);
>
> b. Confer with stakeholders and managers on the preferred performance indicators to evaluate MPs; and
>
> c. Provide working documents specifying how this first implementation of JM MSE framework could be improved so that the Commission could review some preliminary candidate MPs before their 2024 meeting.

114. The **SC noted** the work presented at SC11 on the spatial distribution of jack mackerel and chub mackerel, showing its relationship with temperature anomalies such as El Niño and La Niña. Similar to many other fish species prefers jack mackerel certain temperature ranges which leads to shifts in their distribution due to these temperature anomalies. The impact of climate change on jack mackerel are not well understood yet, and may, in addition to changes to their distribution, also change the connectivity of jack mackerel in the region.

115. It is therefore that the SC:

> **recommended** to continue the research on the spatial distribution of jack mackerel in relation to climate change and annual temperature anomalies such as El Niño and La Niña.

116. An overview of the advice provided by the SC, the management decisions by the SPRFMO Commission and the estimated catch by year has been compiled in Annex 6. This Annex demonstrates that the advice from the SC has been taken up by the Commission.

Table 4.9.1 Catch scenarios from the 1-stock assessment model

Catch Scenario	Catch 2024 (kt)	Catch 2025 (kt)	B_{2025}	P($B_{2025} > B_{MSY}$) %	B_{2029}	P($B_{2029} > B_{MSY}$) %	B_{2033}	P($B_{2033} > B_{MSY}$) %
F = 0	0	0	18415	100	20915	100	22109	100
F = F_{2023}	1280	1405	16058	100	14450	97	14537	94
F = F_{MSY}	4880	3807	10866	94	7766	45	7432	40
F=F_{2023} x 0.75	973	1100	16594	100	15599	98	15756	96
F=F_{2023} x 1.25	1579	1684	15551	100	13491	94	13539	91
TAC = TAC_{2023}	1080	1207	16255	100	12377	95	11013	83
TAC = TAC_{2023} +15%	1242	1367	15470	100	11821	92	10515	79
TAC = TAC_{2023}+20%	1296	1419	15377	100	11646	91	10361	78

4.10 Other jack mackerel matters

117. There were no other jack mackerel topics discussed.

5 Deepwater

5.1 Review of intersessional activities

118. Participants were invited to table the results of intersessional Deepwater activities or research that are required for the SC workplan and not covered by the sub-items below.

119. Work on deepwater issues was largely progressed through New Zealand's South Pacific Working Group (SPACWG), with participation by other interested stakeholders. Submitted papers were first discussed during two preparatory web meetings, occurring on Aug 21/22 and Aug 22/23 of 2023.

5.2 Deepwater assessments

120. New Zealand prepared SC11-DW06, which assesses the potential impacts of carrying forward the orange roughy total allowable catch (TAC) on orange roughy populations, the footprint of the fishery and the overlap of the footprint with predicted abundance distributions for VME indicator taxa. This work was completed to fulfil the task "evaluate the orange roughy population and wider ecosystem impacts of carrying forward of Total Annual Catches (TACs) over multiple years" (COMM-WP17). Simulations were run to evaluate the impact of taking catch annually or alternatively accumulating catch every second, third of fourth year, with intermediate years having no catch, on orange roughy populations and the fishing footprint. The simulation for the orange roughy population revealed that the stock status is very unlikely to be impacted by taking accumulated catches in alternating years. The paper notes a number of assumptions inherent in the fishing footprint simulation, most notably that the fishing footprint simulation outcomes are dependent on historical fishing records and that the more fisher behaviour changes from past behaviour, the greater the likelihood that historical fishing patterns are not a valid predictor of future fishing. In addition, that modelling of the footprint was necessarily conducted by sampling from historical fishing records without replacement and that if modelling had been done with replacement there would be no difference between the annual catch and accumulated catch scenarios. It was found that, on the basis of the assumptions made, the accumulation of catch limits over two, three, or four years, may increase the overall fishing footprint and relative impact on VME indicator taxa depending on how future fishing activity takes place; however, the total impact of this on the predicted abundance of VME indicator taxa has not been determined.

121. Relative to SC11-DW06, the SC noted:

a. Simulation outcomes are dependent on historical fishing records and fisher behaviour and may not reflect future fisher behaviour. The more fisher behaviour changes from past behaviour, the greater the likelihood that historical fishing patterns are not a valid predictor of future fishing.
b. Modelling was necessarily conducted by sampling from historical fishing records without replacement. If modelling had been done with replacement there would be no difference between the annual catch and accumulated catch scenarios.
c. The analysis of ecosystem impact used a relative measure of impact, and it has not been determined if estimated increases in relative impact on VME indicator taxa would correspond to significant adverse impacts on VMEs.
d. The effects of catch accumulation on non-target fish species have not been considered in this analysis.
e. While the analysis used data from both New Zealand and Australian fisheries, it is considered to be more reflective of New Zealand fishing patterns.

The SC agreed that:

f. Orange roughy stock status is very unlikely to be impacted by taking accumulated catches in alternating years.

g. Accumulation of catch limits over two, three, or four years, may increase the overall fishing footprint and relative impact on VME indicator taxa depending on how future fishing activity takes place; however, the total impact of this on the predicted abundance of VME indicator taxa has not been determined.

5.3 VME Encounters and benthic bycatch

122. New Zealand prepared SC11-DW09, which provides an update on the SC multi-annual workplan subtask to develop an ID guide for benthic bycatch, following the steps proposed in SC9-DW12. The paper introduces assessments by taxonomists and para-taxonomists of the taxonomic resolution at which taxa reported in Annex 2 of SC10-DW06 should be included within the ID guide (to improve data quality while avoiding misclassification), noting that there remain several taxonomic groups for which assessments are yet to be completed (i.e., Zoantharia, Leptothecata, Bivalves and Gastropoda). Additionally, the paper also identifies several additional taxa that should be included within the ID guide, based on their known occurrence within the SPRFMO evaluated area. It is suggested that list of taxa reported in Annex 1 of SC11-DW09 is used to begin populating the ID guide.

123. DSCC stated that some questions raised during the preparatory web meeting were not answered, specifically, whether the guide will be applicable outside of the SPRFMO Evaluated Area (CMM 03), for example in the potting fishery on the Foundation Seamount chain. The Cook Islands noted that the Classification guide for potentially vulnerable invertebrate taxa in the SPRFMO Area is already being used in their fishery in this location and has agreed to provide data and cooperate where they can with this study.

124. Relative to SC11-DW09, the SC:

a. Noted that assessments by taxonomists and para-taxonomists of the taxonomic resolution at which taxa reported in Annex 2 of SC10-DW06 should be included within the ID guide has been undertaken, although there remain several taxonomic groups for which assessments are yet to be completed.

b. Agreed that the list of taxa provided in Annex 1 is used to begin populating the ID guide[1].

125. New Zealand prepared SC11-DW10, which includes an update on the SC multi-annual workplan subtask to develop a process to review all recent and historical benthic bycatch data to determine the ongoing effectiveness of the spatial management measures. The paper introduces updated results to help identify broad-scale patterns of VME indicator taxa bycatch following the methodology presented by SC10-DW03 (and accepted by the SC), but with reference to the modified Bottom Trawl Management Areas (BTMAs) proposed by Australia and New Zealand in SC11-DW05 to protect a minimum of 70% suitable habitat for modelled VME indicator taxa. The updated results provide an evaluation of the effectiveness of proposed modifications to the BTMA boundaries in avoiding opening areas to fishing where there has historically been a high frequency of interactions with VME indicator taxa or large bycatch events (likely due to the potential presence of VMEs). SC11-DW10 also proposes a methodology to guide finer-scale spatio-temporal assessments of VME indicator bycatch using example filters to identify focal BTMAs. The application of the proposed methodology identified areas where historic large bycatch events have occurred with no subsequent fishing following the bycatch event (e.g., in the North Louisville FMA) and areas where the encounter protocol would have been triggered repetitively, had the encounter protocol been in place at the time (e.g., in the Central Lord Howe – East

[1] To the extent practical, this guide could be used outside of the Evaluated Area.

BTMA). The paper proposes that work is undertaken to develop filters to help identify areas of interest to management, where additional consideration may be required.

126. The SC discussed the value of VME bycatch that should be used to identify cells of interest. An alternative to the value used in this study (100 kg) was not identified. It was **agreed** that it was the role of the SC to recommend bycatch filters for consideration by the Commission.

127. DSCC noted that the paper only uses data since 2008 as historic bycatch and that more than 30 thousand tows occurred prior to 2008, and these aren't analysed in this report.

128. Relative to SC11-DW10, the **SC noted:**

a. That metrics describing the spatial distribution of historic bycatch of VME indicator taxa have been updated with reference to the modified BTMAs proposed by Australia and New Zealand in SC11-DW05 to protect a minimum of 70% of suitable habitat for modelled VME indicator taxa.

b. That the updated BTMA boundaries presented in SC11-DW05 close some areas where there has historically been fishing events with high levels of VME indicator taxa bycatch, particularly within some of the West Norfolk, Central Lord Howe, Northwest Challenger, Central Louisville and South Louisville BTMAs.

c. That per-cell analyses have been developed to evaluate temporal patterns of fishing effort and associated bycatch of VME indicator taxa.

d. That there is a need to agree how to filter bycatch metrics to identify BTMAs and cells within BTMAs to which per-cell analyses should be applied, and that this should be guided by management objectives.

129. Relative to SC11-DW10, **the SC:**

recommended:

a. That work be undertaken by the SC to agree bycatch filters to identify BTMAs and cells of interest to notify the Commission.
b. Within these cells, the per-cell analysis described in this paper is applied to identify cells where additional management consideration may be required.

130. New Zealand prepared SC11-DW05, which describes proposed modifications to the boundaries of the Bottom Trawl Management Areas established under para 14 and Annex 4 of CMM 03-2023 to allow the Commission to apply a minimum of 70% protection of suitable habitat for each modelled VME indicator taxa, as required under para 19 of CMM 03-2023. The paper provides an overview of previous work undertaken to develop scenarios that encompass protection levels of 70%, 80%, 90%, 95% for the modelled VME indicator taxa, and the genesis of para 19 in CMM 03-2023. Modified Bottom Trawl Management Area boundaries are presented for five Fishery Management Areas (FMAs) (West Norfolk, Central Lord Howe, Northwest Challenger, Central Louisville, and South Louisville) where the 70% protection target is not currently achieved. The proposed boundary modifications achieve the 70% protection for all modelled VME taxa with > 1% of their distribution within each FMA; however, they result in an estimated loss of historical fishing value ranging between 15% and 87% per FMA, with an approximate 47% reduction in the total area open to fishing across all FMAs. The paper recommends that the proposed boundary modifications are adopted by Commission to satisfy requirements in para 19 of CMM 03-2023.

131. HSFG asked for clarification on decision rules for closing 70% of protected areas and stated that the sensitivity considering depths over 1,400 meters as protected from impacts (in SW11-DW01_rev1 Table H2) was updated in the revised paper. HSFG claimed that it was still improperly specified. HSFG stated that Commission decision is clear that the performance of spatial management measures to protect 70% "shall occur at the FMA scale"; it does not say "at the FMA scale excluding depths greater than 1400 m". HSFG pointed out that if depths greater than 1400 m are considered protected, we will see that the 70% protection requirement is already being met for every taxon in every FMA, except perhaps for a single stony coral taxon on the Lord Howe Rise.

    a. The WG Chair clarified that the base-case results for these analyses, as considered by the Commission over the past two years, have always been fishable depths because there is not much information below 1,400 meters.
    b. DSCC stated that with this approach, vulnerable areas are not being adequately protected.

132. Relative to SC11-DW05, the SC

    a. **Noted** that the performance of the modifications to the boundaries of the Bottom Trawl Management Areas (BTMAs) has been assessed against all currently accepted VME indicator taxa habitat suitability models.

    b. **Noted** that the modifications to the boundaries of the BTMAs to meet a 70% protection target, as presented here, substantively reduces access to areas of historic fishing value in five of nine Fishery Management Areas.

    c. **Agreed** that the report on the performance of modifications to the BTMA boundaries is appropriate, with respect to requirements under paragraphs 19 and 39 of CMM 03-2023.

    d. **Recommended** that the Commission applies a minimum of 70% protection of suitable habitat for each modelled VME indicator taxon, within each FMA, as required under para 19 of CMM 03-2023, by adopting the modifications to the BTMA boundaries as presented in SC11-DW05.

    e. **Recommended** that geographic information system (GIS) shape files of the modified BTMA boundaries are submitted to the SPRFMO Secretariat if adopted by the Commission.

133. New Zealand prepared SC11-DW07, which includes an update on the SC multi-annual workplan subtask to develop abundance models for VME indicator taxa. The paper presents spatial predictions of density for 15 VME indicator taxa, based on a data-driven approach using observed abundance data (DTIS) that has previously been endorsed by the SC; and 4 VME indicator taxa, based on a principles-based approach using expert knowledge that has previously been endorsed by the SC (although further work is required to fully assess the appropriateness of this approach). It also presents spatial prediction of relative density for 1 VME indicator taxa based on the vector-autoregressive spatio-temporal (VAST) modelling framework (an approach New Zealand has not previously trialled within the SPRFMO context), showing promising results. Despite the promising results shown by the models developed using the data-driven approach, more observed abundance data (DTIS), particularly in data-limited Fishery Management Areas, are required to perform a full evaluation of the models using independent data. SC11-DW07 presents a trial method to develop VME indices that quantify the vulnerability of VME indicator taxa to physical disturbance using taxon-specific abundance and presence data, showing promising results. SC11-DW07 also presents an update on the SC multi-annual workplan subtask to investigate the relationship between benthic bycatch and predictions of density of VME indicator taxa included in the paper, with no significant correlation found for any of the modelled taxa.

134. HSFG recommended that before spending money on new data collection, to use power analysis to determine the sample size that would be required to make the results significant, and asked about the possibility to test the power of prediction models if data are withheld. HSFG stated that the only way to validate the predictive power of a spatial model is by withholding data during model fitting and then testing the ability of the model to predict the observations that were withheld. When this was done for the new abundance models, the resulting loss of model power (SC11-DW07 Table 3) was a clear sign that these models are over-fitted. It is likely that the HSI models currently being used in the implementation of CMM 03 are also over-fitted, but validation of the HSI models using withheld data has not been done, despite repeated requests via the SPACWG.

135. New Zealand responded that a drop in predictive power is expected with this approach when data are withheld, but the results would be representative given the conditions tested. New Zealand noted that they had responses to the HSFG questions and comments on the Deepwater papers and their issues should be discussed with further model developments and testing.

136. Relative to SC11-DW07, the SC noted that:

a. Spatial predictions of density for 15 VME indicator taxa, based on a data-driven approach using observed abundance data (DTIS) that has previously been endorsed by the SC, have been completed, showing promising results.

b. Spatial predictions of density for 4 VME indicator taxa, based on a principles-based approach using on expert knowledge (RES) that has previously been endorsed by the SC, have been completed, but further work is required to fully assess the appropriateness of this approach.

c. Spatial prediction of relative density for 1 VME indicator taxon based on the VAST modelling framework has been completed, with promising results.

d. A method to develop VME indices that quantify the vulnerability of VME indicator taxa to physical disturbance using taxon-specific abundance and presence data has been trialled, with promising results.

e. The future availability of further imagery data would help facilitate spatial predictions of density for a greater number of VME indicator taxa with increased robustness.

137. Also, from SC11-DW07 the SC:

recommended that:

a. where feasible, that additional data is collected from areas of interest to management (e.g., FMAs) to better inform model development and validation.

b. additional independent data, ideally providing a better coverage of the Evaluated Area, is compiled to perform a full evaluation of the density models.

c. once density models have been fully evaluated, and if considered to be adequate to inform management decisions, they are:

    i. Incorporated into the ongoing review of the effectiveness of the spatial management arrangements.

    ii. Used to quantify the vulnerability of VME indicator taxa to physical disturbance.

5.4 Bottom fishery impact assessment

138. New Zealand and Australia prepared SC11-DW01_rev1, which describes the Cumulative Bottom Fishery Impact Assessment for Australian and New Zealand bottom fisheries, 2023. This updates the previous BFIA (SC08-DW01_rev1) submitted in 2020. The BFIA provides a description of management arrangements and fisheries, the status of main stocks, ecological risk assessments of demersal teleosts and deepwater chondricthyans, fishery interactions with marine mammals, reptiles, seabirds and benthic habitats, a risk assessment of benthic habitats and performance of management measures. Risk assessments for teleost and elasmobranch species are anticipated in the SC Multi-Annual Workplan in 2024. For orange roughy, available stock assessments have concluded the stocks are likely above limit biomass reference points. Elsewhere, a minimum pre-fishing biomass has been estimated and precautionary catch limits are in place. Captures of marine mammals, seabirds and reptiles are rare. It has not been possible to update the risk assessment of benthic habitats, but previous analysis, which should be considered conservative as it does not account for recent reductions in catch limits, suggests the equilibrium status of most VME indicator taxa in most areas is qualitatively favourable. Revised or new HSI models are available for all VME indicator taxa identified in Annex 5 of CMM 03-2023 and have been used to evaluate the performance of current (CMM 03-2023) and proposed (SC11-DW05) spatial management measures (for taxa where > 1% of their predicted suitable habitat is within an FMA). Over 70% of suitable habitat for modelled VME indicator taxa is within areas closed to fishing in four of the nine FMAs (exceptions are West Norfolk, Central Lord Howe, Northwest Challenger, Central Louisville and South Louisville), but all VME indicator taxa meet this target in all FMAs under the proposed modifications to bottom trawl management areas.

139. DSCC recommended that the joint BFIA be rewritten and re-presented next year because there is a need to consider cumulative impacts.

140. HSFG asked for clarification on what is intended when it is asserted that the BFIA has been updated and represents the best science available; does this refer to the RBS or to the 'percent protected' analysis? Australia responded that it includes broad impact assessments, not only benthic, and that the text explains which analysis have been updated and which haven't.

141. HSFG stated that the 'percent protected' method as part of BFIA does not comply with requirements to provide an impact assessment and that the Relative Benthic Status (RBS) analyses have not been updated, violating the requirements of the Bottom fishing Impact Assessment Standard (BFIAS) and CMM 03.

142. HSFG stated the outdated RBS results in the current report are overestimating effort such that actual impact would be 2-6 less than estimated in the report. HSFG noted that proposed area closures are unrelated to estimates of impact and equilibrium VME status.

143. HSFG noted that, even neglecting to update the analysis or correct these acknowledged biases, the outdated RBS results demonstrate that VME status is high for every VME indicator taxon in every SPRFMO FMA: in six of nine FMAs, equilibrium status of every VME indicator taxon is higher than 95%. Only a single taxon in a single FMA has an RBS value lower than 80%. On this basis, HSFG asserted bottom fishing impacts are not high enough to constitute 'Significant Adverse Impact' under any existing international precedent.

144. Australia agreed that some of the issues raised have substance, although uncertainty is well described in SC11-DW01_Rev1. However, managers are not bound to use a single approach to evaluate fishing impact to make informed decisions and that the Commission decided that percent protected should be used as the basis for designing spatial protection to prevent future SAIs on VMEs. HSFG requested that the peer-review of the BFIA referred to in the meeting is shared, if available.

145. Finally, HSFG requested Members to review presentations related to this topic, which can be found in the Teams site (SC11_Obs01 and SC11_Obs02).

146. Relative to SC11-DW01_rev1, the SC

a. **Noted** that the BFIA includes both an impact assessment (RBS) and an evaluation of levels of protection offered by current and proposed spatial management.

b. **Noted** that it has not been possible to update the RBS, and the available analysis included in the BFIA does not reflect recent reductions in catch limits and so provides a conservative estimate of equilibrium status (i.e., it will overestimate impact and underestimate status).

c. **Agreed** to update the quantitative benthic impact assessment component of the 2023 Cumulative BFIA for 2024, using a method consistent with the requirements of the BFIAS.

d. **Noted** that there is currently a lack of a scientific underpinning for defining ecologically appropriate reference points for VME status or protection, but that research exploring thresholds for significant adverse impacts (SAIs) for VMEs at different spatial scales is underway.

e. **Noted** that the SC will update its multi-annual workplan to guide work to reduce uncertainties in risk assessments for benthic habitats and VMEs.

f. **Agreed** that the cumulative BFIA provided by Australia and New Zealand represents: the best science available to the SC at the current time; provides a sound basis for formulating management advice to the Commission; meets international standards (such as the FAO Deep-Seas Guidelines) and complies with the SPRFMO BFIA Standard and, consequently, **accepts** the BFIA.

g. **Agreed** that the impacts of bottom fisheries on target and non-target fish stocks are appropriately assessed under the SPRFMO assessment framework **noting**:

   i. for orange roughy, where stock assessments have been concluded the stocks are likely above limit biomass reference points. Elsewhere, a minimum pre-fishing biomass has been estimated and precautionary catch limits are in place;

   ii. for other target species caught in SPRFMO demersal fisheries, workplans are being developed for stock structure delineation studies, which may inform future assessment and management;

   iii. for non-target and bycatch (discarded) species, ecological risk assessments have been undertaken to categorise these species into the SPRFMO stock assessment framework and prioritisation of species estimated to be at high and extreme relative risk from fishing has been undertaken.

h. **Agreed** that captures of marine mammals, seabirds, reptiles and other species of concern are rare in midwater trawl for bentho-pelagic species and bottom trawl fisheries and appears to be rare in bottom line fisheries but **requests** bottom fishing Members to collaborate to develop a framework for providing precautionary advice on such captures;

i. **Agreed** that, with respect to impacts on benthic fauna and VMEs:

   i. the habitat suitability models have high statistical skill in classifying suitable VME taxa habitat. However, there is great uncertainty in translating model outputs to estimates of abundance of VME taxa on the seafloor, as well as issues of potential model over-prediction leading to over-optimistic estimates of protection for some taxa;

   ii. the estimated footprints of midwater trawls for benthopelagic species and demersal line gears are orders of magnitude lower than those for demersal trawl gears and are thought to represent a low risk to VME status and habitat protection;

iii. the equilibrium status of most VME indicator taxa in most areas is qualitatively favourable across a range of sensitivity analyses, furthermore, the analysis has not been updated to reflect a lowering of catch limits, and so should be considered conservative (i.e., it will over-estimate impact and under-estimate status), although there is a high level of uncertainty;

iv. under current management measures (CMM 03-2023) over 70% of Habitat Suitability for most VME indicator taxa within an FMA is within areas closed to fishing, but this reference point is not met for some taxa, particularly within Northwest Challenger, Central Louisville and South Louisville;

v. under management measures proposed to be adopted by Commission in 2024 (70% scenario in COMM10-Inf03) all VME indicator taxa with > 1% of their HSI within an FMA have at least 70% of habitat suitability within areas closed to fishing.

147. HSFG prepared a paper commenting on perceived procedural anomalies regarding the prepared BFIA and proposed changes to CMM 03 relative to the requirements in CMM 03-2023 (SC11-Obs01). The HSFG expressed concern that the prepared BFIA does not meet the SPRFMO Bottom Fisheries Impact Assessment Standard endorsed by the Commission in 2019, as the percent protected analyses does not represent an impact assessment.

148. The HSFG also prepared a technical response to the BFIA in SC11-Obs02. They expressed concern with the transparency and rigor of the process underpinning the 2023 BFIA. They noted that only the Relative Benthic Status (RBS) outputs meet the definition of an impact assessment under the Bottom Fisheries Impact Assessment Standard, and the RBS was not updated, but instead results from 2020 were presented. They pointed out that the results over-estimate impact and under-estimate VME status, due to an over-estimation of fishing effort. Further, they suggested that because they do not estimate impact or make reference to 'Significant Adverse Impact', the 'percent protected' analyses used to inform the re-design of the BTMAs are insufficient to meet the requirements of the BFIAS, CMM 03, FAO Deep Sea Guidelines, or the UNGA resolution.

149. DSCC provided comments to the Cumulative BFIA in SC11-Obs05 and suggested that the joint BFIA be rewritten and re-presented next year to address the matters identified. They noted that the 2019 Benthic Fisheries Impact Assessment Standard states that the purpose of the assessment is to provide a standardised approach for assessing cumulative impacts of bottom fishing activities on VMEs, deep sea fish stocks and marine mammals, reptiles, seabirds and other species of concern. They argued that none of the matters identified in the Standard are addressed in the BFIA, including matters such as whether impacts will be cumulative with previous impacts in the area; the fact that the frequency of the impact will influence the risk, with activities occurring repeatedly at a site likely to have a greater risk; non-fishing impacts; sustainability concerns, particularly for low productivity species from cumulative impacts, and the importance of evaluating impacts individually, in combination and cumulatively.

150. The DSCC noted that redrafting the BFIA should include assessing cumulative impacts of bottom fishing activities on VMEs, stocks and other species of concern, applying the precautionary and ecosystem approaches, taking into account all bycatch information and applying the requirements of the UNGA resolutions, the FAO Deep Sea Guidelines and the SPRMO Convention. Regarding procedure, the DSCC suggested that in the future, the SC recommends to Commission that responses to the BFIA consultation be put on the website, including any response to submitters, in the interests of transparency.

5.5 Advice to the Commission on Deepwater

151. The SC evaluated paper SC11-DW05, *Modification of Bottom Trawl Management Area Boundaries to Achieve a 70% Protection Target for VME Indicator Taxa* and:

> **recommended** to protect 70% of suitable habitat for each modelled VME indicator taxon, within each FMA, as required under para 19 of CMM03-2023, that the Commission adopt the modifications to the BTMA boundaries as presented in SC11-DW05.

152. The SC evaluated the cumulative BFIA (SC11-DW01_rev1) and:

> a. **agreed** that the cumulative BFIA provided by Australia and New Zealand represents: the best science available to the SC at the current time; provides a sound basis for formulating management advice to the Commission; meets international standards (such as the FAO Deep-Seas Guidelines) and complies with the SPRFMO BFIA Standard and, consequently, **accepts** the BFIA.
>
> b. **recommended** that the quantitative benthic impact assessment for the 2023 BFIA is updated in 2024, using a method consistent with the requirements of the BFIAS.

153. The SC evaluated paper SC11-DW06 *Evaluating the orange roughy population and wider ecosystem impacts of carrying forward of TACs over multiple years*, and **advises** the Commission that:

> a. orange roughy stock status is very unlikely to be impacted by taking accumulated catches in alternating years.
>
> b. accumulation of catch limits over two, three, or four years, may increase the overall fishing footprint and relative impact on VME indicator taxa depending on how future fishing activity takes place; however, the total impact of this on the predicted abundance of VME indicator taxa has not been determined.

154. A number of Workplan items were progressed during the year and the 2023 Workplan was revised with the updating of dates and removal of items where work was complete. New items for the Workplan included:

a. Updating the quantitative benthic impact assessment for the 2023 BFIA in 2024, using a method consistent with the requirements of the BFIAS.

6 Squid

6.1 Review of intersessional activities

155. Supported by the Secretariat, the Squid Working Group held 4 intersessional web meetings between June and August 2023 (reports G91-2023, G104-2023, G111-2023 and G124-2023) prior to the 11th meeting of the SPRFMO Scientific Committee. These meetings focused on squid stock assessment and genetics studies. With regards to the stock assessment, Chile, China and CALAMASUR presented progress and/or results on model development and stock status of the jumbo flying squid. The progress on stock assessment development was mainly in the areas of CPUE, modelling, and updating of the fishery data, with a focus on sharing timely fishery data needed for the stock assessment. Based on data-sharing practice, members as well as the observer involved in assessment modelling (CALAMASUR) agreed to sharing monthly catch, effort, CPUE and weight-length information among the Squid Working Group participants to support stock assessment. In addition, Peru gave presentations on nominal abundance indices in the SPRFMO area and biological information of distribution area of different phenotypes, spawning areas, and seasons in the Peruvian waters.

156. On the genetics and connectivity studies, Chile and Peru presented research on squid genetic population structure, and China also presented their progress. This research focused on mtDNA analysis (ND2 and COI), however, there were different views on genetic differences and/or potential stock structure. The Squid Working Group noted these different views and agreed to: 1) sharing DNA sequence data; 2) using uniformed methodologies and techniques for genetic analysis for consistency; 3) working together to submit an mtDNA analysis report to SC12. Furthermore, the Squid Working Group Chair, Dr Gang Li, organised a small group during SC11 meeting to discuss next work plan and protocol for genetics study as well as allocation of voluntary contributions from China. The new protocol for the genetics study will focus on SNPs. The Squid Working Group agreed on sampling, detailed methodologies, and DNA data sharing, and agreed to submit stock structure and genetic diversity report to SC13 (2025).

157. The Squid Working Group Chair suggested that the new proposal (SC11-WP02, submitted by Peru) be discussed at agenda item 6f, adopted as an annex to the report and added to the workplan as an activity going forward. This recommendation was supported by CALAMASUR, Chile and the Environmental Defense Fund (EDF).

6.2 Squid assessment data (including effort)

158. The Secretariat presented paper SC11-SQ01 which contained a review of the data holdings by the Secretariat and a summary of statistics on vessel activity and fishing effort from annual reports submitted by Members.

159. With respect to data sharing activities, it was noted that the use of standardised data templates that include catch, effort, CPUE and mean length-weight data to satisfy a surplus production model would be beneficial. Peru noted their willingness to share data and to discuss progress on the use of a data template and data repository, further proposing the inclusion of additional data fields and for other delegations to contribute to this dataset. Chile supported the use of standardised data templates and noted several templates already being used for several stock assessment model approaches. The SPRFMO Secretariat Data Manager notes that now is a good time to receive this information (regarding updated data templates) as they are going through the process of reviewing and refining their data management platforms.

160. The SC noted the importance of regularly reviewing the data needs and data templates to inform stock assessments and new information is available and assessment approaches are developed.

161. The SC Chair confirmed that a working group should develop and draft a standardised data template, including the relevant updates and data fields, to be reviewed; and noted that the template can continue to be developed as the stock assessment model improves or changes.

162. Peru presented SC11-SQ03 titled "Determination of size ranges by phenotypic group of *D. gigas* in Peruvian waters, based on the size-maturity analysis". It is known that in the area of distribution of *D. gigas* in the Southeast Pacific we can find up to three population groups with different biological characteristics. However, population assessment exercises of *D. gigas* in the Southeast Pacific are being carried out considering the hypothesis of a single stock, since up to now there is no robust information available during the 2000s that allows these groups to be separated geographically. In this sense, this document presents fragmentary information from investigations carried out in waters off Peru and Chile outside 200 nm and shows evidence that shows biological differences of *D. gigas* in the coast-ocean direction. In addition, it presents how to separate these groups, for which mention is made of the need to collect biological information in fishing areas outside 200 nm.

163. Peru presented SC11-SQ04, providing commentary on estimates of natural mortality of jumbo squid *Dosidicus gigas*. This document presented values of natural mortality in *D. gigas* from various studies to date, highlighting the high variability of among estimates, which is associated with the methods used, time periods and spatial areas. Because the natural mortality parameter has an influence on potential yield, optimal capture, among other outputs, it is emphasised that its estimation must be as robust as possible, and in the case of jumbo flying squid, the existence of population subgroups must be considered.

164. Methods to determine the squid's stage of maturity were discussed. While the colour of the mantle is relatively easy to obtain it is also more subjective and the determination of maturity based on analysis of the gonads is more robust.

165. The SC noted the importance of considering the natural mortality estimates in a stock assessment model and discussed how natural mortality can be estimated. Peru noted that the squid have a very specific life history, and that natural mortality is more related to age at maturity than to the weight of the squid.

6.3 Genetics and connectivity

166. SC11-SQ02, was prepared by Chile to describe the genetic population structure and genetic diversity of *Dosidicus gigas* along the Pacific Ocean. Species with high connectivity usually lack genetic differentiation at regional scale, but isolation by distance may generate genetic differentiation along species distribution. In this study, they tested the genetic population structure of *Dosidicus gigas* along the Pacific Ocean, considering sample sites from Ecuador to southern Chile and sequences from Genbank from Alaska to Chile. To achieve this objective, they sequenced one mitochondrial gene (COI). The analyses of these markers indicated that all the studied localities in Ecuador, Peru and Chile, as well as the region as a whole, are characterised by low genetic diversity. Conversely, the localities in northern hemisphere from Alaska to Panama showed higher genetic diversity. Furthermore, two genetic units were recognised, corresponding to northern and southern hemisphere localities. Therefore, their findings suggest the presence of two genetic units of *D. gigas* along the Pacific Ocean, and this spatial genetic structure is associated with isolation by distance model.

167. Peru prepared document SC11-SQ06 on the population genetic analysis of the *D gigas* along its distribution range based on mtDNA ND2 gene. The jumbo flying squid is a straddling species widely distributed in the Eastern Pacific Ocean, where it sustains coastal and high seas fisheries of great commercial importance. Several markers have been studied to understand its population genetics throughout its distribution range, as well as its population structure and related phenotypic size-groups. In this sense, a population genetic analysis based on the mtDNA ND2 gene analysis is presented with the aim to (a) reevaluate the genetic differentiation among organisms for the three phenotype sizes-groups collected in different latitudinal and longitudinal geographic areas along Peruvian jurisdictional

waters; and (b) evaluate the population genetic structure of the species along its wider Eastern Pacific distribution range. After evaluating the presence of stop-codons in the aligned sequences obtained according to our sampling design in Peruvian jurisdictional waters, pairwise Fst analysis showed significant differences, mainly between central oceanic (medium and large phenotype size-groups); while group comparisons done with AMOVA showed a significant difference between coastal and oceanic groups. This was also observed with SAMOVA, where a differentiation among coastal and oceanic groups (Fct and Fst p values < 0.05) was recorded, also related to the large phenotype group. On the other hand, when sequences of organisms collected in our study and in those of others from southern hemisphere (n=594) were compared with those of organisms from the northern hemisphere (n=239), a clear and significant discrimination was observed with SAMOVA analysis (Fct and Fst, $p < 0.05$) between both groups. The median-joining haplotype network showed two main haplogroups formed by the southern organisms, while different small haplogroups for the northern organisms were observed.

6.4 Standardise biological sampling

168. Protocols for biometric and biological sampling of *Dosidicus gigas* to be used in SPRFMO, have been proposed in SC11-SQ05. This document describes the methods used by Peru for artisanal fisheries to obtain biometric and biological data on the jumbo flying squid *D. gigas* and aims to establish guidelines for the collection and recording of this information.

169. Peru highlighted the acceptance of Annex 4 in CMM 16-2023 and discussed an alternative observer program to adapt for vessels less than 15 m in length. In response to questions from China, Peru noted that their analysis estimated the frequency of mantle lengths in groups of five was done for operational reasons; and that measurements of the length of testes are performed in the laboratory noting difficulties in obtaining exact lengths due to the size of the testes. CALAMASUR noted that Peru presented a very complete biological sampling program but noted the absence of information from statoliths. Peru confirmed that this analysis hasn't been undertaken and that due to the short life span and fast growth of squid, age may not be a good indicator of stock status. It was noted that resolving the age dynamics between the different phenotypes will go a long way to understanding the squid stock.

170. Chinese Taipei noted that Annex 4 in CMM 16-2023 is only applicable to Peruvian fleets and suggested that there should be a focus on standardised data to ensure that all Members can provide the same agreed data. The proposed protocols measure maturity stages that differ from the stages agreed at SC08 and this is important for standardisation. The Squid Working Group Chair suggested that the proposed protocols should use the accepted maturity stages agreed in 2020; and that body weight should be reported in grams where practical. Peru suggested further discussion to agree on standardised biological sampling protocols.

6.5 SC11 advice to COMM12 on appropriate level of observer coverage

171. The SC discussed the current progress towards providing advice to the Commission on an appropriate level of observer coverage under CMM 16-2023, noting key limitations in understanding the observer requirements for compliance, biological sampling and bycatch rates. The United States stated that the observer coverage requirement of the CMM is unclear and thus it is difficult to determine if it is being met. The requirement for "5 full-time at-sea observers" is very different from the other requirement of "5% of fishing days observed" noting that, for example, the observer report from China indicated that, just as last year, 5 full-time observers covered less than 1% of fishing days. With respect to bycatch, current literature suggests that 20% of fishing effort is an acceptable minimum level of coverage for quantifying bycatch; but to adequately estimate the true frequency of rare events, the coverage level should be higher. The US further suggested that a coverage level of 10%, which is currently

implemented in the jack mackerel and deepwater longline fisheries, might be a reasonable level to start with.

172. The United States proposed conducting a pilot study to increase observer coverage for a period of time (e.g., 3 years) to obtain the necessary data to quantitatively assess an optimal level of observer coverage. The proposal was broadly supported by several Members and observers, highlighting the need to ensure biological samples are representative by both vessel and geographically; and to first understand and empirically validate actual bycatch rates before an appropriate level of coverage is determined.

173. Several concerns were raised by China and Chinese Taipei, noting that the squid fishery is a very targeted fishery with very low levels of bycatch, the current level of biological sampling is very high, and there are several other mechanisms in place for monitoring (e.g., VMS and transhipment monitoring). It was noted that squid vessels always operate during the night which further mitigates risks to seabirds; and from 2018 to present there has been no seabird bycatch in the squid fishery.

174. Both China and Chinese Taipei in general do not oppose the conduct of research on bycatch under the guidance of the SC, noting that bycatch rates are low due to the unique fishing practices within a squid fishery and specific research may not be scientifically justified. Chinese Taipei further suggested the need for consistency in how the level of observer coverage is calculated across members. The US noted that even if bycatch is rare, there is still a low tolerance for even a low number of seabirds (for example) being caught.

175. As an alternative to increasing the observer coverage, China suggested the use of electronic monitoring (EM) to enable a squid fishery to meet the scientific and compliance requirements. The applicability of EM was raised, noting the complexity in developing an EM framework to review squid fishing footage and the development of a standards-based program. ACAP have produced a series of guidelines for the use of EM in fisheries but noted that this doesn't currently consider squid jigging methods. If warranted, further work could be undertaken by ACAP to expand these guidelines to include squid jigging. In combination with EM, the use of artificial intelligence (AI) technology may provide significant benefits to data collection protocols in the future but would initially require considerable development and training and is not directly relevant to the bycatch issues.

176. Many Members recommended that the Squid Working Group explore the possibility of a pilot program that would temporarily increase the level of observer coverage to determine the level of observer coverage required to 1) quantify the characteristics of the jumbo flying squid stock, and 2) to reliably estimate the frequency of bycatch events for species of concern. Such a program should be spatially and temporally representative for quantifying the characteristics of the squid stock, but could focus on the areas where the strongest overlap of the distribution of species of concern with the squid jigging fishery exists. Ideally, a progress report from this undertaking should be presented at SC12.

177. The SC noted that they have added to their workplan the task to explore the possibility of a pilot program on observer coverage levels. However, that plan was not supported by all Members and China submitted a statement available as Annex 10.

6.6 Assessment progress and CMM development

178. Chile presented SC11-SQ07 on an update of the Stochastic Production model in Continuous Time (SPiCT) apply to *D. gigas* in the FAO area 87. Recommendations for short-lived squid stock assessment include depletion models with several recruitment pulses, however, this kind of model requires a fine time scale to correctly identify the depletion events and the arrivals of new pulses of recruitments. In-season stock assessment and in-season management seems to be hard to implement for *D. gigas* in the SPRFMO area. Payá (2022) did a first attempt to apply the Stochastic Production model in Continuous Time (SPiCT) to *D. gigas* in FAO area 87, with a sensitivity analysis. Three cases analysed estimated low intrinsic growth rates (r) than the expected for a fast-growing and short-life species, and their values depended on the production model used. The aim of the present document was to update the application of SPiCT to *D. gigas* in the FAO87 area, and to evaluate: the impact of fitting the model to one global abundance index or to several indices by country; the impact of fixing the Schaefer model; the use of more informative r prior distribution; and the impact of initial year in the data. More informative r priors were defined using r values for the same or similar squid species. Seven cases were analysed to evaluate the effect of different abundance indices, productive curves, and r priors. The population growth parameter estimations were improved by r priors and by the change in the initial year. The Biomass and F did not have any important retrospective pattern, while Biomass/B_MSY and F/F_MSY did. Stock status was highly uncertain, but the stock seems to be overfished. The TAC at F_{MSY} ranged from 473,000 (case 5) to 636,000 (case 6) tonnes. Further analyses are required to improve the abundance indices and to include different phenotypes in the analysis.

179. There remains difficulty in incorporating different intrinsic growth rates, carrying capacity and production curves of the three squid phenotypes. The population growth parameter estimates have been improved. Abundance indices still need to be improved. All cases estimated the squid stock with an overfished stock status on the Kobe plot, but with high uncertainty due to process errors and variability in the target reference point.

180. The stock status results were questioned by Peru, which have demonstrated different model outputs and stock status results. China suggested that the k parameter may be being underestimated and that this should be checked against the absolute biomass to determine how much squid biomass is being estimated by the model, noting some presented results which indicated that the catch is larger than the biomass, which is unlikely to be accurate.

181. Chile presented additional information on a “squid simulator” to test the different model approaches that could be applied to the squid fishery. Previous iterations of the simulator have been presented to SC before. Chile proposed to continue the development of simulator making additional improvements including: the consideration of multiple phenotypes, and population dynamics on a finer resolution time scale. It was further noted that the population dynamics may also be considered within the different phenotypes. The variability of phenotypes and the proportion of phenotypes in the model can inform some of the environmental and age-structure dynamics within the squid stock. China suggested that basing the simulator on the surplus production model would be more appropriate than the population dynamics models.

182. The SC suggested that a repository of information be provided for this work and:

> recommended posting this to GitHub (or similar), making it available for other members to view, use and contribute to this work.

183. Peru proposed a simulated assessment task group (ASTG) for jumbo flying squid. Due to the complexities in the population structure of jumbo flying squid, there is a need to create a task group to consider the simulated data, different phenotypes, uncertainty and the range of stock assessment model approaches. The proposed TORs (refer to Annex 8) include the generation of simulated data, protocols to compare candidate models and reporting results to the SC. The time to deliver the proposed simulation work is short and the task group will require a Chair, external experts and workshops to facilitate discussion and technical progress. China suggests that the simulation work should be implemented alongside MSE testing, noting that this proposal is a step in the right direction to doing MSE and agreeing on an operating stock assessment model for this stock.

184. EDF provided support for the development of these simulations and urged Peru and the proposed simulation working group to use this opportunity to explicitly examine the population dynamics of squid in response to climate variability and change.

185. The SC noted it would be valuable to use the simulations to determine the thresholds of El Niño intensity and other climate variables that induce population declines and contribute to the stock fluctuations. A deeper understanding of these mechanisms and the development of specific climate indicators that relate to stock status is going to be necessary to provide climate-ready management advice to the Commission in the future.

186. The SC noted that climate is likely to have more immediate impacts, either positive or negative, on squid which is a short-lived stock, and that at this early stage it may be difficult to incorporate specific climate change indices, but these may be still captured initially under broader environmental variability.

187. The SC agreed that the working paper be included as an annex to this report (Annex 8); that climate change parameters be included in the TOR; and the Assessment Simulation Task Group (ASTG) for jumbo flying squid be formed and added to the SC workplan, noting that the work may ultimately extend progress towards MSE testing an operating model. SC Members were encouraged to share models and simulations.

188. China presented their paper SC11-SQ08 on developing state-space biomass dynamics model with different time steps to assess the jumbo flying squid in Southeast Pacific Ocean. The CPUEs of China's squid-jigging fishery were standardised by the assumption of following a gamma distribution and used as relative abundance indices. Bayesian state-space surplus production models were employed to assess this stock from 2012 to 2021, taking into account annual and monthly data, as well as environmental conditions (El Niño and La Niña). Furthermore, we consider utilising three different CPUEs in the assessment model due to the differences in operating methods and regions in Peru, Chile and China.

189. In the annual model, the stock has never been overfished and overfishing. In El Niño or La Niña years, K, MSY, and B_{MSY} increased, while the intrinsic rate of increase (r) decreased during El Niño conditions but increased during Niña years.

190. In the monthly model, stock biomass exceeded 0.3 B_{MSY} but fell below B_{MSY} in some months (mostly August-December during 2017-2021 except 2019). Fishing mortality remained much lower than F_{MSY} regardless of environmental impacts, indicating no overfishing. The cause of this result still needs to be further studied.

191. The fishing mortality rate set at F2021 (0.366~0.667) and 1.5F2021-12 (0.046~0.073) were optimal for the future jumbo flying squid stock. In any given catch strategy, monthly biomass would rise and recover to B_{MSY}. There is uncertainty in the actual process of population dynamics, which can be addressed by calculating the biomass that takes into account environmental impacts based on predicted Oceanic Niño Index. In addition, short-term management decision for jumbo flying squid should attempt to set various levels of monthly fishing mortality based on life history characteristics.

192. CALAMASUR presented SC11-Obs03 on the regional assessment of the jumbo flying squid in the South-Eastern Pacific with Peruvian, Chilean and Asian fleets data and Impacts of El Niño environmental cycle: 1969 to 2021. The jumbo squid fishery is the largest invertebrate fishery in the world and one of the largest even when including finfish fisheries. In the South East Pacific Ocean (SEP) it is fished in four regions: (i) Ecuadorian, (ii) Peruvian and (iii) Chilean exclusive economic zones (EEZ), and (iv) international waters west of those EEZs. In international waters, the main operators currently are China, Chinese Taipei and South Korea. During the last two years, the jumbo squid Working Group of the South Pacific Regional Fisheries Management Organisation (SPRFMO) has led efforts to build standardised databases for regional stock assessment with contributions from all SPRFMO Commission Members fishing the jumbo squid in the SEP. We present here a stock assessment methodology and its application to a database built by CALAMASUR through these collaborative efforts. This methodology consists of two stages. At stage 1, a database of catches, fishing effort and mean weight of squids in the catch was built to apply multi-annual and multi-fleet depletion models at monthly time steps covering the period of January 2012 to December 2021 for Chilean, Peruvian and Asian fleets. This part of the methodology followed the advice of a review article recently published by experienced cephalopod fisheries scientists. At Stage 2, a generalised surplus production utilised (i) the total annual landings across the SEP from 1969 to 2021 and (ii) predicted monthly biomass and its standard error from the depletion model (stage 1) using a hierarchical statistical inference framework to fit parameters of the population dynamics and biomass productivity of the stock. At stage 2 the assessment took into account the El Niño environmental cycle in the SEP with models having time-varying parameters. NOAA's ENSO index was used to define six environmental phases during our study period. Time-varying parameters on each phase led to eight alternative hypotheses describing increasingly complex changes in the carrying capacity of the environment, the symmetry of the production function, and the intrinsic rate of population growth.

193. Results of the multi-annual, multi-fleet depletion models at stage 1, show adequate fits with satisfactory residuals and quantile diagnostics. Natural mortality was estimated in 1.9393 per year with good statistical precision. Recruitment has been decreasing for the Peruvian fleets, increased substantially in 2016 for the Asian fleets, and despite a high value in 2014, has remained the lowest for the Chilean fleets. Biomass has wide intra-annual fluctuations, with maxima near March which is 10 times the size of the minima around September, but it has remained fluctuating about a constant mean. Fishing mortality is much lower than natural mortality and has been increasing in recent years, with the annually aggregated exploitation rate (catch ÷ escapement biomass) close to 40% in latest years.

194. Results of the time-varying parameters surplus production model at stage 2 support the hypothesis that only the carrying capacity varies between environmental phases although hypotheses that included changes in the intrinsic rate of population growth also had substantial support and may become best supported as the database to fit the depletion model grows to include the data from fishing in 2021 and onward. Parameters of the best supported hypothesis were estimated with good precision, but the biomass dynamics had wide error bands due to only nine years of data to fit the depletion model. Despite fluctuations and strong impact of the environmental cycle, landings are fairly lower than biomass even when considering the observed wide intra-annual fluctuations. Due to fluctuations, the MSY and B_{MSY} are not adequate reference points. Overall, results of both the depletion model as well as the surplus production model indicate that the stock is being harvested in a sustainable manner, not over-fished and not undergoing over-fishing. However, wide intra-annual fluctuations in biomass might be a matter of concern for managers of the jumbo squid stock in the SEP.

195. Results from this stock assessment methodology can be improved by extending the times series of catch, effort and mean weights up to 2022 from Asian and Peruvians fleets. Completion of the Ecuadorian database would also help providing the methodology with more data and spatial comprehensiveness. We discuss our results with a focus on the ecological drivers underpinning population functioning and abundance fluctuations in the jumbo squid stock under different phases of the environmental cycle.

196. CALAMASUR presented a number of key points to consider to progress this work including: updated data from Peru and Ecuador; better definitions of the time scales of the environmental cycles which should be agreed within the working group; the development of depletion models that take into account such environmental cycles; and the development of depletion models that have different estimates of natural mortality for each of the three fleets active in the squid fishery.

197. The SC discussed the results of the regional assessment including the minimal influence of variability in the mean weight estimates on the model; how the model allows for recruitment to occur at each time step (month); that the depletion model could incorporate movement of stocks between regions, fleets or phenotypes noting that this would require data with greater temporal resolution which is likely difficult to obtain and likely unsuccessful; that an analysis of escapement biomass is needed; that the stock is likely to fall into a cycle of highs and lows and the fishery will need to adapt to "navigating the fluctuations"; and, that the remains uncertainty where variability in squid catch and landings could be driven by multiple factors such as fishery removals, environmental conditions, fishery dynamics and the relationship between market prices, catch and abundance.

198. It was proposed that the models that have been developed by Chile, China, Peru and CALAMASUR should be made available to the SC (e.g., on GitHub) by Jan 2024.

6.7 Advice to the Commission on squid

199. The SC discussed appropriate level of observer coverage and **noted** the prospects for the application of electronic monitoring for the squid fishery and its development in tuna RFMOs and **advises** that the Commission review the observer coverage considering the percentage of vessels sampled and consider the feasibility for the future development of EM to monitor the squid fishery bycatch in the Convention area.

200. The SC evaluated stock assessment papers from Chile (SC11-SQ07), China (SC11-SQ08) and CALAMASUR (SC11-Obs03), and **noted** the progress made in the stock assessment development for squid. However, there were differences in the perception of stock status among the discussed assessment models. The SC also **noted** that the nominal CPUE increase in the recent 3 years and **advised** its members to continue its efforts to improve methods used to derive abundance indices from CPUE.

201. Therefore, the SC:

> **recommended** that the Commission maintain the current fishing effort limitation levels and exemptions as specified in CMM 18-2023 and **advised** that the SC will monitor CPUE trends and other indicators.

202. The **SC noted** that the assessments reviewed included environmental effects and that El Niño could have near-term impacts on the relative abundance and size of squid.

7 Habitat Monitoring

7.1 Review of intersessional activities

203. The Habitat Monitoring Working Group (HMWG) had two intersessional meetings during 2023 before the 11th SC Meeting in Panama City. The first one was conducted on 17 March to identify the activities to be executed according to the agreed Workplan of the HMWG last year. It was agreed to perform: (1) the 11th Workshop on jack mackerel, chub mackerel and other species of the Peruvian Current of the Humboldt System from June 26th to 30th in Lima; (2) the second virtual workshop of the assessment methods subgroup (held on 13 July); (3) the metadata workshop during the 11th SC meeting in Panama; and (4) the first workshop on the jumbo squid habitat of the Peruvian Current of the Humboldt System (scheduled for 11-13 December 2023 in Lima, Peru).

7.2 Metadata Workshop

204. During the 11th SC meeting, a workshop was conducted by the HMWG to discuss a proposal for metadata associated with acoustic data collected form vessels of opportunity, to monitor habitat and climate change. The workshop discussed information pertaining to available data including spatial and temporal coverage, data source, and the methods/technologies associated with the data generation. The aim of this workshop is to advance habitat monitoring efforts in the context of climate change by leveraging metadata. A key proposal was to adopt the ICES metadata protocol related to acoustic data.

7.3 Indicators from fishing vessels on target pelagic species

205. Peru presented paper SC11-HM01 on abundance of jack mackerel and chub mackerel in the Peruvian sea between 2020 and 2023. In recent years there has been a positive trend regarding an increase of the jack mackerel abundance and availability, that is, an increase towards average levels of abundance in comparison with past decades. Catches in the same period (1983-2023) also show, in general, better fishing performance in years when calculated biomass has been higher. The calculated abundance of jack mackerel, using various stratification methods based on acoustic data collected during the summer 2023, have been given in a range of 53 to 223 thousand tonnes in the areas prospected by fishing vessels only.

206. Also, in recent years there has been a positive trend regarding the chub mackerel biomass, i.e., an increase towards average levels of abundance in comparison with past decades. Catches in the same period (1983- 2023) show, in general, better catches in years when biomass has been higher. The calculated abundance of chub mackerel, using various stratification methods based on acoustic data collected during the summer 2023, have been given in a range of 100 to 750 thousand tonnes in the areas prospected by fishing vessels only.

207. Chile presented paper SC11-HM05 on the spatial distribution and biomass estimate of Chilean jack mackerel off South central Chile 2023. Spatial distribution, mean density and biomass estimates obtained from acoustic data recorded by 5 vessels of the Chilean jack mackerel (CJM) fishing fleet in their usual fishing operations during 2023 are presented and compared with previous years. The abundance calculation was made for 2019, 2020, 2021, 2022 and 2023 based on a completely random sampling design and applying geostatistical method. Acoustic data were obtained with eco-integration systems that allow digital recording of the information during the entire trip of each vessel from the harbour to the fishing grounds and back.

208. Results show a reduction in the spatial distribution of CJM observed between 2018 and 2020, then begin a slight increase in the latitudinal distribution in 2021 and 2022, to finally present a new latitudinal contraction in 2023 where CJM exhibited a particular positioning. In January, distributed between 35° to 36.5° S. However, by February, a noticeable shift occurred as CJM extended to the south, specifically between 38° and 38.5° S. This transition coincided with a gradual increase in its density in the southern area and the decrease in availability at the northern sector of its distribution area.

209. Since January to April of 2023, the average density of CJM was stable, presenting its maximum values in March and February, respectively. It is observed that January shows the highest density compared to previous years. In April of 2023, the CJM abundance and biomass estimated were lower than in 2022, with an abundance of 1.328 million of individuals and a biomass of 1,210,359 tonnes (CV= 17.95%), which represents a decrease of 11.82% and 20.75% in abundance and biomass, respectively. The decrease in the CJM abundance and biomass can be explained because the spatial distribution area of CJM during 2023 was lower too. Considering the size structure of CJM since 2019 to 2023, it is observed that CJM shows an increase in the time towards larger specimens, which has had consequently the sustained decrease in the abundance in the last five years.

210. Finally, a comparison was made between results obtained by the CJM annual hydroacoustic evaluation cruise (systematic sampling) in the south-central zone of Chile from 2017 to 2022 and the hydroacoustic evaluation carried out with data recorded by fishing vessels (random sampling) for the same years in the same zone. Results show a remarkable coincidence using both types of sampling.

211. The SC noted the presentation and associated papers. Discussion followed on how the El Niño-Southern Oscillation contributes to changes in stock distribution, production, and recruitment, with La Niña years corresponding to reduced recruitment.

7.4 Standardised oceanographic data products and modelling

212. Peru presented SC11-HM04 on seasonal oceanographic preferent ranges of jack mackerel habitat off the Peruvian coast between 1992 and 2023. This research focuses on the investigation of oceanographic preferences of jack mackerel (*Trachurus murphyi*) off the Peruvian coast, using catch data from artisanal and industrial fleet over an extended period, from 1992 to 2023. The aim of this study was to describe the preferred oceanographic ranges of sea surface temperature (SST), sea surface salinity (SSS), sea surface height (SSH), chlorophyll concentration (CHL) and Eddy kinetic energy (EKE) for jack mackerel in different climatic of austral seasons using Principal Component Analysis (PCA) and Generalized Additive Models (GAM). In light of our results we observed that the preferred ranges found for summer were: (SST: 19.33-25.62°C, SSS: 34.57-35.38 PSU, SSH: -0.001-0.177 m, CHL: 0.07-7.08 mg/m3 and EKE: 0.005-0.464 cm2 /s2),autumn (SST: 14.83-24.96°C, SSS: 34.69-35.31 PSU, SSH: -0.012-0.213 m, CHL: 0.06-5.91 mg/m3 and EKE: 0.007-0.351 cm2 /s2); winter: (SST: 13.84-21.04°C, SSS: 34.66-35.35 PSU, SSH: -0.013-0.168 m, CHL: 0.09- 0.84 mg/m3 and EKE: 0.013-0.401 cm2 /s2); and spring: (SST: 14.57-23.25°C, SSS: 34.67-35.39 PSU, SSH: -0.020-0.179 m, CHL: 0.16-1.61 mg/m3and EKE: 0.007-0.351 cm2 /s2). GAM results showed that all variables were significant (p-value e<0.05) for all seasons with exception of chlorophyll in summer. In the results of the PCA for all seasons it was found that the variables that have the greatest contribution to dimension 1 were SST, SSS and SSH; SSS ranges were not significantly different. In the biplot analyses it was observed that both summer and autumn have the same correlations between the same group of variables oceanographic, in the same way it happened for winter and spring.

7.5 Species behaviour and preferences

213. Habitat conditions of jack mackerel (*Trachurus murphyi*) and chub mackerel (*Scomber japonicus*) in the Peruvian sea between 2021 and 2023 were discussed in SC11-HM02. An update of the analysis on changes in the habitat of jack mackerel (*Trachurus murphyi*) and chub mackerel (*Scomber japonicus*) has been made, with emphasis on what was observed between summers 2021 and 2023. The summer of 2023 has been characterised by being dominated by negative temperature anomalies until the beginning of February when there was rapid warming of the sea from north to south, up to approximately the latitude of Callao; at the end of February, ENFEN officially announced the development of conditions for the Coastal El Niño. In this context, and regarding the habitat, it was observed that during the summer 2023 the presence of jack mackerel and chub mackerel has again occurred in a typical way, that is, along the fronts between oceanic and coastal waters, unlike the year 2020 in which they were observed in oceanic waters, which was considered unusual at least for that season. From the analysis of the various variables analysed regarding the habitat of these species, it is concluded that there have been different conditions in recent years, where the only parameter analysed that remained within a narrow range is salinity. Another aspect to notice is that both species have been available for fishing in areas with low chlorophyll concentration and with relatively high values of altimetry and sea surface anomaly. In the case of jack mackerel, its main distribution area closer to the coast in the centre-south zone is remarkable, while in the north it was less abundant. In the case of chub mackerel, a latitudinally wider availability was observed compared to jack mackerel.

214. Peru presented paper SC11-HM03 on identifying seasonal patterns in the 3D habitat suitability related to the dynamics of the artisanal fleet of *D. gigas* in the Peruvian area of national jurisdiction (ANJ). The jumbo flying squid is widely distributed in the Southeast Pacific and is affected, like other marine resources, by climate variability at different scales. In the present work, a 3D seasonal characterisation of this resource in Peruvian waters will be carried out. For this purpose, acoustic data from IMARPE's scientific surveys will be used, as well as data from the artisanal fleet. Based on the results, it can be observed that the environmental variability had important variations (sea surface temperature (SST) variance) in the coastal, being more variable during the 1990-1999 and 2010-2022 than in the decade of the 2000-2009. In addition, decadal variations in the sea surface temperature are observed, with warm periods (1990-1999 and 2010-2022) compared to the decade between 2000-2009. In addition, based on the acoustic results, no clear seasonal pattern was observed in the depth of this resource, but a clear nictemeral pattern was observed, with this resource being found up to 400 meters during the day and in the first 50 meters at night. Additionally, it was observed that these decadal variations were also replicated in the dynamics of fishing, with a greater expansion of fishing areas for the last decade (2010-2022) and greater distance from the coast. This shows that environmental dynamics have an impact on fishing dynamics.

215. Chile presented findings on the role of Lagrangian coherent structure (LCS) on the Chilean jack mackerel distribution. The work found a strong relationship between the Finite Size Lyapunov Exponent (FSLE) and jack mackerel distribution, and FSLE is a useful predictor in addition to existing metrics. The SC noted the presentation and discussed the importance of analysing different mesoscale dynamics in relation to the jack mackerel distribution. There was also discussion about how when stock distribution changes over time and the fleet follows the fish, this could result in a sampling bias with respect to LCS. Chile acknowledged this and noted it is working to manage this potential source of bias retrospectively in its analyses.

7.6 Symposium update

216. The habitat monitoring symposium is scheduled for 6-10 November 2023 in Conception, Chile. The goal of the symposium is to share and review current best practices related to habitat monitoring and research in order to better inform ecosystem-based management approaches for marine resources. SPRFMO Members and colleagues are invited and encouraged to participate in this symposium. The HMWG Chairs thanked the US and New Zealand for funding to support the symposium.

217. The symposium proceedings will be published in a special journal issue, and this was added annual work plan.

7.7 Advice to the Commission on Habitat Monitoring topics

218. The SC:

recommended:

a. Adopting ICES metadata convention developed by their “FAST” working group for data management.

b. Conducting a periodic large-scale synoptic ecosystem survey using fishing vessels from Peru and Chile, as survey platforms.

8 Exploratory Fisheries

8.1 Exploratory fishery updates (CK, EU, NZ)

219. The Cook Islands presented SC11-DW12 which covers the most recent data analysis from the Cook Islands lobster and crab trap fishery exploratory fishery. The exploratory trap fishing provided for by Conservation Management Measure CMM 14b-2023 has successfully completed seven trips between 2019 and 2023. New biological information has been collected on lobsters (*Jasus caveorum)* and crabs (*Chaceon* sp.) The key findings are that initially the fishery caught primarily lobsters but when targeting sets below 350m the catch is dominated by crabs. For both lobsters and crabs most of the catch is made up of males (84% and 92% respectively), and that most females were not carrying eggs (in berry). This analysis provided information on population trends and the stock response to fishing and information on bycatch including bycatch of Vulnerable Marine Ecosystem (VME) indicator taxa. The Cook Islands will continue to analyse all data collected as some material is yet to be processed. In addition, to maximise the value of future data collection for both the Cook Islands and the fishing company, we need to gain an understanding of the distribution, dynamics and status of stocks of *J. caveorum* and *Chaceon* sp.

220. The *Chaceon* sp. CPUE is very stable and has not changed appreciably since the inception of the fishery. There are no trends evident for lobsters on most seamounts. However, on Kopernik Seamount, where most of the lobster catch has been taken, the CPUE has declined substantially. As a result of the declines in CPUE the Cook Islands has closed the Kopernik Seamount to lobster fishing as per our pre-agreed management response. A number of amendments have been made to the Cook Islands fishing operational plan these include: the closure of the Kopernik Seamount to lobster fishing; an allowance for longer lines with 200 traps when setting for crabs, that is for sets below 350m; and the inclusion of a risk assessment.

221. The Cook Islands noted that the lobster CPUE dropped below the CPUE threshold of 4kg/trap. As per the Cook Islands' agreed management arrangement in CMM 14b-2023, when that occurs, the Kopernik seamount will be closed to lobster fishing. The closure will remain in place for the remainder of 2023 and beginning of 2024. Consideration will be given to determine under what conditions that Seamount could be re-opened. This includes potential non-extractive fishing to estimate replenishment rates. Crab fishing (below 350m) will be permitted. A new risk assessment was included which includes consideration for teleost and elasmobranch fishes, cephalopods, Species of Special Interest, seabirds and VMEs.

222. The Cook Islands asked the SC under what conditions the lobster fishery at Kopernik seamount could be reopened. Relevant to reopening is whether the stock replenishment is through reproduction or migration.

223. The SC raised concerns that the CPUE had dropped below the minimum 4kg/trip CPUE threshold for fishery closure in 2019 (although this provision in CMM 14b-2020 did not come into effect until May 2020) and expressed concern over stock status.

224. With regard to SC11-DW11_rev1, New Zealand noted that paragraph 7 of CMM 14a-2022 governing Exploratory Fishing for Toothfish by New Zealand-Flagged Vessels in the SPRFMO Convention Area states that the Scientific Committee will review available results from the New Zealand exploratory fishing each year and advise the Commission on progress, including whether any stock indicators show sustainability concerns and what, if any, additional measures might be required to restrict the likely bycatch of deepwater sharks and/or other non-target species. This is the interim report on 2023 activities.

225. The authorised New Zealand vessel San Aspiring carried out a single exploratory fishing trip after our 2022 interim report, with fishing taking place during late March and early April 2023. Unfortunately, due to an issue with microbial fuel contamination the vessel was compelled to return to port prematurely. A total of 13 days were spent within the designated SPRFMO Research Strata, during which five sets were carried out, 15,515 hooks were set following the stipulated cluster design. A catch of 34.4 tonnes of Antarctic toothfish was taken during the trip. Non-target fish catches constituted less than 0.05% (by weight) of the overall catch, mostly consisting of blue antimora and grenadier. As part of the joint SPRFMO/CCAMLR stock assessment programme 135 Antarctic toothfish were tagged. Two tagged toothfish were recovered (one a within-season capture only briefly at liberty). Antarctic toothfish of both sexes were found to be generally in a pre-spawning/developing gonad stage with one male found in a ripe gonad state and three male fish in the spent condition. This is consistent with the previously hypothesised winter spawning. The length frequency of fish sampled during 2023 is broadly consistent with previous records from the area fished. In contrast with previous years when Antarctic toothfish sex ratios have been consistently skewed with males dominating, sex ratios were almost even in 2023.

226. The EU presented SC11-DW14 which covers the results of year 2 out of a 3-year exploratory Patagonian toothfish (TOP, *Dissostichus eleginoides*) bottom longline fishing program in the George V Fracture Zone (CMM 14e-2021). Objectives for the exploratory fishery, fishing vessel and methods, and data collection continued similarly from 1st year (2021) fishing campaign. A total of 32 lines were set over 13 days in 2022 (06-21 October 2022) approximately on the same seamounts as in the 2021 campaign. Total catch weight was 75,991 kg consisting of the TAC of 74,898 kg of TOP, and the remainder as finfish bycatch. Bycatch of each species was less than 1% of the total catch. Catch rates of toothfish and bycatch species varied throughout the area. No seabird mortalities were observed throughout fishing activity by observers or by vessel crew. No marine mammals or reptiles were observed or caught. VME indicator taxa were recovered from 8 out of 32 lines, totalling 4.3 kg and being comprised of small amounts of sea fans/bamboo corals (Gorgoniidae), stony coral fragments (Scleractinia) and a small amount of black coral (Antipatharia). Seabed video indicates patchy rock and silty sand habitat with low abundance and diversity of VME indicator taxa. A total of 380 TOP was tagged, equating to a rate of just over 5 tagged fish per tonne. Three tagged TOP were recovered that were originally tagged in the GVFZ in 2021. All three fish were recovered on the same seamount from which they were released. Two tagged TOP were recovered that were originally tagged in the Macquarie Ridge fishery, bringing the total number of Macquarie tagged fish recovered to 6. A total of 1,007 TOP individuals were sampled by the scientific observers, comprising 286 females and 721 males, and recording reproductive stage of all sampled fish. A total of 318 sets of otoliths were collected, and 29 tissue samples for genetics. In addition, biological data were recorded for all bycatch species. TOP data will be used for biomass estimation and improved understanding of the *Dissostichus eleginoides* stock and management in this under-studied region of the Southern Ocean.

227. With regard to the Cook Islands' exploratory trap fishery, the SC:

a. **noted** that in late 2022 and early 2023 the fishery continued for 1.5 months despite the precautionary CPUE threshold limit been exceeded prior to being closed;

b. **noted** that preliminary assessments indicated that the resource biomass has declined substantially and that fishing mortality is estimated to be high.

c. **noted** that Kopernik seamount has been closed to lobster fishing, and requested that in 2024 non-extractive test fishing be undertaken to evaluate the extent to which the stock has replenished;

d. **recommended** that the preliminary surplus production model for lobster (or any alternative modelling approach) be reviewed;

e. **agreed** to the proposed changes for the Cook Islands trap fishing FOP;

f. **accepted** the amendment to allow for longer lines with 200 traps to be used when setting for crabs, that is for sets below 350m;

228. The SC:

accepted the exploratory fishery updates from New Zealand (SC11-DW11_rev1) and the European Union (SC11-DW14).

8.2 New exploratory fishery proposals (AU, CK, EU)

229. The Cook Islands presented a proposal for a new Fisheries Operation Plan (FOP) (SC11-DW02_rev1), targeting *Polyprion oxygeneios* using dropline and/or jig fishing gear. This fishery will take place as an adjunct to the ongoing Cook Islands lobster trap fishing explorations. The objective of this new FOP is to test the fishery potential of *P. oxygeneios* and collect and provide the scientific data for evaluating the sustainable exploitation of the population(s) found on the fishing areas within the SPRFMO Convention Area. The data collected will be made available to assess any potential impacts on the target species, associated or dependent species, and the marine ecosystem, and to evaluate any mitigation measures that may be required. Data collection will include evaluations of the geographical range of the target species, evaluations of the biology of the target species and the documentation of VME encounters. The proposal includes an annual (calendar year) total allowable catch of 500 t, with a 25 t per seamount limit and 15 t per seamount per trip limit. The stated objective of the fishery is to explore the fishery potential of *P. oxygeneios* to sustain a commercial fishing operation in the Foundation Seamount Chain and the Northern Seamounts. The proposal includes an interim target reference point of 40%B_0 and an interim limit reference point of 20%B_0. These reference points will be monitored as a change from the initial CPUE ($CPUE_{init}$) rate which we will equate with B_0.

230. DSCC proposed that the northern seamounts be excluded from the proposal as this included the biodiversity hot spot of Salas y Gómez ridge which is being researched by Chile for marine protection.

231. A risk assessment was included which includes consideration for teleost and elasmobranch fishes, cephalopods, Species of Special Interest, seabirds and VMEs.

232. Members expressed concern over the precautionary nature of the proposed total allowable catch (TAC) of 500 t with 25 t limit, per seamount and year, the spatial extent including the Nazca Ridge seamount chain, the number of seamounts to be targeted and the proposed reference points. After some clarifications from the presenter and further discussion by the SC, a TAC of 500t with 25t seamount limit was considered sufficiently precautionary by the SC but more detail on the implementation would be appreciated by Members. Given the lack of knowledge on the area it was unclear how many seamounts would be targeted assuming that there are many seamounts in the area, of which, several may be considered features with an area of several hundreds of square kilometres. Given the longevity of the species, precaution was advised and genetic sampling together with bomb radiocarbon age validation for this species could lead to improved stock size estimates. The Cook Island agreed to provide more information on the estimated number of seamounts if available before the Commission meeting.

233. On the basis of this discussion, the SC:

a. **noted** the Cook Island proposal and its Fisheries Operation Plan for an exploratory dropline/jig fishery for Hapuka (*Polyprion oxygeneios*)

b. **recognised** the scientific benefits of the proposed data collection;

c. **approved** the Data Collection Plan included in the proposal;

d. **advised** the Commission that the proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2023 (bottom fisheries), and the BFIAS.

234. Australia presented their proposal for New Exploratory Fishery SC11-DW03. The purpose of this paper is to provide information on the elements set out in CMM 13-2021 Management of New and Exploratory Fisheries in the SPRFMO Convention Area for an application for an Australian vessel to undertake exploratory fishing on the Macquarie Ridge for Toothfish species (*Dissostichus* spp.). As required by CMM 13-2021 the current paper contains a Fisheries Operational Plan outlining the target species, proposed fishing method and gear, proposed timeframe of fishing and a preliminary data collection plan for the proposed exploratory fishing. Proposed activities will occur from 2024-2026 on the Macquarie Ridge Continuation Research Block (MRC RB), in the SPRMFO area between the Macquarie Island EEZ and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) boundary (see SC11-DW03, Figure 1 – Map). The proposed fishing occurs outside the established SPRFMO bottom fishing footprint and contains a risk assessment of bottom fishing in the proposed area as required by CMM 03-23 Bottom Fishing in SPRFMO Convention Area.

235. The SC discussed the Australian FOP and noted that there was no spatial separation in sets proposed. Such a separation would ensure fishing effort to be spread over a larger fishing area. Australia considered this point in a revision of the FOP, where spatial separation of all sets was included. No further comments were made regarding this FOP.

236. On the basis of this discussion, **the SC**:

a. **noted** Australia's proposal and its Fisheries Operation Plan for an exploratory demersal longline fishery for toothfish
b. **recognised** the cautious, exploratory nature of the proposal;
c. **recognised** the scientific benefits of the proposed data collection, especially for understanding the distribution, movement, spawning dynamics, and stock structure of toothfishes and supporting the CCAMLR stock assessment models for toothfish;
d. **approved** the Data Collection Plan included in the proposal;

e. **advised** the Commission that the proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2021 (bottom fisheries), and the BFIAS.

237. The European Union presented a proposal for New Exploratory Fishery SC11-DW04. The European Union (EU) wish to apply for a second exploratory fishing program for Patagonian/Antarctic toothfish (*Dissostichus eleginoides* and *D. mawsoni*) in the SPRFMO Convention Area. This application contains the elements established by CMM 13-2021 on the Conservation and Management Measures for the Management of New and Exploratory Fisheries. This proposal includes the Fisheries Operation Plan, including area, target species, proposed fishing methods, fishing gear, period and a preliminary data collection plan for the exploratory fishing activities to be undertaken during 2024-26 in FAO area 57.4 (SC11-DW04, Figure 1), and which falls under the SPRFMO jurisdiction. The proposal also identifies the relevant elements of CMM 03-2023 on Bottom Fishing in the SPRFMO Convention Area, notably an assessment of bottom fishing activities outside the established footprint, and a risk assessment following the Bottom Fishery Impact Assessment Standard (BFIAS) (2019).

238. On the basis of this presentation, **the SC**:

a. **noted** the EU proposal and its Fisheries Operation Plan for an extension of the exploratory demersal longline fishery for toothfish;

b. **recognised** the cautious, exploratory nature of the proposal;

c. **recognised** the scientific benefits of the proposed data collection, especially for understanding the distribution, movement, spawning dynamics, and stock structure of toothfishes and supporting the CCAMLR stock assessment models for Antarctic toothfish;

d. **approved** the Data Collection Plan included in the proposal; and

e. **advised** the Commission that the proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2021 (bottom fisheries), and the BFIAS.

8.3 Catch composition research

239. The Species Composition Task Group reconvened in 2023 to update analyses presented to SC10 (SC10-Doc13) in 2022 with additional historical data provided by the Russian Federation. SC11-Doc11 provides updated analyses, based on similar methodologies presented in 2022, to evaluate the catch composition and fishing patterns of SPRFMO fishing activities targeting jack mackerel, alfonsino, or redbait. Using a combination of exploratory analyses, hierarchical clustering, and generalised additive modelling, the task group has concluded that there are fishing activities in SPRFMO generally grouped under the 'jack mackerel fishery' that have characteristics suggesting they are in fact different fishing modes, and they represent activities that fall outside existing Conservation and Management Measures (CMMs). Modes of fishing have generally been characterised by species composition, fishing depth and gear depth from the bottom, and spatial location of fishing activities. The task group has highlighted the need to improve upon those provisions in the existing CMMs and to perhaps revisit CMM 13 to clarify the conditions under which a fishery is a new and exploratory fishery and under what conditions fishing activities outside of those explicitly managed through quotas (or effort limits) are permitted within SPRFMO. It has recommended that the SC consider prioritising the species of interest, similar to the tiered system developed for deepwater species, and develop workplan tasking to address these needs.

240. The SC:

a. **noted** this paper;

b. **agreed** that the provisions in existing CMMs should be improved upon to clarify the conditions under which a fishery is a new and exploratory fishery and under what conditions fishing activities outside of those explicitly managed through quota (or effort) limits are permitted within the SPRFMO Convention Area;

c. **recommended** that stocks affected by current fishing practices should be considered for future stock assessments, even if data-limited (with a specific focus on chub mackerel).

8.4 Assessment development for species that are bycaught or subject to targeted fishing

241. Mariano Gutierrez, co-Chair of the Habitat Monitoring Working Group (HMWG) presented on SC11-HM02 relating to the habitat preferences of jack and chub mackerel from Peruvian fishery-dependent data. Peru notes that chub mackerel is not bycatch as it has been the target of a directed fishery for decades. It was noted that although the two species have different habitat preferences, chub generally being distributed more to the north in colder waters, as compared to jack mackerel, they two species are often caught together in mixed schools of similar fish sizes. The SC noted a variety of environmental conditions are associated with shifts in biomass of these species, and there has been an increase in chub mackerel observed in the same areas of jack mackerel. More discussion is expected to take place at the upcoming habitat monitoring symposium to be held in Chile in November.

242. Paper SC11-HM01 described abundance estimates of jack and chub mackerel using acoustic data collected during fishing operations and geostatistical models. Biases and limitations of these analyses were presented, as the data are collected via preferential sampling of fishing vessels. In addition, it is understood that jack mackerel scatter more easily when approached by vessels, as compared to chub mackerel, thereby creating potential biases in the relative abundance estimates between the two species. Future activities plan to explore the use of sonar, with a broader view of the underwater environment, as compared to the acoustics in use at this point. This work is ongoing. The SC discussed the possibility of fish avoidance with the acoustic surveys and the need to consider sonar capabilities and different analyses (i.e., function of density). It was discussed that there is no specific CMM for the chub mackerel fishery and that it could be useful to better understand the stock structure of chub mackerel compared to jack mackerel, including the relationship (if any) between chub mackerel found in the South Pacific and the North Pacific.

243. The SC noted the need to address the increase in chub mackerel bycatch in the jack mackerel fishery. This appears to be responsive to environmental and oceanic conditions.

244. The SC:

> recommended to perform a large-scale ecosystem synoptic survey across the most productive areas of the South Pacific to contribute to the development of IPCC models and to track the possible trajectories of animal biomass in the main zones.

8.5 Redbait fishery precautionary approach

245. Regarding the development of redbait stock assessment, Members reported that redbait catch was very low in 2022 (no redbait catch reported by the European Union; 45 t reported by the Russian Federation) and 2023 (not yet reported). There are no plans to fish for redbait in the near future, and to develop a stock assessment, data on redbait from several countries over several adjacent years would be required.

246. Noting that recent SPRFMO analyses indicated that it is possible to target redbait specifically, thus the SC:

> recommended that any future targeted fishery for redbait should be undertaken as part of an agreed exploratory fishery.

9 Climate Change

247. The United States presented SC11-Inf01. The SC Multiannual Workplan specifically tasks the SC to "identify key area and management implications of climate change on VMEs and main fisheries in the SPRFMO Area". The United States solicited feedback for development of this information paper in Circular G89-2023 and this paper contains summarised responses from three Members and one Observer. The paper (SC11-Inf01) includes the summarisation of feedback on how the SC can develop a comprehensive climate change strategy for SPRFMO that includes prioritising related research, understanding the impact of environmental changes on species' populations, anticipating shifts in habitat distributions, analysing trends in response to ongoing climate change, assessing the implications on management performance, devising robust future decision-making processes, and identifying and addressing gaps in data collection or analyses. Responses included examples from another RFMO that may be applied to fisheries management within SPRFMO's jurisdiction, some specific ideas for climate-related research within the SPRFMO Convention Area, and a specific example of research conducted in a Member's EEZ that could be applied to the SPRFMO Area.

248. The SC discussed the importance of incorporating and prioritising climate related data and information into SPRFMO scientific and management processes. A variety of research has been and is being conducted by Members and other regional bodies and notably the SEAPODYM model was discussed as a possible tool for SPRFMO to consider using in the future to forecast environmental effects due to climate change and incorporate these into stock assessments.

249. Members and Observers were appreciative and supportive of the proposal to elevate the importance of incorporating climate change into the work of the SC. The DSCC, EDF and CRHS prepared statements in support of this topic, which are included in Annex 10.

9.1 Analyses and data collection programmes to illustrate impacts of Climate Change

250. With respect to developing climate change related analyses and products, one Member noted that SPRFMO should avoid duplication of effort and work to collaborate with other RFMOs on this topic. For example, the WCPFC uses the SEAPODYM model which covers the entire Pacific and was used previously (2014) to tune the jack mackerel model for the MSE and for the spatial assessment model to project biomass under different climate change scenarios.

251. The SC noted that it would be beneficial to promote greater data sharing among Members, generally, to support more holistic spatial modelling of stock dynamics in SPRFMO.

252. Chile and New Zealand noted that they have been working with oceanographic models, and that more work is needed to improve habitat monitoring in the South Pacific and to explore changes under different climate scenarios. Chile reiterated support for a synoptic ecosystem survey to ground truth these models and to monitor changes in species distributions.

253. The SC:

a. noted the information paper.

b. recognised the importance of climate change and how climate change data is related to fishery resources managed by SPRFMO.

c. appreciated the intervention from the Environmental Defense Fund (EDF) regarding their work to develop tools to improve fisheries management decision-making in the context of climate change and welcomed their offer to hold a side event on this work at the 12th Commission meeting.

254. The SC:

> **recommended** that the Habitat Monitoring Working Group develops an inventory of available climate-related data and existing models applicable for SPRFMO fisheries and identifies any gaps.

9.2 Management implications of climate change on habitat and fisheries in the SPRFMO Area

255. Chile presented a statement (refer to Annex 10) recalling that one of the most effective approaches to address climate issues in fisheries is nature-based solutions, including the ecosystem protection and restoration as a critical step to enhance the ocean as a carbon sink and to increase ocean resilience to other threats, as well as an instrument for adaptation. In this regard, one of the areas identified as critical for the health of the South Pacific are the Salas & Gómez and Nazca Ridges.

10 Other Matters

10.1 Data Working Group Update

256. The Secretariat prepared SC11-Doc12 to update the SC on data-related activities over the past year. The paper detailed the progress associated with switching data service providers and migrating the central SPRFMO database, the activities of the Data Working Group, and highlighted data prioritisation needs and planned activities to address them.

257. The **SC noted** the paper and **supported** the continuation of the data working group.

10.2 Review of the SPRFMO Seabird Bycatch and Data Standards CMMs Against ACAP Advice

258. The Eleventh Meeting of the SPRFMO Commission (COMM11) tasked the Scientific Committee (SC) with reviewing the seabird bycatch mitigation measures in CMM 09-2017 and the seabird related data collection requirements in CMM 02-2022 against the Agreement on the Conservation of Albatrosses and Petrels (ACAP) Best Practice Advice. SC11-Obs04, prepared by ACAP, provides such a review and identifies a number of proposed amendments to the relevant SPRFMO CMMs to achieve more complete alignment to ACAP advice. A brief update on the activities of ACAP since COMM11, including updates to ACAP Best Practice Advice made at its Thirteenth Advisory Committee Meeting is also provided:

259. Relative to SC11-Obs04, the **SC**:

a. **Noted** that while sections of CMM 09-2017 and CMM 02-2022 are consistent with ACAP advice, some inconsistencies remain; therefore, a number of amendments have been proposed to achieve more complete alignment and help enable SPRFMO to achieve its objective outlined in Article 3(1).

b. **Agreed** to convene a workshop to prioritise and draft the proposed amendments to CMM 09-2017 and 02-2022 as recommended in SC11-Obs04.

10.3 Crosscutting issues

260. Crosscutting issues were centred around climate changes and workplan tasking for the different working groups. The SC workplan has been updated to reflect the additional tasking.

10.4 Appointment of officers

261. The positions of SC Chairperson, vice-Chairperson, and Deepwater Working group Chair will all be vacated following the 12th annual meeting of the SPRFMO Commission. Members were requested to put forth nominees; however, there were none proposed. The Commission would need to consider ways to resolve the issue of the vacancy of the SC Chairperson. The SC **suggested** that the following options be considered:

a. Solicit a volunteer from Members. This relies on the good will of the membership and availability of personnel within member organisations. This approach has led to few delegations carrying the bulk of the workload.

b. Rotational chairperson. Requires a commitment of two years for members. Applying this to both the chairperson and vice chairperson creates development opportunities if the vice chairperson inherits the role but would then require a four-year commitment if it applied to the chairperson and vice chairperson. This may require financial support for travel to the SC and Commission meetings. It would also require additional work from the Secretariat in the development of a detailed chairpersons brief and in-meeting support.

c. Paid chairperson. This works well in other RFMOs but at a relatedly high cost US$40,000-50,000 pa. The success is dependent on a successful applicant.

10.5 Planned Inter-sessional activities and funding

262. The Executive Secretary presented SC11-Doc08 which reports on the status of the scientific support fund. The SC thanked the Secretariat for the paper and acknowledged the support provided by the Commission for Scientific Activities as well as the voluntary contributions received from the European Union, China, and the USA.

10.6 Next meeting venue and timing

263. Future meeting plans were discussed in the context of SC11-Doc09. Peru offered to host the 12th meeting of the Scientific Committee in 2024 and the Russian Federation offered to host the 13th SC in 2025. The SC thanked Peru and the Russian Federation for their offers.

264. The SC:

> **requested** that Members and CNCPs consult with their national contacts regarding the possibility of hosting future SC meetings (2026, 2027 and 2028) so that any offers may be presented during the next annual meeting.

10.7 Other business

265. There was no other business apart from the other elements in the agenda section.

11 Report Adoption and Meeting Closure

266. The report was adopted at 17:12 on 16 September 2023. The SC thanked Dr Jim Ianelli for once again leading the meeting to a successful conclusion and thanked the Secretariat for their support throughout the meeting. The SC expressed their utmost gratitude to the Republic of Panama for their hosting of SC11.

267. The meeting was closed at 17:21 hrs on 16 September 2023.

Annex 1: Collated SC Recommendations and Requests

(Items that the SC "noted" or "agreed" are in the main body of the report and not repeated here)

On Commission guidance and intersessional activities

Section 3.2 Status of the SC Fund

- The SC **recommended** that the Commission consider hiring staff dedicated to supporting the SC in its functions as per Article 10 of the SPRFMO Convention to: coordinate intersessional Working Group activities by scheduling, staffing, taking minutes, and producing reports for Working Group meetings; assist the SC Chair to run the SC meeting and produce the SC report; plan, support the SC to conduct and review scientific assessments of the status of fishery resources; encourage and promote cooperation in scientific research and; provide other scientific expertise to the Commission and its subsidiary bodies as they consider appropriate, or as may be requested by the Commission; provide support to Members in the coordination of the Scientific Committee Multiannual Workplan adopted by the Commission; analyse the data collected and exchanged through relevant CMMs.

On Jack Mackerel Items

Section 4.5 Jack mackerel assessment

- The SC **recommended** that the time series be truncated to reflect only the time series over which there is information on changes in efficiency for future analyses.
- The SC **noted** the paper on modelling CPUEs of the Chilean fleet and **recommended** these models to be further analysed in the next jack mackerel benchmark.
- The SC **recommended** these data series to be further analysed within the assessment model at the next jack mackerel benchmark.
- The SC **recommended** that the Commission highlight this and strongly support members activities in conducting acoustic and other surveys. These are critical for the stock assessments and potentially in developing simulation-tested management procedures.

Section 4.7 Connectivity research

- The SC supported the proposal and **recommended** the Commission consider funding this research, in the amount of NZ$ 600K.

Section 4.9 Advice to the Commission on jack mackerel

- The SC **recommended** for 2024 a 15% increase of the 2023 TAC, throughout the range of jack mackerel, at or below 1,242 kt. This advice for catch limits in 2024 does not depend on the stock structure hypothesis that is used.
- The SC **recommended** banking and borrowing to be evaluated within the management strategy evaluation (MSE) to test the impact on long-term risk to overexploitation. It was noted however from international experience that BaB is usually considered riskier when the stock is at or below B_{MSY}. The SC noted that conservation concerns associated with a potential Commission decision to implement BaB for 2024 were considered negligible for jack mackerel if the BaB limit was constrained to be a small percentage of the quota (e.g., up to 10%).

- The SC **recommended** that Member scientists:
    - Work closely with the technical group to continue the development of all aspects of the MSE and in specific the operating model (OM) and management procedures (MP);
    - Confer with stakeholders and managers on the preferred performance indicators to evaluate MPs; and
    - Provide working documents specifying how this first implementation of JM MSE framework could be improved so that the Commission could review some preliminary candidate MPs before their 2024 meeting.
- The SC **recommended** to continue the research on the spatial distribution of jack mackerel in relation to climate change and annual temperature anomalies such as El Niño and La Niña.

On Deepwater Items

Section 5.3 VMW Encounters and benthic bycatch

- The SC **recommended**:
    - That work be undertaken by the SC to agree bycatch filters to identify BTMAs and cells of interest to notify the Commission.
    - Within these cells, the per-cell analysis described in this paper is applied to identify cells where additional management consideration may be required.
- The SC **recommended** that the Commission applies a minimum of 70% protection of suitable habitat for each modelled VME indicator taxon, within each FMA, as required under para 19 of CMM 03-2023, by adopting the modifications to the BTMA boundaries as presented in SC11-DW05.
- The SC **recommended** that geographic information system (GIS) shape files of the modified BTMA boundaries are submitted to the SPRFMO Secretariat if adopted by the Commission.
- The SC **recommended** that:
    - where feasible, that additional data is collected from areas of interest to management (e.g., FMAs) to better inform model development and validation.
    - additional independent data, ideally providing a better coverage of the Evaluated Area, is compiled to perform a full evaluation of the density models.
    - once density models have been fully evaluated, and if considered to be adequate to inform management decisions, they are:
        - Incorporated into the ongoing review of the effectiveness of the spatial management arrangements.
        - Used to quantify the vulnerability of VME indicator taxa to physical disturbance.

Section 5.4 Bottom Fishery Impact Assessment

- The SC **agreed** that the cumulative BFIA provided by Australia and New Zealand represents: the best science available to the SC at the current time; provides a sound basis for formulating management advice to the Commission; meets international standards (such as the FAO Deep-Seas Guidelines) and complies with the SPRFMO BFIA Standard and, consequently, **accepts** the BFIA.

Section 5.5 Advice to the Commission on Deepwater

- The SC **recommended** to protect 70% of suitable habitat for each modelled VME indicator taxon, within each FMA, as required under para 19 of CMM 03-2023, that the Commission adopt the modifications to the BTMA boundaries as presented in SC11-DW05.
- The SC **agreed** that the cumulative BFIA provided by Australia and New Zealand represents: the best science available to the SC at the current time; provides a sound basis for formulating management advice to the Commission; meets international standards (such as the FAO Deep-Seas Guidelines) and complies with the SPRFMO BFIA Standard and, consequently, **accepts** the BFIA.
- The SC **recommended** that the quantitative benthic impact assessment for the 2023 BFIA is updated in 2024, using a method consistent with the requirements of the BFIAS.
- The SC **advises** the Commission that orange roughy stock status is very unlikely to be impacted by taking accumulated catches in alternating years.
- The SC **advises** the Commission that accumulation of catch limits over two, three, or four years, may increase the overall fishing footprint and relative impact on VME indicator taxa depending on how future fishing activity takes place; however, the total impact of this on the predicted abundance of VME indicator taxa has not been determined.

On Squid Items

Section 6.6 Assessment progress and CMM development

- The SC **suggested** that a repository of information be provided for this work and **recommended** posting this to GitHub (or similar), making it available for other Members to view, use and contribute to this work.

Section 6.7 Advice to the Commission on squid

- The SC … **advises** that the Commission review the observer coverage considering the percentage of vessels sampled and consider the feasibility for the future development of EM to monitor the squid fishery bycatch in the Convention Area.
- The SC … **advised** its members to continue its efforts to improve methods used to derive abundance indices from CPUE.
- The SC **recommended** that the Commission maintain the current fishing effort limitation levels and exemptions as specified in CMM 18-2023 and **advised** that the SC will monitor CPUE trends and other indicators.

On Habitat Monitoring Items

Section 7.7 Advice to the Commission on Habitat Monitoring

- The SC **recommended**:
    - Adopting ICES metadata convention developed by their "FAST" working group for data management.
    - Conducting a periodic large-scale synoptic ecosystem survey using fishing vessels from Peru and Chile, as survey platforms.

On Exploratory fisheries Items

Section 8.1 Exploratory fishery updates

- With regard to the Cook Islands' exploratory trap fisher the SC **recommended** that the preliminary surplus production model for lobster (or any alternative modelling approach) be reviewed.
- With regard to the Cook Islands' exploratory trap fishery the SC **agreed** to the proposed changes for the Cook Islands trap fishing FOP and **accepted** the amendment to allow for longer lines with 200 traps to be used when setting for crabs, that is for sets below 350m.
- The SC **accepted** the exploratory fishery updates from New Zealand (SC11-DW11_rev1) and the European Union (SC11-DW14).

Section 8.2 New Exploratory Fisheries

- The SC **advised** the Commission that the [COK Exploratory Fishery for dropline/jigging] proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2023 (bottom fisheries), and the BFIAS.
- The SC **advised** the Commission that the [AUS Exploratory Fishery for toothfish] proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2023 (bottom fisheries), and the BFIAS.
- The SC **advised** the Commission that the [EUR Exploratory Fishery for toothfish] proposal is acceptable in terms of Articles 2 and 22, CMM 13-2021 (exploratory fisheries), CMM 03-2023 (bottom fisheries), and the BFIAS

Section 8.3 Catch composition research

- The SC **recommended** that stocks affected by current fishing practices should be considered for future stock assessments, even if data-limited (with a specific focus on chub mackerel).

Section 8.4 Assessment development for species that are bycaught or subject to targeted fishing

- The SC **recommended** to perform a large-scale ecosystem synoptic survey across the most productive areas of the South Pacific to contribute to the development of IPCC models and to track the possible trajectories of animal biomass in the main zones.

Section 8.5 Redbait fishery precautionary approach

- The SC **recommended** that any future targeted fishery for redbait should be undertaken as part of an agreed exploratory fishery.

On Climate Change

Section 9.1 Analyses and data collection programmes to illustrate impacts of Climate Change

- The SC **recommended** that the Habitat Monitoring Working Group develops an inventory of available climate-related data and existing models applicable for SPRFMO fisheries and identifies any gaps.

On Crosscutting issues

Section 10.1 Dasta Working Group updatge

- The **SC noted** the paper [SC11-Doc12] and **supported** the continuation of the data working group.

Section 10.4 Appointment of officers

- The SC **suggested** that the following options be considered:
    a. Solicit a volunteer from Members. …
    b. Rotational chairperson. …
    c. Paid chairperson. …

Section 10.6 Next meeting venue and timing

- The SC **recommended** that Members and CNCPs consult with their national contacts regarding the possibility of hosting future SC meetings (2026, 2027 and 2028) so that any offers may be presented during the next annual meeting.

Annex 2: SC11 List of Participants

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Annex 3: SC11 Meeting Agenda

1) OPENING OF THE MEETING a. Adoption of Agenda b. Meeting Documents c. Nomination of Rapporteurs d. Meeting programme and timetable	Documents SC11-Doc03 SC11-Doc04
2) ANNUAL REPORTS DISCUSSION	Taken as read SC11-Doc13 to SC11-Doc33
3) COMMISSION GUIDANCE AND INTER-SESSIONAL ACTIVITIES a) SC multi-annual workplan b) Secretariat SC related activities	 SC11-Doc05, SC11-Doc08 SC11-Doc07
4) JACK MACKEREL a) Review of inter-sessional activities b) Assessment data review and evaluation c) Management Strategy Evaluation update d) Jack mackerel assessment e) Connectivity research f) Ageing research g) Advice to the Commission on jack mackerel h) Other jack mackerel matters	 SC11-JM03, SC11-JM12, SC11-JM15 SC11-JM16 SC11-JM14, SC11-JM08-09 SC11-JM02 SC11-JM05 SC11-JM13
5) DEEPWATER a) Review of inter-sessional activities b) Deepwater assessments c) VME Encounters and benthic bycatch i. VME taxa id guide ii. Review of VME catch and benthic bycatch iii. Catchability of benthic bycatch iv. Investigate benthic bycatch relationship with habitat suitability and abundance models d) Bottom fishery impact assessment e) Advice to the Commission on Deepwater	 SC11-DW06 SC11-DW09 SC11-DW10 SC11-DW07_rev1 SC11-DW05 SC11-DW01, SC11-Obs02, SC11-Obs05, SC11-Inf02

6) SQUID a) Review of inter-sessional activities b) Squid assessment data (including effort) c) Genetics and connectivity d) Standardise biological sampling e) COMM 12 advice on appropriate level of observer coverage f) Assessment progress and CMM development g) Connectivity research h) Advice to the Commission on squid	 SC11-SQ03, SQ04 SC11-SQ02, SQ06 SC11-SQ05 SC11-SQ07, SC11-Obs03
7) HABITAT MONITORING a) Review of inter-sessional activities b) Indicators from fishing vessels on target pelagic species c) Standardised oceanographic data products and modelling d) Species behaviour and preferences e) Symposium update f) Advice to the Commission on Habitat Monitoring topics	 SC11-HM01, HM05 SC11-HM03, HM04 SC11-HM02
8) EXPLORATORY FISHERIES a) Exploratory fishery updates (CK, EU, NZ) b) New exploratory fishery proposals (AU, CK, EU) c) Catch composition research d) Assessments development for species that are bycaught or subject to targeted fishing e) Redbait fishery precautionary approach	 SC11-DW11, DW12, DW13, DW14 SC11-DW02, DW03, DW04 SC11-Doc11
9) CLIMATE CHANGE a) Analyses and data collection programmes to illustrate impacts of Climate Change b) Management implications of Climate Change on habitat and fisheries in the SPRFMO Area	 SC11-Inf01
10) OTHER MATTERS a) Data working group b) ACAP review of CMM 09 and best practices c) Crosscutting issues (as necessary) d) Appointment of Officers e) Planned Inter-sessional activities and funding f) Next meeting venue and timing g) Other business	 SC11-Doc12 SC11-Obs04 SC11-Doc09
11) REPORT ADOPTION AND MEETING CLOSURE	

Annex 4: SC11 Meeting Schedule

11 to 16 September 2023, Panama City, Panama

SC General	Jack mackerel	Deepwater	Squid	Habitat	Exploratory

Monday 11 September	*08:00-09:00*	*Registration and name tag pick-up*
	09:00-10:30	*Item 1 Welcome and Introduction* *Item 1 Administration arrangements* *Item 2 Annual reports discussion*
	10:30-11:00	*COFFEE BREAK*
	11:00-11:30	*Item 3b SC related activities*
	11:30-12:30	*Item 8a Exploratory Fishery updates (CK, EU, NZ)*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 8b New exploratory fisheries (AU, CK, EU)* *Item 8c Catch composition research* *Item 8d Assessment development for bycaught or targeted species* *Item 8e Redbait fishery precautionary approach*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 5a Review of intersessional activities* *Item 5b Deepwater assessments* *Item 5c VME encounters and benthic bycatch*
Tuesday 12 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 4a Review of intersessional activities* *Item 4e Connectivity research*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 4b Assessment data review and evaluation* *Item 4c Jack mackerel assessment*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 5d Bottom fishery impact assessment*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	
Wednesday 13 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 4c Jack mackerel assessment (cont.)* *Item 8c Catch composition research (e.g., jack and chub mackerel)*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:00	*Item 4c Management Strategy Evaluation update* *Item 4f Ageing research* *Item 4h Other jack mackerel matters*
	12:00-12:30	*Item 9a Analyses and data collection programmes to illustrate impacts of climate change*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 9b Management implications of climate change in the SPRFMO Area* *Item 10b ACAP* *Item 10a Data working group*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 5f Advice to Commission on Deepwater*

Thursday 14 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 6a Squid intersessional research* *Item 6b Squid assessment data (including effort)*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 6c Genetics and connectivity* *Item 6d Standardise biological sampling*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 6e COMM 12 advice on appropriate level of observer coverage* *Item 6f Assessment progress and CMM development* *Item 6g [Duplicated with 6c?]*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 4g Advice to the Commission on jack mackerel*
Friday 15 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 7a Habitat Monitoring review of intersessional activities* *Item 7b Indicators from fishing vessels on target pelagic species* *Item 7c Standardise oceanographic data products and modelling*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 7d Species behaviour and preferences* *Item 7e Symposium update* *Item 7f Advice to the Commission on Habitat Monitoring topics*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 6g Advice to the Commission on Squid*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 10b Crosscutting issues (as necessary)* *Item 3a SC Multi-annual workplan*
Saturday 16 September	*08:45-09:30*	*Review of meeting progress and report/advice drafting*
	09:30-10:30	*Item 9b Appointment of Officers* *Item 9c Planned inter-sessional activities and funding* *Item 10e Next meeting venue and timing* *Item 10f Other business*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 11 Report adoption*
	12:30 -14:00	*LUNCH*
	14:00-18:00	*Item 11 Report adoption and meeting closure*

Thursday 29 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 4c Jack mackerel assessment (cont.)* *Item 4d Advice to the Commission on jack mackerel*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 6f Assessment progress and CMM development (cont.)*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Item 6d Standardise biological sampling* *Item 6e COMM11 advice on appropriate level of observer coverage*
	15:30-16:00	*COFFEE BREAK*
	16:00-17:00	*Item 6g Advice to the Commission on Squid*
Friday 30 September	*08:45-09:00*	*Review of meeting progress and report/advice drafting*
	09:00-10:30	*Item 7a Habitat Monitoring review of intersessional activities* *Item 7b Acoustic analysis review* *Item 7c Habitat monitoring data repositories* *Item 7d Classified list of vessels deploying digital acoustic systems*
	10:30-11:00	*COFFEE BREAK*
	11:00-12:30	*Item 7e Species habitat preferences* *Item 7f Symposium update* *Item 7g Advice to the Commission on Habitat Monitoring topics*
	12:30-14:00	*LUNCH*
	14:00-15:30	*Report drafting*
	15:30-16:00	*COFFEE BREAK*
	16:00-19:00	*Item 9a Crosscutting issues (as necessary)* *Item 3a SC Multi-annual workplan* *Item 9b Appointment of Officers* *Item 9c Planned inter-sessional activities and funding* *Item 9d Next meeting venue and timing* *Item 9e Other business* *Item 10 Report adoption and meeting closure*

Annex 5: Scientific Committee Multiannual Workplan

1. Introduction

COMM11-Doc06 presented the 2023 Multi-annual Plan for the Scientific Committee. This previous SC multiannual plan is presented as a working document to SC11, so that the Scientific Committee might be guided in its deliberations and for it to be used as a basis for a proposed 2024 multi-annual plan to be presented to COMM12 in February 2024.

The following tables are meant to track priority tasks with timelines. The year noted is the Scientific Committee meeting at which the work is expected to be reported back. In some cases, the work is expected to be repeated over a number of years, and this is indicated with a plus sign. The column labelled "Coordinator" identifies the Member(s) (or in some cases the Secretariat or Chair) who has specifically been assigned to ensure that progress towards the task is made intersessionally. In some cases, no Member has been specifically identified and this is indicated with a blank. The funding required is identified, and funding sources (such as the SC Scientific Support Fund or a Member voluntary contribution) if this is known. A notation of "In-kind" signifies that the work will be conducted by Members and that no additional funding is expected to be required.

In this report, additional detail regarding the funding sources for the projects outlined in the multi-annual workplan has been included as an Annex to this document.

- During SC11 the Working Groups and Scientific Committee are requested to revise the multi-annual workplan.
- This involves updating years, removing tasks that have been achieved, and adding new tasks that encourage and promote cooperation in scientific research and/or have been identified as work that is needed to support advice and recommendations to the Commission.

1. Jack Mackerel Working Group

Jack Mackerel				
Task	Subtask	Timeline	Coordinator	Funding
Jack mackerel assessment	Review available input data and its quality for the JM assessment	2024	Chile/EU	In-kind
	~~Finalize development of quality control diagnostics of the catch input data to the assessment~~	~~2023~~	~~EU~~	~~In-kind~~
	Continue to update and compare standardizations of commercial tuning indices among different fleets and the impacts of increased efficiency in the fleets	2024	Chile, Peru, EU	In-kind
	SC and other funds to support experts during SC assessment	2024+	SC Chair Secretariat	NZ$15K (SC)
	Provide TAC advice according to Commission request (based on the updated assessment and MSE results)	2024	SC	In-kind
	Evaluate the impact on stock status in the short and medium term based on deterministic projections of the jjm model.	2024	SC	In-kind
	Development of projection software for the jjm model to support catch scenario evaluation.	2024+	EU	In-kind
	Update and compare standardizations of commercial tuning indices among different fleets and review the potential bias in CPUE indices due to possible increased efficiency of the fleet and observed changes in the jack mackerel spatial distribution (benchmark)	2025+	Chile	In-kind
	Develop protocol for inclusion of acoustic data in the JM assessment (benchmark)	2025+	Chile	In-kind
Jack mackerel MSE	MSE workshop at COMM12 with stakeholders and managers to present outcomes and receive feedback on future developments	2024	ECU	In-kind
	Develop and carry out an MSE (see COMM8-Report Annex 8b). This shall include revising the operating model to be consistent with the assessment developed during the 2022 benchmark workshop. Initial management procedures (MPs) will be developed to accommodate some desired management settings (e.g., paragraphs 80, 102, 118 COMM8-Report; including carryover).	2023+	EU	NZ$60k (EU)
Jack mackerel connectivity research	Task group on CJM connectivity to improve the understanding of origin and admixture of populations or subpopulations of jack mackerel in the Southern Pacific. Terms of reference as included in G137-2022.	2024-2027	Chile Peru	NZ$161K/yr
Jack mackerel ageing techniques	Organize a workshop to (1) establish an age-reading protocol for jack mackerel otoliths and (2) perform otolith age-readings consistency tests for national age readers on the basis of a reference set.	2024	Chile	NZ$ 15k (EU)

Jack Mackerel				
Task	Subtask	Timeline	Coordinator	Funding
Jack and chub mackerel habitat and impact of climate change	Analyze the spatial distribution of jack mackerel and chub mackerel, showing its relationship with the environment and impacts of climate change to changes in its distribution	2024+	Chile, Peru	In-kind
Chub mackerel	Compile available catch, effort and biological sampling data to support the development of stock assessment models for Chub mackerel	2024+	Peru, Chile	In-kind

2. Deepwater Working Group

Deepwater				
Task	Subtask	Timeline	Coordinator	Funding
Orange roughy assessment	• Explore alternative stock assessment models • Estimate stock status • Provide advice on sustainable catch levels	2025	NZ	In-kind
Orange roughy assessment data	Coordinate and design acoustic surveys for relevant stocks (*intersessional consideration*)	2024+	NZ	In-kind
Deep water stock structure	Review the list for deepwater stock structure analyses based on assessment for non-orange roughy stocks	2025		In-kind
	Develop workplan to drive stock structure delineation studies for orange roughy and alfonsino and other key target species	2024+	NZ	In-kind
Other stock assessments, & ecological risk assessment	Review the risk assessment of teleost and elasmobranch species considering new available information and methods	2024	AU	In-kind
	Develop a tier-based assessment framework for all DW stocks and recommend relevant reference points and/or management rules for these stocks	2024+	AU	In-kind
VME Encounters and benthic bycatch	Develop VME taxa ID guide for benthic bycatch, following the steps proposed in SC9-DW12, and associated training videos	2024+	NZ	In-kind
	Development of a process to review all recent and historical benthic bycatch data to determine the ongoing effectiveness of the spatial management measures.	2024+	NZ	In-kind
	Assess the feasibility and develop a research programme within the SPRFMO Convention Area to allow the determination of taxon-specific estimates of catchability for VME indicator taxa.	2024+	NZ	In-kind

CMM 03 request regarding Encounters with VMEs	Developing a multi-spatial scale risk-based approach to assess encounters with VME indicator taxa	2024+	NZ	In-kind
	Develop an encounter review standard	2024	NZ	
	Review all reported VME encounters	2024+	DWWG	In-kind
CMM 03 request regarding ongoing appropriateness	Review all available data and provide advice on the ongoing appropriateness of the management measures to ensure the CMM continues to achieve its objective and the objectives of the Convention	2024+	DWWG	In-kind
Bottom Fishery Impact Assessment	Explore thresholds for "significant" adverse impact (SAI) for VMEs at different spatial scales, and understanding knowledge gaps and uncertainties	2024	NZ	NZ$74K (EU)
	The Scientific Committee shall review, and update if required, the SPRFMO BFIAS every 5 years, to ensure that it reflects, as appropriate, best practice. Standing item	2025	DWWG	In kind
	Validate abundance models for VME taxa using independent data	2024+	NZ	
	Work to reduce uncertainties in risk assessments for benthic habitats and VMEs by exploring: • the overlap between the spatial distribution of bottom trawling fishing impact (i.e., the 'naturalness layer') and abundance estimates of VME indicator taxa[potentially at multiple spatial scales, including Management Areas] Contingent on previous task	2024++	NZ	In kind
	Complete Cumulative BFIA. Standing item	2026	AU/NZ	
	Update the quantitative benthic impact assessment for the 2023 BFIA.	2024	AU/NZ	In kind
CMM 03 request regarding Marine mammals, seabirds, reptiles and other species of concern.	The Scientific Committee shall provide advice biennially to the Commission on: • Direct and indirect interactions between bottom fishing and marine mammals, seabirds, reptiles and other species of concern; • Any recommended spatial or temporal closures or spatially/temporally limited gear prohibitions for any identified hotspots of these species; and • Any recommended bycatch limits and/or measures for an encounter protocol for any of these species.	2024 2026 2026	AU/NZ	In-kind

3. Squid Working Group

Squid				
Task	Subtask	Timeline	Coordinator	Funding
Squid workshop	Squid Workshop including potential assessment techniques and abundance indices; to be held virtually intersessionally	2024	SQWG Chair/ Secretariat	NZ$10K (SC)
Squid assessment and CMM development	Develop a plan for more detailed within-season fishery Monitoring depending upon the uptake of EM, etc.	2024	SQ WG	In-kind
	Form a task group to conduct simulation and model evaluations for squid stock assessments	2024-25	SQ WG	In-kind
	Design and evaluate MSE and harvest control rules	2026+	SQ WG	In-kind
Standardise biological sampling	Identify where protocols differ, e.g., type of sampling, areas and timing of sampling, ageing	2024	Peru, Chile	In kind
Observer Coverage	Provide advice on the appropriate level of observer coverage in the jumbo flying squid fishery	2024+		In kind
	Explore the possibility of a pilot observer placement and/or EM program to determine the optimal level of observation coverage for both squid and bycatch.	2024		In kind
Squid assessment data	Revise data template to sufficient detail and create scripts and data repository to allow assessment methods to be used. This should also allow future higher resolution approaches (e.g., depletion estimator by phenotype) to be conducted	2024		In-kind
Squid connectivity	Collect and analyze samples for population genomic studies (Convention area and adjacent National Jurisdiction Areas)	2024-25		NZ$90K (China)
	Register DNA sequences in public DNA database (GenBank), considering a list of metadata related to samples analysed (using the template in the SC9-Report).	2024		In-kind
	Provide a single report describing the genetic diversity based on mtDNA ND2 gene marker, integrating data from all members and include a review of the existing protocol	2024		In-kind
	Reaching an updated agreement on consistent approaches to population genomic analyses (SNPs) for jumbo flying squid and provide a report describing the population genomics structure.	2024+		In-kind

4. Habitat Monitoring Working Group

Habitat Monitoring				
Task	Objective	Timeline	Coordinator	Funding
Evaluate the applicability of data collected from fishing vessels targeting pelagic species	Mapping spatial-temporal population density distribution of jack mackerel using a combination of the existing acoustic survey data and acoustic information as obtained from industry vessels	Permanent	Peru/Chile	In-kind
	Subgroup of specialists to evaluate advantages and biases of analysis methods *Workshop to be virtually conducted*	2024	Peru/Chile	In-kind
	Subgroup of specialists to organise classification of fishing fleets and develop an inventory of technologies available aboard fishing vessels in order to identify the potential to collect data using the technologies currently being deployed *Workshop to be virtually conducted*	2024	Peru/Chile	In-kind
Further developments of standardised oceanographic data products and modelling	Characterise jack mackerel habitat (e.g., past studies done in Peru and Chile)	2024	Peru/Chile	In-kind
	Provide ecosystem status overview for SC at seasonal to decadal scale	2024	Peru/Chile	In-kind
	Explore the concept of jack mackerel habitat under an interdisciplinary ontogeny approach for jack mackerel and other species (by life history stages and regions) *Workshop to be conducted virtually*	2024	Peru/Chile	In-kind
	Integration of databases provided by different members of the HMWG and other working groups of the SC with linkage to a metadata repository	2024+	Peru/Chile	In-kind
	Development an inventory of available climate-related data and existing models applicable for SPRFMO fisheries and identifies any gaps.	2024+	US/Chile/Peru	
Species behaviour and preferences	Analyse the habitat preferences of jumbo squid and jack mackerel, noting the useful data and analyses provided by Peru and Chile	2024+	Peru/Chile	In-kind
	Habitat suitability modelling of jack mackerel	2024+	Peru/Chile	In-kind
	Incorporate behaviour, distribution, and abundance information about mesopelagic, euphausiids and other key species of the Humboldt Current System	2024+	Peru/Chile	In-kind
Use of new Tools	Develop new approaches based on different tools such as GAM, GLM, INLA, ROMS, eADN, Biogeochemical, Geostatistics, big data and machine learning (e.g., for acoustic classification of targets) and utilization of different platforms (Scientific surveys, fishing vessels, satellite oceanography, gliders, buoys, AUV)	Permanent	Peru/Chile	In-kind

Habitat Monitoring				
Task	Objective	Timeline	Coordinator	Funding
Symposium	Symposium on Habitat Monitoring organised after the 2023 meeting of the Commission to review the state of the art of habitat research in order to recommend specific lines of investigation in this topic within the framework of the SPRFMO Publish in a special volume in a journal	2023-2024	Symposium Steering Committee	NZ$63k (SC) (US$25k) USA

5. Other (Crosscutting issues)

Crosscutting				
Task	Subtask	Timeline	Coord.	Funding
Seabird/ bycatch monitoring	Progress southern hemisphere quantitative risk assessment (SEFRA)	2024+		In-kind
Seabird bycatch mitigation	Convene a workshop to prioritize and draft amendments to CMMs 02 and 09 based on the review carried out by ACAP and the best-practice advice provided (SC11-Obs04)	2024+	NZ/PER	In-kind
EBSA	Evaluate impacts of fishing activities	2024+		In-kind
CMM 17 Marine pollution	SC Members and CNCPs are encouraged to undertake research into marine pollution related to fisheries in the SPRFMO Convention Area to further develop and refine measures to reduce marine pollution and are encouraged to submit to the SC and the CTC any information derived from such efforts	2024+		In-kind
Climate change	Identify management implications of climate change on habitat and fisheries in the SPRFMO area (Decision 13-2023)	2024+	USA	In-kind
CMM 02-2020 Data Standards	Review and update data standards to ensure appropriate scientific data are collected in SPRFMO fisheries (Paragraph 8 of CMM 02-2020)	2024+		In-kind
FAO ABNJ Deep Sea Fisheries	Coordinate activities over their next five-year plan that could involve member scientists and a number of SPRFMO science projects	2024+	Secretariat	In-kind
Alignment	Work involving the alignment of Deepwater and Habitat Monitoring workstreams	2024+		In-kind
Species synopses	To update long version profiles (FAO species synopsis format) for jack mackerel, chub mackerel and jumbo flying squid	2024+		

Research in the Nazca and Salas y Gomez ridges area	Research cruises aimed to know the bio-oceanographic and meteorologic characteristics of Salas y Gomez ridge; as well as biodiversity, current circulation, morphology and geology of sea bottom.	2023-2024	Chile	In-kind
	Climate change impacts of fisheries in Salas y Gomez and Nazca ridges	2024	Chile	In-kind
	Expedition to Salas y Gomez and Nazca aboard oceanographic research vessel	2024 - 2025	Chile	In-kind
Data Working group	Create terms of reference and prioritization for data needs of Members (SC10 report).	2024+		In-kind
CPPS joint work plan	Increase cooperation and collaboration between both organisations as envisioned under the existing MoU (SC10 report)	2024+	Secretariat	In-kind
Secretariat scientific support	Continue with analyses of catch composition and fishing activities; support CPUE analyses; and general scientific analyses, as capacity allows.	2024+	Secretariat	In-kind
Assessment and monitoring	Development of assessments for species in the SPRFMO Convention Area that are bycaught or subject to targeted fishing operations (in line with tier-based assessment approach)	2024+		In-kind

Annex 6: Jack Mackerel Summary of Advice

Stock status summary for Jack mackerel, September 2023

Stock: Jack Mackerel (*Trachurus murphyi*)
Region: Southeast Pacific

In conformity with the approach by the SC since 2012, a comparison was made between the 1-stock (H1) and 2-stock (H2) model configurations for Jack mackerel. Both models showed similar trends with an increasing overall biomass, high recruitments in recent years, and low fishing mortality.

Advice for 2024

Following the guidelines set out by the accepted rebuilding plan and given stock assessment results, 2024 catches should be at or below 1 242 000t.

Stock status

		2022	2023
Fishing mortality in relation to:	F_{MSY}	Below	Below
Spawning stock biomass in relation to:	B_{MSY}	Above 100%	Above 100%

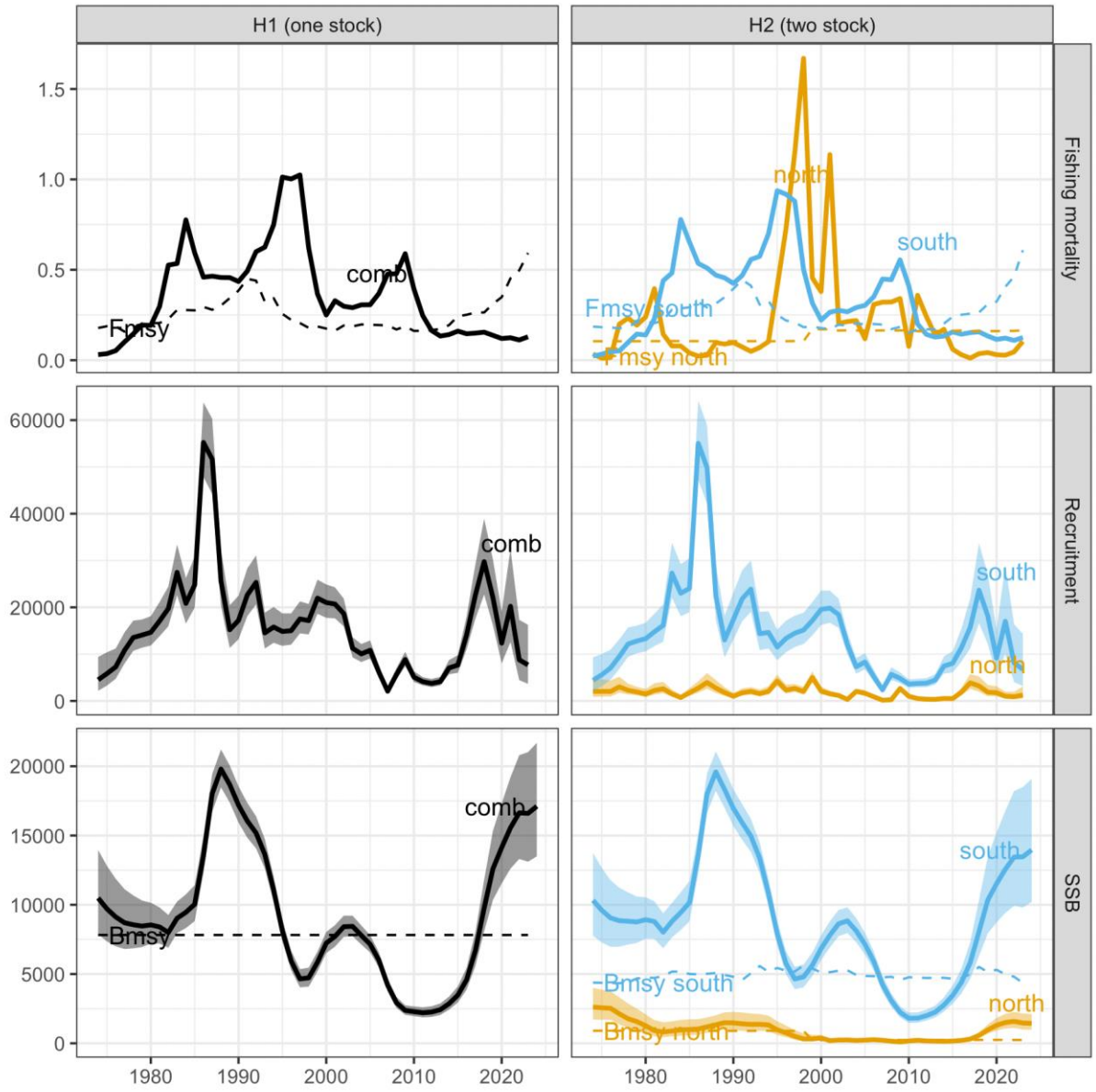

Figure 1. Jack mackerel in the southeast Pacific. Summary of stock assessment estimates over time showing spawning biomass (in thousands of tonnes; top), total fishing mortality (as an instantaneous rate per year; middle), and recruitment at age 1 (millions; bottom). Columns show results for the one-stock hypothesis (H1, left) and two-stock hypothesis (H2, right, "north" stock in yellow and "south" stock in blue). Shaded areas refer to the estimated uncertainties.

Table 2: Advised catch, Catch Limits and reported catch of jack mackerel in the southeast Pacific.

Year	Advice	Recommended Maximum Catch	Catch Limit CMM area	Catch Limit throughout range	Catch throughout range
2013	Projection results under the assumption of recent average recruitment at the levels estimated for the recent period (2000–2012) indicate that fishing mortality should be maintained at or below 2012 levels to improve the likelihood of spawning biomass increasing. This results in catches for 2013 on the order of 441kt or lower.	441,000	360,000	438,000	355,539
2014	In sum, the advice to the Commission is to aim to maintain 2014 catches for the entire jack mackerel range in the southeast Pacific at or below 440 kt.	440,000	390,000	440,000	415,366
2015	The Commission should aim to maintain 2015 and 2016 catches for the entire jack mackerel range in the southeast Pacific at or below 460 kt.	460,000	410,000	460,000	395,210
2016	The SC agreed that the recommendation from 2014 for catches in 2016 is still appropriately precautionary. Namely, that the Commission should set 2016 catches limits for the entire jack mackerel range in the southeast Pacific at or below 460 kt, based on a status quo fishing mortality of 2014.	460,000	410,000	460,000	389,101
2017	On the application of the adjusted rebuilding plan adopted by the 2nd Meeting of the Commission as proposed from SC02, the Commission should aim to maintain 2017 catches for the entire jack mackerel range in the southeast Pacific at or below 493 kt.	493,000	443,000	493,000	406,126
2018	Given current stock status, the second tier of the Jack mackerel rebuilding plan could be applied, thereby substantially increasing the potential catch. Considering the uncertainties in the assessment however, the Scientific Committee adopts a precautionary approach and advises to maintain 2018 catches for the entire Jack mackerel range in the southeast Pacific at or below 576 kt.	576,000	517,582	576,000	527,539
2019	The SC recommended status quo fishing effort which gives 2019 catches throughout the range of the Jack mackerel stock(s) at or below 591 kt. Although the stock is estimated to be in the "second tier" of the harvest control rule (>80% of B_{MSY}), the retrospective analysis shows a tendency of overestimating the stock size. In addition, there is information that suggests that the growth of jack mackerel has been underestimated. These two factors warrant additional precaution and further investigation.	591,000	531,061	591,000	635,569
2020	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above B_{MSY}, the SC recommended a 15% increase in 2020 catches throughout the range of Jack mackerel resulting in a total catch limit at or below 680 thousand tonnes.	680,000	618,001	680,000	725,945
2021	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above B_{MSY}, the SC recommended a 15% increase in 2020 catches throughout the range of Jack mackerel resulting in a total catch limit at or below 782 thousand tonnes.	782,000	710,702	782,000	802,048
2022	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the Jack mackerel biomass is estimated to be above 100% of BMSY, the SC recommended: a precautionary 15% increase in 2022 catches throughout the range of Jack mackerel- at or below 900 kt.	900,000	817,943	900,000	961,428
2023	In line with the accepted rebuilding plan ("Adjusted Annex K") and because the jack mackerel biomass is estimated to be above BMSY, the SC recommended a precautionary 15% increase in 2023 catches throughout the range of jack mackerel- at or below 1,035 kt. This advice for catch limits in 2023 does not depend on the stock structure hypothesis that is used.	1,035,000	981,832	1,080,000	1,134,612*
2024		1,242,000			

2013 advice was given by the Science Working Group.

* Preliminary value estimated at SC11

Annex 7: Jack Mackerel Technical Advice

Accessible via the SC11 meeting webpage when available

Annex 8: Squid Assessment Task Group - Terms of Reference

Proposal for the Creation of an Assessment Simulation Task Group for the jumbo flying squid in the Southeastern Pacific Ocean

Submitted by IMARPE - PRODUCE

Summary

A strong evidence of the complex population structure of the jumbo flying squid (*Dosidicus gigas*) in the Eastern Pacific Ocean exists. Three morphotypes with different size ranges, maturity sizes, and spatial distribution have been described for this species. Currently, three stock assessment models are under discussion in the context of the SPRFMO. However, these models do not take into account the biological and ecological knowledge of the species. Therefore, the creation of an Assessment Simulation Task Group (ASTG) for the jumbo flying squid assessment with simulated data is proposed. The objective of the ASTG is to test the robustness of proposed models to the multiple uncertainties in the population structure of jumbo flying squid. Thus, simulated assessment can provide understanding of the uncertainties associated with the use of those assessment models and the impacts on the management of the resource.

1. Introduction

Currently, there are difficulties in assessing cephalopods worldwide given the life history of this resource and the information available from fisheries. In these species, with particular biological characteristics (e.g. high phenotypic plasticity, rapid growth, short lifespan, among others), it is difficult to develop a tool that attempts to reproduce its population dynamics in a more realistic manner (Arkhipkin et al. 2021), even more if there is evidence of a complex population structure as in the case of the jumbo flying squid *Dosidicus gigas* (Arguelles et al. 2001, 2017, 2019, 2019, 2023a, 2023b, Csirke et al 2018, Fang et al 2017, Gretchina & Zúñiga 2017 and 2018, Nigmatullin et al. 2001, Payá 2019, Xu et al 2018). The jumbo flying squid in the Eastern Pacific Ocean presents high variability in size at maturity, as was described by Nigmatullin et al. (2001) where three groups with different size ranges, maturity sizes and spatial distribution are mentioned.

Despite these difficulties, within the framework of the SPRFMO, efforts have been made to implement models that attempt to reproduce the population dynamics of *D. gigas*. Within the SPRFMO Jumbo Flying Squid Working Group, preliminary assessment models have been presented (China: Xu et al 2018 - SC6-SQ06, Peru: Cordue et al. 2018 - SC6-SQ07), whose implementation required biological information (e.g., size, maturity) throughout its distribution area. Subsequently, three models presented during SC 10 (SPRFMO SC10-Report 2022) were discussed. To date, three models are under discussion (SC11-SQ07, SC11-SQ08 and SC11-Obs03). However, one limitation of these models is that they work on the assumption of a single population with the same longevity, length at maturity, growth rate, and natural mortality throughout the extensive range of distribution of the jumbo flying squid.

In this sense, the creation of **an Assessment Simulation Task Group (ASTG) for the jumbo flying squid assessment with simulated data is proposed**. This proposal is based on the precedent of the evaluation of models with simulated data for the Jack mackerel (SP-07-SWG-JM-01, SWG-09-JM-01, SWG-09-JM-02A). Also, the ASTG will test the robustness of the proposed models to the multiple uncertainties in the population structure of jumbo flying squid (i.e. existence of at least three clearly differentiated morphotypes in the Southeastern Pacific according toArkhipkin et al. 2021), and provide understanding of the uncertainties associated with the use of the proposed assessment models and its impacts on the

management of the resource. This document presents the objectives of the group, , the requirements for the simulated data generated and the Terms of References for the activities of the group.

2. Simulated data requirements

The simulated data should fulfill the following requirements:

i. Biology: to reproduce the different morphotypes of jumbo flying squid identified in the Southeastern Pacific (Nigmatullin et al. 2001), considering their differences in both growth and size at first maturity.
ii. Ecology: to consider ontogenetic migrations reported in the literature (e.g. Csirke et al. 2015, Hu et al. 2022), as well as the high degree of cannibalism observed in this species. To consider the effect of climate variability on key parameters related to the life history of this species (e.g. growth, natural mortality, among others).
iii. Fisheries: to take into account the differences in selectivity among the various fleets operating on this species in the Southeastern Pacific, both at the size level (e.g., offshore vs. inshore fleets) and sex level (e.g., trawl vs. jigging).
iv. Sampling: to consider different uncertainty scenarios associated with different levels of sampling effort (e.g. observer coverage, number of ports sampled).
v. Data reporting: to produce both aggregate statistics (i.e. catches, average sizes) and disaggregated data by size, fishing area and fleet type, consistent with a standardization of sampling effort among Members.

3. Terms of Reference

The objective of the ASTG is to test the robustness of proposed models to the multiple uncertainties in the population structure of jumbo flying squid.

The ASTG has the following Terms of Reference:

- Generate simulated data consistent with the requirements described above (section 2).
- Elaborate a protocol for the comparison of candidate models for the jumbo flying squid stock assessment in the Southeastern Pacific.
- Apply this protocol for the comparison of candidate assessment models.
- Produce a realistic simulation model of the population dynamics of the jumbo flying squid in the Southeastern Pacific for its future use in a management strategy evaluation (MSE) context.
- Report the results to the Scientific Committee.

The activities of the ASTG will require several virtual meetings and an in person final workshop to discuss the obtained results and draft a final report for the SC.

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Annex 9: Statements

Chile's Statement on MSE

To the Scientific Committee:

- Chile recognizes and values the importance of developing a Management Strategy Evaluation (MSE) for the jack mackerel fishery, which is one of the most relevant fisheries in Chile and a cornerstone of the country's social and economic development.
- Chile appreciates the work done by those who have led the process, and has supported most of the agreements arrived at the technical level.
- However, the Chile delegation has identified some matters of concern, which lead us to not fully endorse the proposed set of operating models (OMs). In particular, referring to the configuration of movement rates of the two-stock with connectivity OMs.
- This objection has been reported multiple times during the MSE technical meetings of the JMWG.
- Chile has repeatedly requested for the most updated scientific evidence to be considered, where recent genetic evidence indicates a highly connected jack mackerel population throughout the South Pacific Region.
- Regarding movement rates, further discussion and analysis should take place on a range of possible values. Chile sustains its position regarding this matter.
- Nevertheless, Chile maintains its commitment to collaborate with this project and will not delay it, understanding that this work is still in progress.

Statement of Peru and Russia Delegations regarding the Operating Models (OMs) of the Jack Mackerel Management Strategy Evaluation (MSE) and the consideration of the various stock structure hypotheses

To the Scientific Committee, from Peru and Russia delegations:

- We are strongly committed to the development of the Management Strategy Evaluation (MSE) of the Jack mackerel, as envisaged since the first Scientific Committee meetings. Although the specifications of the Operating Models (OMs) are still under development, it has been clear since the 11th Science Working Group (Lima, Perú, 2012) that, pending a clear definition of what is the Jack mackerel stock structure, the SPRFMO assessments were to be made on the basis of the two main stock structure hypothesis, i.e., of 1-stock in the whole distribution range in the SE Pacific, and of 2-stocks, with a northern and a southern stock in the same distribution range. Therefore, as a minimum, the MSE should consider these two hypotheses. And, furthermore, given the more recent developments and proposals, it is our belief that other hypotheses, such as the one of a metapopulation could and should also be considered as part of the MSE exercise. Noting that during the various MSE technical meetings, the JMWG has been open and never restricted the possible inclusion of more OMs or alternative specifications to be considered. Stressing, however, that any further suggestions could be discussed and included, but must be based on solid scientific information (e.g.: as discussed and agreed in the Scientific Committee or peer-reviewed research articles).
- It is generally accepted that sound fisheries management requires the development of robust assessment models based on the best scientific evidence and information available, which should include a clear definition and sound knowledge of the population structure of the stock or stocks in question. The main uncertainties regarding the population structure of Jack mackerel (i.e., the 1-stock and 2-stock hypotheses) have been incorporated since the initial planning and development of MSE. And, in addition, the JMWG has already considered the development of an OM considering the metapopulation hypothesis.
- We also support the JM and SC chairs request made during the second MSE technical workshop (G93-2023) to consider the structural uncertainty (i.e., stock structure) in the OMs. Noting that on that occasion the invited expert, Dr. Iago Mosqueira, confirmed that up to three structurally different OMs are already being considered for future projections (i.e., regarding the 1-stock, 2-stocks, and metapopulation hypotheses).
- We share the view that the identification of the population genetic structure, connectivity, admixture, and the delimitation of geographical boundaries of divergent groups of Jack mackerel, are important goals to pursue for an effective management of the species (SC9-JM08). Also agree that discussions related to the Jack mackerel connectivity be addressed in the Connectivity Task Group, which has developed and submitted a proposal for the holistic and multidisciplinary study “Characterization of the population variability of jack mackerel Trachurus murphyi on a spatio-temporal scale, in order to determine the existence of stocks or population units and their level of connectivity” (SC11-JM02).
- With regards to the bullet five of the Chile Declaration being derived from paper SC11-JM14 of the genetic studies, in the sense that “..recent genetic evidence indicates a highly connected jack mackerel population throughout the South Pacific Region”, we acknowledge that genetic technologies are recognized for their usefulness in multidisciplinary studies of population

structure, but we also stress that the great importance of the sampling design for its correct interpretation is also widely recognized. In this sense, we express our great concern regarding the sampling design, the population statistical results interpretation, and the conclusions presented in the above mentioned document, and we challenge their estimates of migration rates, among other estimations.

- Although, there are several other aspects that need to be more critically examined, our main specific concerns regarding the above mentioned document are: (1) the comparison between groups was made wrongly considering a mixture of samples collected in different years, i.e., in 2007 in some Peruvian locations combined with others collected in Chile during 2022, without taking into account that several different generations have passed through during those 15 years, whose population dynamics and genetic variability could also have been affected by environmental changes; (2) the strange and unexplained finding that some estimated migration rates between Peru and New Zealand were higher than between Peru and Chile; (3) the authors overlooked and have not considered the significant Fst values reported between groups from different longitudinal distribution areas, which could be a parameter related to the existence of a population differentiation along its longitudinal distribution, suggestive of results opposite to that of a single stock claimed and intended in the Chilean statement; (4) their estimated migratory rates are contradictory and changing depending on the sampling years. Indeed, the reported migration rates based on samples collected during 2007 were much higher than those reported for 2010 (i.e., migration rate of 1 between the north of Peru and New Zealand and of 0.7-0.8 between Peru and Chile was reported during 2007, while a lower rate of 0.3 between Peru and New Zealand and of 0.15-0.37 between Peru and Chile was reported for 2010). Although this possibility is ignored in the paper, we note that this might be an indication of a possible metapopulation structure; (5) conclusion 6 of the SC11-JM14 clearly indicates that “the results obtained suggest that Chilean jack mackerel shows population structure and adaptation despite considerable gene flow in the South Pacific Ocean…”, which partly contradicts the observation on which the 5th bullet of the statement presented by the Chilean delegation is based.
- Furthermore, we firmly confirm our commitment with the objectives and relevant work of the SC, and of the SPRFMO as a whole, and wish to commend the objectivity and seriousness with which the scientific work of this Committee has been conducted.

China Statement to the Scientific Committee of SPRFMO

To the Scientific Committee,

- China recognizes and values the importance of the on-board observer in collection of scientific information to support research and functions of the Commission and its subsidiary bodies.
- China has done the best to dispatch observers on board to collect scientific data and share it with members to support the squid genetic research and stock assessment. In 2022, the observers and studying vessels have collected information on over 100,000 squid and taken tons of samples to send to the lab for analysis. These samples covered the entire year and the entire fishing ground.
- Based on these practices above mentioned and the highly selectivity of the squid jigging fishery, China believes that the current of observer coverage level meet the requirements of the scientific and compliance purposes.
- Since the Scientific Committee does not reach a consensus with regard to the pilot observer placement program, it is not appropriate to included it in the 2024 SC Multi-Annual Work Plan (2024 SC Workplan), because according to the provisions of article 10, paragraph 3, of the Convention, which stipulates that “the rules of procedure of the Commission shall provide that where the Scientific Committee is unable to provide its advice by consensus, it shall set out in its report the different views of its members.” So, it is China’s view that the SC meeting report should include the different views of its members on this issue.
- China is willing to maintain communication and cooperation with members on the issue of observer coverage.

Chile's statement regarding Climate Change and Salas y Gómez and Nazca Ridges

Chile welcomes the opportunity to discuss climate change issues in the SPRFMO framework. Considering the challenges that climate change represents for the health and sustainability of the fisheries in the South Pacific area, Chile notes the importance of adopting a precautionary and ecosystemic approach for the management of the Convention's Area. As it was presented by some delegations on the information paper to facilitate the Climate Change agenda item, Chile shares the necessity of strengthening decision-making processes including consideration of climate change effects on fisheries resources and vulnerable marine ecosystems, and their close interactions with fishing.

In that line, Chile recalls that one of the most effective approaches to address climate issues in fisheries is nature based solutions. Ecosystem protection and restoration can be a critical step to enhance the ocean as a carbon sink, increase ocean resilience to other threats, as well as an instrument for adaptation. In this regard, one of the areas identified as critical for the health of the South Pacific are the Salas & Gómez and Nazca Ridges.

In this area, both Chile and Peru have undertaken efforts to protect the unique biodiversity, which is also relevant for the fishing resources in the SPRFMO area, including jack mackerel and its reproduction and recruitment areas. Both countries have already adopted conservation policies in their own EEZ, where Chile's Nazca-Desventuradas and Motu Motiro Marine Parks and Rapa Nui Multiple Uses Marine Protected Area, and Peru's Nazca Ridge National Reserve represent a huge effort to protect this global biodiversity hotspot. However, currently protection of the Salas y Gómez and Nazca Ridges only reaches national jurisdiction areas, which leaves 73% of this ecosystem unprotected.

In this context, Salas y Gómez and Nazca Ridges represent a focus of concern, due to their vulnerability and exposition to climate risks and to anthropogenic activities. This area is compounded by two adjacent seamounts chains, which together stretch across over 2,900 km of seafloor. The isolation of this area produces a unique biodiversity that represents the highest levels of marine endemism on Earth. That means that this area concentrates species that cannot be found anywhere else on the planet.

The importance of this ecosystem for SPRFMO is undeniable: this area is an important corridor for many commercially important fisheries species. In addition, it is a critical habitat as breeding and feeding grounds for large whales and other migratory species, offering connectivity between marine ecosystems. However, this key ecosystem is highly susceptible to climate change and numerous species are threatened or endangered by anthropogenic and climatic disturbances. According to climate prediction models, Salas y Gómez and Nazca Ridges will suffer substantial negative impacts in this century. Their location near the center of the South Pacific Gyre make them particularly susceptible. These impacts will be exacerbated by "El Niño" Southern Oscillation and the Pacific Decadal Oscillation, whose deleterious effects are already visible in our region. In addition, climate change has impacts on the Southeast Pacific Subtropical Anticyclone, which has already experienced a poleward shift, which is projected to continue (SC10-Doc30).

The portion of this ecosystem in areas beyond national jurisdiction concurs with the area of competence of SPRFMO. Considering their substantial role as biological corridors for several endangered species, and aiming for the connection of protected areas established by Chile and Peru, the protection of Salas y Gómez and Nazca Ridges located in areas beyond national jurisdiction represents a unique opportunity to preserve a key area for biodiversity in the South Pacific.

SPRFMO has the power and mandate to do that, the objective of the SPRFMO includes the provision to "safeguard the marine ecosystems in which these resources occur" and the article 3 of the Convention

establishes as a principle "(vii) marine ecosystems shall be protected, in particular those ecosystems which have long recovery times following disturbance."

According to UNGA Resolution 71/123 (185), RFMOs should take into account the potential impacts of climate change when taking measures to manage deep-sea fisheries and protect vulnerable ecosystems. In addition, Articles 5 and 6 of the 1995 United Nations Fish Stocks Agreement provide the obligation to protect habitats of special concern and biodiversity.

Salas y Gómez and Nazca Ridges harbour vulnerable ecosystems that could be preserved without significantly affecting the fishing industry, due to the relatively low fishing effort in this area, but with enormous benefits for ecosystem connectivity, climate regulation, food security, and other ecosystem services. Chile wishes to encourage the other Members of SPRFMO to consider the possibility of studying the establishment of a scheme of protection for this area, to serve as an example of conserving biodiversity in areas beyond national jurisdiction and international cooperation and coordination.

EDF statement on Climate Change

Thank you chair and thank you to the United States for coordinating the important effort of bringing climate change onto the agenda at SPRFMO. Environmental Defense Fund would like to express our strong support for incorporating climate change into the work of the scientific committee and ultimately into science-based adaptive management decisions by the Commission. Climate change is an existential threat to fishery livelihoods in many parts of the world. There are serious environmental justice implications for small-scale artisanal fishers from coastal developing states who lack the resources to shift their fishery distributions in response to changes in stock availability, and there are serious implications for food security in developing nations and vulnerable coastal communities that need to be considered.

EDF would like to commit our in-kind support to advance the important effort of integrating climate change into SPRFMO, and we think the initial activities outlined by the US delegation sound like good first steps. This effort will require strong coordination between working groups, and we would be happy to help facilitate or support the US delegation in this role. We would also like to offer our support to plan and host a climate change symposium in Manta next year to facilitate a discussion by decision-makers around best practices in climate-smart fisheries management including lessons learned from other fisheries management bodies.

DSCC statement on Climate Change

DSCC thanked the US for a very helpful and timely submission. DSCC made some suggestions about addressing climate change in 2021 in COMM10-Obs03. We associate ourselves with EDF comments just made. A brief outline follows of the recommendations:

Precautionary approach:
Review of CMMs to identify where specific consideration of climate impact should be included - Incorporation of climate impact statements in new CMMs and fisheries plans.

Ecosystem approach:
Incorporate EBA approach into all existing and new CMMs relating to management of species.

Research and monitoring:
Establish an intersessional SC working group to develop research and monitoring programs to progress understanding.

MPA network for biodiversity refugia and ecosystem resilience
Proactive and systematic identification of VMEs across the Convention area - and of climate change vulnerable species and habitats. Progress work undertaken by Chile on protecting the Nazca and Salas y Gomez Ridges.

International cooperation
Review existing cooperative arrangements for opportunities for joint research and climate change response action.

Inclusion of climate change considerations in all decisions
Establish an intersessional SC group to develop advice on scientific requirements - Establish an intersessional Commission group to develop response plan options.

Oceana statement on Climate Change

Thank you, Chair.

I am honored to speak on behalf of the Coral Reefs of the High Seas Coalition, a global alliance of partners created in 2019 that aims to protect coral reefs on the High Seas by advancing the science, strategic communication, and political support necessary to catalyze conservation action.

We support and celebrate Chile's leadership and demonstrated commitment over many administrations to recover fisheries and protect the ocean. We echo Chile's statement on the importance of addressing climate change impacts through implementing conservation measures. Our own scientific analysis supports Chile's assessment that the Salas y Gómez and Nazca Ridges should be a priority for conservation action due to not only to its incredible ecological significance, but also because of its deep cultural importance.

The uniqueness of every seamount in these ridges has been documented by a series of scientific research efforts, which also highlighted the opportunity to connect and enhance the ridges' seamounts already protected areas. This wealth of scientific information on the Nazca and Salas y Gomez ridges is compiled on our webpage, and we are happy to provide the direct link to access these papers.

We look forward to further discussion of conservation of these ridges in upcoming commission and Scientific Committee meetings.

Thank you.