

## 8<sup>th</sup> MEETING OF THE SCIENTIFIC COMMITTEE

*New Zealand, 3 to 8 October 2020*

SC8-JM05

### Summary of MSE project

*European Union*

# SPRFMO EU grant project on Jack mackerel: progress report

Niels Hintzen, Iago Mosqueira, Nicola Tien

## Summary

The EU has undertaken a study to investigate #1 Jack mackerel management targets and management plan as well as #2 to define a generic framework to study the Jack mackerel habitat.

For the first aspect, four online meetings were held in which a number of discussions took place. The first decision that was made in the first online meeting related to aspect i., to define hypothesis on stock structure to be used in the MSE. It was concluded that three different stock structure hypotheses were going to be tested: a single stock, two separate stocks and a hybrid stock structure assumption in which there is exchange of individuals between two stocks: one in the South and one in the North. In addition to that, it was concluded that two different growth assumptions were going to be evaluated as well as two different assumptions on productivity. Combining these aspects results in 12 different scenarios. The spatial heterogeneity of the Jack mackerel stock, aspect ii. Is included in the MSE through including different sources of uncertainty such as a variability in selectivity patterns of the different fleets, weight at age, and the migration rate of individuals under the hybrid stock structure assumption. The final conclusions on the spatial heterogeneity are to be made by the MSE group of the SPRFMO SC. It is anticipated that these conclusions are made near the 2020 SC. A simple management strategy, aspect iii., has been implemented in August 2020 for illustration purposes. In collaboration with the SC but also the Commission other management strategies will be developed early 2021. A separate study has focused on aspect iv. in which we've looked at the behaviour of the fishing fleets under changing environmental and or quota conditions. for this aspect we've looked at la Nina events and El Nino events and how this effects landings by the four different fleets. Final results on this aspect will be reported in December 2020. the final evaluation of management regimes as is described under aspect v. will take place after consultation of the Commission. The technical framework however is already designed and implemented that it allows to test different management regimes. It is however not a task of the SC to decide on management regimes. Reporting on each of these aspects will be finalised in December 2020 and includes all progress made till that point.

In the part of the study in which we attempt to define the Jack mackerel habitat, we undertook 2 explorations. the first related to data evaluation in which we developed a standardised approach to download environmental data relevant for the distribution of Jack mackerel. This was completed by January 2020 and includes analysis of industry data. A statistical model was also developed to evaluate the impact certain environmental conditions have on the distribution of Jack mackerel. To be able to report on appropriateness of this model more data is needed at this stage for which a request is pending with different members of SPRFMO. It is expected that by December 2020 final results can be presented.

## Progress

### Define the hypotheses on stock structure to be used in the MSE

In discussions on the development of the management strategy evaluation three different stock structure hypothesis for Jack mackerel were discussed and agreed upon at the end of 2019. The three hypothesis are that Jack Mackerel constitutes one single stock or two separate stocks: one in the North and one in the South and a hybrid in which there is migration between a northern and southern stock. The single stock and the two stock hypothesis are already used within the scientific committee to provide advice to the Commission. The third assumption, the hybrid approach, is based on previous data and literature analysis, as well as simulations in the management strategy evaluation in 2012. The joint Jack mackerel model that is used to assess the stock can be used to parameterise each of these three hypothesis. For the hybrid approach however, an additional assumption has to be made on migration / exchange of individuals between a northern and southern stock. There are preliminary exchange rates available from the 2012 study which could be used in this simulation as well. If other data becomes available to improve on these rates this will be used. Aspect a<sub>i</sub> of the study is considered to be completed.

### Define spatial heterogeneity of the Jack mackerel stock

Work by different members of the SC have presented the spatial heterogeneity of Jack mackerel throughout its distribution range. In addition to these analyses the current study also investigates if there is a relationship between stock size and proportion of resource available to each of the different fleets. For this purpose a simple statistical model is set up to look at the proportion of resource catch related to overall stock size. This model will finally indicate how variable availability of the resource to the different fleets is over the years. Final results will be described in a report by December 2020.

**Design management strategies** In 2019 and 2020 the FLR software has been expanded to allow a smooth interface between the MSE software (in FLR) and the joint Jack mackerel model. The examples that were presented in the most recent two online meeting sessions showed that the FLR software was able to reproduce the stock assessment results and predict the stock into the future. The entire workflow has been designed and now needs specific input in terms of uncertainty on parameters and biological traits such as weight at age to complete the MSE loop. Structural uncertainty has been covered under the first point. Aspect a<sub>iii</sub> of the study is considered to be completed. The software is available on github and available to all users to review and contribute to. Software is generic in the sense that it can simulate stock structure hypothesis and also do different assumptions on growth and productivity. The next step is to design a simple harvest rule that can be evaluated to test if management is robust against the uncertainties that were defined in terms of stock structure, growth, productivity and parametric uncertainty. The SC sub-group dealing with the MSE will provide alternative harvest control rule designs that can be used in the discussion with the Commission to select appropriate means to manage the Jack mackerel stock.

### Define fisheries behaviour for the different fleets under changing environmental and/or quota conditions

Fisheries behavior of the four different fleets that target Jack mackerel was investigated by correlating total landings for each of these fleets to El Niño and La Niña events. A simple statistical model, GLM, was designed to correlate total landings to El Niño and La Niña events, average temperature and duration of these events. Final results will be presented at the end of 2020.

## Evaluate management regimes

A simple management regime has already been implemented to demonstrate the newly developed software. At the fourth informal MSE meeting it was suggested that members should start to think about suitable management regimes that they would like to see tested inside the MSE. These management regimes will be evaluated and presented to the commission at their next annual meeting in a dedicated workshop where managers are expected to indicate what objectives the management regimes should meet. Final evaluation of management regimes will take place in 2021 and after a benchmark for Jack mackerel has been completed.

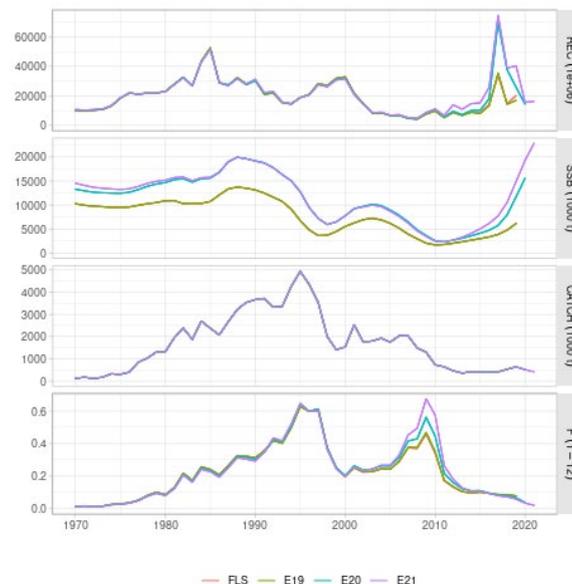


Figure 1: Example runs of the JJMS model with new observations, for years 20198, 2020 and 2021, being generated by the Observation Error Model being applied to an Operating Model that reduced catches by 20% per year. Trajectories only indicate that the a new JJMS estimate can be obtained from observations taken from the OM every year.

## Defining the Jack mackerel habitat - Data Evaluation

In collaboration with Peruvian and Chilean scientists different environmental data has been downloaded and analysed to design a statistical model that describes the distribution of the Jack mackerel stock. The data has been downloaded and analysed in a standardized way to allow future updates to be processed in a time efficient manner. Data was freely available and could be run on a server to update the analysis annually. A report describing the data that has been used in this study including meta description will be provided at the end of 2020.

## Defining the Jack mackerel habitat - Statistical modelling

A template statistical model has been designed to describe the Jack mackerel habitat based on environmental conditions. The model is coded in R making use of the INLA library and models the distribution of the fishing fleet based on VMS data in relation to the environmental variables. INLA allows for correction of spatial and temporal correlation which is by default present in fisheries data such as VMS data. Trials with this model have been executed, for final evaluation more data from other members is needed. This data will become available later in the year and final results will be presented in a report at the end of 2020.