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Scientific, Technical and Economic Committee for Fisheries (STECF) - Quality checking of MED & BS data and reference points. (STECF-22-03)

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Joint Research Centre

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report documents the outcomes of STECF EWG 22-03 held online 2-6 May 2022. The EWG was tasked with two man tasks: checking of 2021 data call for 47 MS/species/GSA combinations; and development of reference points for stocks within the Western Med MAP.

The data checking analysis methods applied and the issues detected are reported by MS/GSA and species. The outcomes have been passed to MS at the conclusion of the meeting for where possible incorporation into the 2022 data call.

The preliminary results for the development of reference are provided by stock for the Western Med. The approach applied was coherent across the stocks, based on the underlying assumption of a stock recruit function with a relationship between R and SSB rising to a plateau at an SSB<20% of B_0. Where data supported a fitted point of inflection these were used to give values of B_{Lim}, and where no point of inflection could be found, a point at 25% of Bmsy was used. The report provides a summary of input data, exploration of fit and results for 14 stocks from the Western Mediterranean for which assessments were available.

SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Quality checking of MED & BS data and reference points (STECF-22-03)

1.1 Introduction

1.2 Background provided by the Commission

Terms of Reference for EWG-22-03

Background TOR 1 - Quality checking of MED & BS data

In recent years, STECF Expert Working Groups (EWG) on stock assessment have mainly focused on stocks in the Western Med, Adriatic and Ionian/Aegean Seas; for the remaining areas and stocks there is no information on the quality of the collected data. With regards to the Med & BS data call, the Regional Coordination Group (RCG) Med & BS[1] end user subgroup[2] considered that quality checks by EWGs on stock assessments only cover stocks to be assessed and not the whole set of data reported in the data call. This creates unbalanced reporting on data issues among MS and puts some MS in an unfavourable position[3]. In addition, not all stocks are assessed in the year following data collection, so some potential problems in data submitted in response to a data call during year N will be spotted by end-users in years N+2, N+3, N+4 etc. Such a situation is not ideal, if one takes into account that other end-users (projects etc.) may eventually use these data.

The RCG Med & BS end user subgroup discussed several possible ways to improve data quality before the operational deadline of data calls, including a specific ad-hoc EWG on data quality, accuracy and completeness with a focus to improve data quality before data use in the EWGs for stock assessments. The **EWG 21-02**[4] served this purpose. This EWG was requested to check and assemble Length Frequency Distribution (LFD) data for the stocks identified as target for assessment activities in 2020. The EWG checked underlying data sets and defined the correct procedures to deal with missing data, raising procedures (specifically for survey data), wrong length measurements, and proposed standardized procedures to be followed from then on.

As a follow up to EWG 21-02, COM proposed an ad hoc EWG to quality check the Med & BS data not currently scrutinized in STECF stock assessments. This EWG should use the outcomes of the EWG 21-02 and apply them to, at least, the priority stocks for each country, as well as agree on other possible quality checks to describe the level of completeness of data submitted to the DG MARE Med & BS data call.

Following COM proposal, STECF[5] considered that it could be beneficial to have a general overview of the quality of the data collected by the MS under the Mediterranean and Black Sea data call. Given the large number of species, GSA and country combinations, STECF considered that the number of data quality checks and number of species/GSA should be proportionate to the duration and workload of the EWG and therefore subject to some prioritization.

To this end, the RCG Med & BS held a joint meeting with all involved parties[6] to identify the priority stocks/GSA to be tackled by this EWG. As an outcome of this meeting, the MS - using the CFP monitoring exercise as a basis - proposed a list of stocks not assessed by STECF[7], based on landings and income/value, averaged over 3 years, including data availability as an additional factor (Annexes I and II).

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[1] https://www.fisheries-rcg.eu/rcg-medbs/

[2] Regional Coordination Group Med & Black Sea Subgroup on 'Meeting with End-users of Scientific Data' (12-14 March 2019, Rome). The report is available on the DCF website (https://datacollection.jrc.ec.europa.eu/docs/rcg).

[3] Due to the fact that specific stocks are assessed, only the relevant Member States that collect data on these stocks receive data issues from STECF EWGs.

[4] EWG 21-02: Methods for supporting stock assessment in the Mediterranean, 12 - 16 April 2021 (Report)

[5] STECF Plenary 21-02: 5.1 EWG 21-02 Methods for supporting stock assessment in the Mediterranean (Report).

[6] Joint meeting of the RCG Med & BS, DG MARE, JRC & STECF on data quality and availability, 16 December 2021, online.

[7] previous STECF EWGs.

TOR 1

The EWG is requested to check the coverage and quality of the data hosted in the JRC database for the stocks of Annex I. If time allows, the EWG is invited to repeat the same exercise for (as many of) the remaining stocks proposed by Member States, as listed in Annex II. For this purpose, the EWG is invited to use the outcomes of the EWG 21-02, as well as additional relevant tools that may be available from other sources, such as other STECF EWGs, GFCM, checks developed and used by JRC, work under projects and grants etc. The EWG may also develop new tools. The consolidated checks used under the EWG should be clearly listed and described, to allow their use by the Member States in the future.

The EWG may contact the National Correspondents of Member States to request clarifications on the data sets during the meeting, if needed. Relevant reports of working groups from STECF and GFCM may also be used as background documents.

One of the main outcomes will be to produce a report per MS, where the results of the data checks will be described. In addition, the EWG is requested to propose possible actions to improve the data sets, as well as improvements to the future data collection activities of the MS. The EWG should clearly highlight cases where the applied and available checks may not be adequate/ relevant for specific data sets and propose ways forward.

All unresolved data issues encountered during the EWG meeting should be reported on line via the Data Transmission Monitoring Tool (DTMT) available at https://datacollection.jrc.ec.europa.eu/web/dcf/dtmt (with restricted access). All output should clearly indicate that issues come from this specific EWG ('EWG 22-03'). Further guidance on precisely what should be inserted in the DTMT, log-on credentials and access rights will be provided separately by the STECF Secretariat focal point for the EWG.

Following the preliminary outcomes of this EWG[8], and if time permits, the Member States will be requested to re-upload corrected historic data sets during the official data calls.

Background TOR 2 - reference points

These ToRs deal with the methodology and estimation of conservation reference points for demersal stocks in the Western Mediterranean.

The Western Mediterranean multiannual management plan (West Med MAP) was adopted in 2019. It encompasses a fishing effort regime and various technical and conservation measures to address the overexploitation of demersal stocks, in particular of six main target species listed in Article 1(2).

The main objective and legal obligation (Article 7(3)b) of the West Med MAP is to achieve fishing mortality securing Maximum Sustainable Yield (Fmsy) for all demersal stocks by 1 January 2025 at the latest.

Article 5 of the West Med MAP specifies which Conservation reference points are to be used for the management decisions:

"the following conservation reference points shall be requested, in particular from STECF, or a similar independent scientific body recognised at Union or international level, on the basis of the plan:

(a) precautionary reference points, expressed as spawning stock biomass (BPA); and

(b) limit reference points, expressed as spawning stock biomass (BLIM)."

And Article 2 of the West Med MAP provides the following legal definitions:

(5) 'FMSY point value' means the value of the estimated fishing mortality that, with a given fishing pattern and under current average environmental conditions, gives the long-term maximum yield;

[8] before the outcomes are discussed at STECF Plenary.

(10) 'BLIM' means the limit reference point, expressed as spawning stock biomass and provided for in the best available scientific advice, in particular by STECF, or a similar independent scientific body recognised at Union or international level, below which there may be reduced reproductive capacity;

(11) 'BPA' means the precautionary reference point, expressed as spawning stock biomass and provided for in the best available scientific advice, in particular by STECF, or a similar independent scientific body recognised at Union or international level, which ensures that the spawning stock biomass has less than 5 % probability of being below BLIM;

The safeguard mechanisms under the West Mediterranean EU MAP7 demersal plan can thus be triggered by levels of SSB falling below given thresholds. For stocks for which targets relating to MSY are available, and for the purpose of the application of safeguards, it is necessary to establish conservation reference points, expressed as precautionary reference points (B_{pa}) and limit reference points (B_{Lim}).

Appropriate safeguards should be provided for in order to ensure that the targets are met and to trigger, where needed, remedial measures, inter alia, where stocks fall below the conservation reference points.

TOR 2

In preparation for the Expert Working Group on stock assessments in the western Mediterranean Sea (EWG 22-09) and the Expert Working Group on fishing effort regime for demersal fisheries in the western Mediterranean (EWG 22-11), EWG 22-02 is requested to estimate preliminary B_{Lim} and B_{pa} biological reference points, as well as other reference points that could be estimated (e.g. Bmsy), for the 6 main target species under the West Med MAP. The preliminary values and the approach should be presented to STECF summer plenary with the aim of giving final values in EWG 22-11.

Using existing stock assessments, EWG 22-02 is requested to define an appropriate practical framework for deriving the conservation reference points (i.e. B_{pa} and B_{Lim}) for the demersal stocks in the West Mediterranean listed in Annex III. The proposed values shall be related to long-term high yields and low risk of stock/fishery collapse and ensure that the exploitation levels restore and maintain marine biological resources at least at levels which can produce the maximum sustainable yield. The supplied approach should draw on the experience with other approaches (e.g. ICES and GFCM) where applicable. Where other approaches are needed specifically for species with short time series, alternatives should be proposed.

ToR ANNEX I

List of stocks for TOR 1

Member State	Area (GSA)	Scientific name
Spain	GSA 1	*Sardina pilchardus*
Spain	GSA 5	*Engraulis encrasicolus*
Spain	GSA 6	*Engraulis encrasicolus*
France	GSA 7	*Sparus aurata*
France	GSA 8	*Sparus aurata*
Malta	GSA 15	*Scomber colias*
Malta	GSA 15	*Boops boops*
Italy	GSA 16	*Engraulis encrasicolus*
Italy	GSA 19	*Engraulis encrasicolus*
Slovenia	GSA 17	*Merlangius merlangus*
Slovenia	GSA 17	*Eledone moschata*
Croatia	GSA 17	*Sardina pilchardus*
Croatia	GSA 17	*Engraulis encrasicolus*
Greece	GSA 20	*Sepia officinalis*
Greece	GSA 22	*Sepia officinalis*

Greece	GSA 23	*Sepia officinalis*
Cyprus	GSA 25	*Boops boops*
Cyprus	GSA 25	*Spicara smaris*
Bulgaria	GSA 29	*Engraulis encrasicolus*
Bulgaria	GSA 29	*Merlangius merlangus*
Romania	GSA 29	*Engraulis encrasicolus*
Romania	GSA 29	*Merlangius merlangus*

<u>ToR ANNEX II</u>

List of additional stocks for TOR 1

Member State	Area (GSA)	Scientific name
Spain	GSA 1	*Engraulis encrasicholus*
Spain	GSA 1	*Sardinella aurita*
Spain	GSA 1	*Trachurus mediterraneus*
Spain	GSA 1	*Trachurus trachurus*
Spain	GSA 1	*Octopus vulgaris*
Spain	GSA 1	*Lophius budegassa*
Spain	GSA 1	*Micromesistius poutassou*
Spain	GSA 1	*Scyliorhinus canicula*
Spain	GSA 5	*Octopus vulgaris*
Spain	GSA 5	*Sardina pilchardus*
Spain	GSA 5	*Raja clavata*
Spain	GSA 5	*Trachurus mediterraneus*
Spain	GSA 5	*Loligo vulgaris*
Spain	GSA 5	*Lophius budegassa*
Spain	GSA 5	*Sepia officinalis*
Spain	GSA 6	*Sardina pilchardus*
Spain	GSA 6	*Sardinella aurita*
Spain	GSA 6	*Trachurus mediterraneus*
Spain	GSA 6	*Trachurus trachurus*
Spain	GSA 6	*Octopus vulgaris*
Spain	GSA 6	*Lophius budegassa*
Spain	GSA 6	*Eledone cirhosa*
Spain	GSA 6	*Sepia officinalis*
Spain	GSA 6	*Micromesistius poutassou*
France	GSA 7,8	*Octopus vulgaris*
France	GSA 7,8	*Scomber scombrus*
France	GSA 7,8	*Eledone cirrhosa*
France	GSA 7,8	*Lophius budegassa*
France	GSA 7,8	*Trachurus mediterraneus*
Malta	GSA 15	*Mullus surmuletus*
Italy	GSA 16, 19	*Aristeus antennatus*
Italy	GSA 16, 19	*Aristaeomorpha foliacea*
Italy	GSA 16	*Parapenaeus longirostris*
Italy	GSA 16	*Merluccius merluccius*
Italy	GSA 16, 19	*Mullus surmuletus*
Italy	GSA 16, 19	*Mullus barbatus*
Italy	GSA 16, 19	*Sardina pilchardus*

Slovenia	GSA 17	*Sparus aurata*
Slovenia	GSA 17	*Solea solea*
Slovenia	GSA 17	*Loligo vulgaris*
Slovenia	GSA 17	*Mullus barbatus*
Slovenia	GSA 17	*Pagellus erythrinus*
Slovenia	GSA 17	*Dicentrarchus labrax*
Slovenia	GSA 17	*Mugilidae*
Slovenia	GSA 17	*Sardina pilchardus*
Croatia	GSA 17	*Scomber colias*
Croatia	GSA 17	*Trachurus mediterraneus*
Croatia	GSA 17	*Trachurus trachurus*
Croatia	GSA 17	*Eledone moschata*
Croatia	GSA 17	*Octopus vulgaris*
Greece	GSA 20, 22, 23	*Boops boops*
Greece	GSA 20, 22, 23	*Mullus surmuletus*
Greece	GSA 20, 22, 23	*Pagellus erythrinus*
Greece	GSA 20, 22, 23	*Panaeus kerathurus*
Greece	GSA 20, 22, 23	*Spicara smaris*
Greece	GSA 20, 22, 23	*Scomber japonicus*
Cyprus	GSA 25	*Mullus surmuletus*
Cyprus	GSA 25	*Mullus barbatus*
Cyprus	GSA 25	*Siganus rivulatus*
Cyprus	GSA 25	*Siganus luridus*
Cyprus	GSA 25	*Diplodus sargus*
Bulgaria	GSA 29	*Mullus barbatus*
Bulgaria	GSA 29	*Rapana venosa*
Bulgaria	GSA 29	*Scophthalmus maximus*
Bulgaria	GSA 29	*Sprattus sprattus*
Bulgaria	GSA 29	*Squalus acanthias*
Bulgaria	GSA 29	*Trachurus mediterraneus*
Romania	GSA 29	*Mullus barbatus*
Romania	GSA 29	*Rapana venosa*
Romania	GSA 29	*Scophthalmus maximus*
Romania	GSA 29	*Sprattus sprattus*
Romania	GSA 29	*Squalus acanthias*
Romania	GSA 29	*Trachurus mediterraneus*

ToR ANNEX III

List of stocks for TOR 2

Area	Common name	Scientific name
GSA 1-5-6-7	Hake	*Merluccius merluccius*
GSA 1-5-6-7	Deep-water rose shrimp	*Parapenaeus longirostris*
GSA 1	Red mullet	*Mullus barbatus*
GSA 5	Striped red mullet	*Mullus surmuletus (*)*
GSA 6	Red mullet	*Mullus barbatus (*)*
GSA 7	Red mullet	*Mullus barbatus (*)*

GSA 5	Norway lobster	*Nephrops norvegicus*
GSA 6	Norway lobster	*Nephrops norvegicus*
GSA 8-9-10-11	Hake	*Merluccius merluccius*
GSA 9-10-11	Deep-water rose shrimp	*Parapenaeus longirostris*
GSA 9	Red mullet	*Mullus barbatus*
GSA 10	Red mullet	*Mullus barbatus*
GSA 9	Norway lobster	*Nephrops norvegicus*
GSA 11	Norway lobster	*Nephrops norvegicus*
GSA 1-2	Blue and red shrimp	*Aristeus antennatus*
GSA 5	Blue and red shrimp	*Aristeus antennatus* (*)
GSA 6-7	Blue and red shrimp	*Aristeus antennatus* (*)
GSA 8-9-10-11	Giant red shrimp	*Aristaeomorpha foliacea*
GSA 8-9-10-11	Blue and red shrimp	*Aristeus antennatus*

(*) if feasible, explore the possibility to merge red mullet in GSAs 5-6-7 and blue and red shrimp in GSAs 5-6-7.

(2 or 8) to be discussed by experts whether data of GSA 2 and 8 can be added to the assessment.

1.3 Request to the STECF

STECF is requested to review the report of the EWG 22-03, evaluate the findings and make any appropriate comments and recommendations, especially with regards to the upcoming EWG 22-09 on stock assessment in the Western Mediterranean Sea and EWG 22-11 on management measures for demersal fisheries in the western Mediterranean Sea.

1.4 STECF comments, observations, recommendations etc.

EWG 22-03 met online from 2-6 May with 23 experts of which 3 were members of JRC, and 2 were members of STECF. The objective of EWG 22-03 was to carry out data quality checks on a list of Member States, species, and areas (hereby referred to as “combinations”) supplied by DG MARE. The EWG also proposed biomass reference points for stocks assessed in the STECF EWGs on Western Mediterranean stock assessments, in accordance with the ToRs supplied.

The EWG was split in two sub-groups, with 14 experts dealing with TOR 1 (data checking), and 9 concentrating on TOR 2 (reference points). JRC staff assisted as required for both TORs. STECF acknowledges the EWG has addressed both TORs, giving priority workload to TOR 1 as requested by DGMARE. STECF acknowledges the extensive work carried out by the EWG, which is a major step forward for data quality checking and assessment of Mediterranean stocks. **Under ToR 1** STECF notes that the EWG has carefully evaluated data quality for all the priority 1 species and areas in the ToRs and an additional 25 species / areas (Table 1.4.1.1). STECF notes that in agreement with the procedures adopted, the information on errors or uncertainties in the data have already been communicated to the Member States National Correspondents.

1.4.1 ToR 1:

During its plenary discussion, STECF has noted a difference of perception between DG MARE and the EWG participants on the extent to which ToR 1 had been addressed. The EWG was requested to evaluate the data quality of 22 priority 1 combinations and “if time allowed”, as many as possible of the 73 priority 2 combinations. Additionally, at the request of DGMARE Unit D1 shortly before the EWG, *Chamelea galina* (Venus Clam) in GSA 17-18, *Aristaeomorpha foliacea* (Giant Red shrimp) in GSA 18-19-20 and *Aristeus antennatus* (blue and red shrimp) in GSA 18-19-20 were added to the list of stocks to be checked. This was based on data needs for STECF EWG 22-16. STECF notes that the EWG has carefully evaluated data quality for all the priority 1 combinations (including the 3 additional stocks, corresponding to 10 combinations), and an additional 15 priority 2 combinations totalling 47 combinations (Table 1.4.1.1). Combinations checked within the priority 2 list were freely selected by experts attending the EWG, spreading the workload across all GSAs. The remaining priority 2 combinations could not be checked due to time constraints.

STECF understands DG MARE's wish that all 73 Priority 2 combinations could have been checked by the EWG but agrees with the EWG that thoroughly investigating and documenting data quality is tedious and time-consuming (and even more for new combinations that had never been checked previously). STECF underlines that there is a limit in how many combinations could reliably be checked in the course of a 5-day EWG. Considering that this time limitation was also acknowledged by DG MARE in its formulation of the ToR 1, distinguishing between Priority 1 and Priority 2 combinations, STECF considers that ToR 1 has been adequately and thoroughly addressed. However, STECF acknowledges that more work is still needed to completely fulfil DG MARE's needs on this topic and considers that all procedures and tools developed and used by EWG 22-03 will be excellent support for helping future initiatives.

STECF notes that in agreement with the procedures adopted, information on errors or uncertainties in the data were listed in the Data Transmission and Monitoring Tool (DTMT). These have been communicated to the Member States National Correspondents through a pdf document reporting all the data issues observed during the quality checks. All of this information was transmitted by 17 May 2022.

STECF notes that the RDBqc package tested during the meeting provided consistent results compared to the JRC routine. The RDBqc package is an R package containing routines for data quality checks, developed under the RDBFIS regional grant (Call MARE/2020/08), which has the objective of developing the Med&BS regional database. The RDBqc package will be integrated within the Med&BS regional database as a web-based framework, allowing Member States to check the quality of the data before submission to the different data calls (MED&BS, FDI, AER). The JRC routines were developed and tested by the JRC team before the EWG and will be publicly available as annexes of the final report for EWG 22-03. The two routines, though, do not work on the same data format. The JRC routines work on the Med&BS Data Call format, while the RDBqc package is aimed at working on primary data (e.g., SDEF format), before the transformation in the format requested by the Data Call.

Table 1.4.1.1 List of MS/GSA/species data checked during the EWG (priority 1 combinations are in bold; priority 2 combinations are in black (not in bold); additional combinations requested for EWG 22-16 are in blue).

Slovenia	GSA 17	*Merlangius merlangus*	Cyprus	GSA 25	*Boops boops*
	GSA 17	*Eledone moschata*		GSA 25	*Spicara smaris*
	GSA 17	*Sparus aurata*		GSA 25	*Mullus barbatus*
	GSA 17	*Chamelea galina*	Malta	GSA 15	*Scomber colias*
Croatia	GSA 17	*Sardina pilchardus*		GSA 15	*Boops boops*
	GSA 17	*Engraulis encrasicolus*		GSA 15	*Mullus surmuletus*
	GSA 17	*Scomber colias*	Greece	GSA 20	*Sepia officinalis*
	GSA 17	*Atlantic horse mackerel*		GSA 22	*Sepia officinalis*
	GSA 17	*Mediterranean horse mackerel*		GSA 23	*Sepia officinalis*
	GSA 17	*Chamelea galina*		GSA 20	*Boops boops*
Bulgaria	GSA 29	*Engraulis encrasicolus*		GSA 22	*Boops boops*
	GSA 29	*Mullus barbatus*		GSA 23	*Boops boops*
	GSA 29	*Merlangius merlangus*		GSA 20	*Aristeus antennatus*
Romania	GSA 29	*Merlangius merlangus*		GSA 20	*Aristaeomorpha foliacea*
	GSA 29	*Mullus barbatus*	Italy	GSA 16	*Engraulis encrasicolus*
	GSA 29	*Engraulis encrasicolus*		GSA 19	*Engraulis encrasicolus*
France	GSA 7	*Sparus aurata*		GSA 16	*Aristeus antennatus*
	GSA 8	*Sparus aurata*		GSA 18	*Aristeus antennatus*
	GSA 7	*Octopus vulgaris*		GSA 19	*Aristeus antennatus*
Spain	GSA 5	*Engraulis encrasicolus*		GSA 18	*Aristaeomorpha foliacea*
	GSA 6	*Engraulis encrasicolus*		GSA 19	*Aristaeomorpha foliacea*
	GSA 1	*Sardina pilchardus*		GSA 17	*Chamelea galina*
	GSA 1	*Engraulis encrasicolus*		GSA 18	*Chamelea galina*
	GSA 6	*Sardina pilchardus*			

1.4.2 ToR 2:

STECF notes that the EWG has provided a framework based on deterministic age-structured equilibrium computations that integrates estimated stock recruitment functions with yield per recruit analysis. This allows evaluation of biomass reference points (Section 4.2 of the EWG report) and preliminary biomass reference points for all 14 of the western Mediterranean stocks for which full analytical assessments are available (Table 1.4.2.1). Stock recruitment relationships were fitted and evaluated with the FLR (Fisheries Library in R: Kell et al., 2007) package FLSRTMB (2021; https://github.com/flr/FLSRTMB), using maximum likelihood estimation in Template Model Builder (TMB; Kristensen 2015).

The available stock recruitment relationship models used were:

- Geometric mean
- Conditioned Hockey-Stick
- Beverton and Holt
- Ricker

STECF notes that the refinement of the Conditioned Hockey-Stick model (ICES, 2022) allows constraining the fitting algorithm of the segmented regression so that the breakpoint (Blim) is restricted to a specific range relative to virgin biomass B0 (1%-20% B0, Section 4.2.5 of the report). If no clear breakpoint can be identified within the defined range of 1%-20% B0, the EWG recommended that a reasonable first estimate of Blim can be computed as 25% of the biomass BF0.1 that corresponds to F0.1 (Section 4.2.3 in the report).

STECF acknowledges that the refinement of the Conditioned Hockey-Stick was possible thanks to extensive preparatory work by the JRC modelling group before the fitting could be run during the EWG.

STECF notes that for the estimation and evaluation of biomass reference points, a dedicated R package FLRef was specifically developed by the JRC for this EWG. This is now available on https://github.com/Henning-Winker/FLRef. This package is implemented with FLR and makes use of the optimisation routine for estimating fisheries reference points at equilibrium that is available in the FLBRP package.

STECF notes that Bpa was estimated as 2*Blim. A value of 2*Blim corresponds to a sigma (standard deviation of ln(SSB) at the start of the year following the terminal year of the assessment of 0.4, while the ICES procedure is based on a sigma = 0.2 when sigma is unknown. STECF endorses this adjustment which is justified to account for the larger presumed uncertainties in the estimates of the SSB in the terminal year in the assessment of the Mediterranean stocks.

STEFC notes that the EWG developed a decision-tree to provide guidelines for choosing the most appropriate approach to estimate Blim based on decision rules related to stock depletion and the contrast in the stock-recruitment data. STECF considers this decision-tree is highly useful and would merit scientific dissemination beyond EU Mediterranean stock assessment EWGs.

STECF endorses the proposed framework developed by the EWG which proved to be suitable/appropriate to estimate biological reference points in general as well as for short time series and stocks in poor conditions (See Section 4.3.1 of the report).

STECF notes that the framework has resulted in a preliminary classification of 14 stocks into three categories, based on the biomass status in the last assessment year: above B_{pa}, between B_{Lim} and B_{pa} and below B_{Lim}. For the remaining 5 stocks from Annex III, full analytical assessment models are not available, therefore biomass reference points could not be estimated for these. The assessment EWGs (e.g. EWGs 21-11 and 21-15) currently provide advice sheets with catch options based on exploitation status and target F_{MSY}, (for Mediterranean stocks F_{01} is used as a proxy of F_{MSY}) and $F_{MSY\ Transition}$, without consideration for potential additional measures to increase biomass. With the new estimation of biomass reference point provided by EWG 22-03, such additional considerations may now be provided in the catch options for stocks with biomass $<B_{pa}$.

STECF notes that ICES already accounts for such situations and provides exploitation advice under the following rule:

1. $F = F_{MSY}$ when the spawning–stock biomass is at or above MSY $B_{trigger}$; and
2. $F = F_{MSY} \times$ spawning–stock biomass/MSY $B_{trigger}$ when the stock is below MSY $B_{trigger}$ and above B_{Lim};
3. If the F following from applying rule 2 is insufficient to bring the stock above B_{Lim} in the short term, ICES advice is based on bringing the stock above B_{Lim} in the short term. This may result in zero catch advice.

STECF notes that such rules may be adapted in the context of the framework defined in the Western Med Map, with Bpa used as a trigger point. Option 1 above may also include substitution of F_{MSY} with $F_{MSY\ Transition}$ if, the stock is expected to be in transition to MSY, as is the case for some of the stocks assessed in the Western Mediterranean.

STECF suggests that DG MARE needs to consider if such catch options are required, and if so include them in the Terms of Reference for EWG 22-09 for inclusion in the Short-Term Forecast table. DG MARE should indicate if the headline advice in the first paragraph of Section 5 of the assessment EWG report should be based on the appropriate option (i.e., options 1 to 3) or based solely on option 1 regardless of biomass status as is the case currently.

STECF considers that it is appropriate to re-evaluate biomass reference points at regular intervals, the timing of which depends on the evolution of the status of the stock as well as on any substantial changes in data input, model assumptions or assessment methods. These revisions may be time-consuming as they require reconsidering the most appropriate and updated methods for deriving the biomass reference points. Therefore, dedicated ad-hoc EWGs may be convened when considered appropriate by the assessment EWGs, to assure coherent procedures of estimation of reference points are applied across stocks. To achieve this an overarching benchmarking strategy needs to be developed (e.g., periodicity and methodologies). In case of shared stocks, a coordinated strategy should be developed with international regional bodies such as GFCM.

Table 1.4.1.2 Summary of reference points results and status by stock. Recruitment model either Hockey-stick (hs) or Geometric Mean (gm) recruitment. The basis of B_{Lim} (B_{Lim} basis) is the fitted point of inflection in the Hockey Stick (hs. B_{Lim}) or 25% of B at $F_{0.1}$ (gm.0.25). Where $B_{F0.1}$ derived from is the MSY F proxy used in the EWG (F0.1) and is the estimated SSB at $F_{0.1}$. Un-fished biomass (B_0). Value of B_{Lim} (B_{Lim}). Value of B_{pa} (B_{pa}) based on factor of 2 from B_{Lim}, equivalent to a sigma of approximately 40%. F_{pa} is the F that will give B_{pa} on average. A number of ratios are provided to indicate where the stock parameters are located: Ratio of B_{Lim} to $B_{F0.1}$ (B_{Lim} / $B_{F0.1}$); Ratio of $B_{F0.1}$/ B_{pa} ($B_{F0.1}$/ B_{pa}) which represents the region below BMSY where risks of reduce recruitment are less than 5%; Ratio of B_{Lim} to the un-fished biomass (B_{Lim} / B_0), the region where it is considered R is not depleted. Ratio of B_{Lim} to BMSY (B_{Lim} / $B_{F0.1}$). Current stock status is also indicated relative to BMSY (B_{cur}/ $B_{F0.1}$) and relative to B_{Lim} (Bcur/ B_{Lim}). Current F status relative to FMSY (F_{cur}/F0.1)

Stock	**S-R / B_{Lim}**	**$F_{0.1}$**	**$B_{F0.1}$**	**B_0**	**B_{Lim}**	**B_{pa}**	**F_{pa}**	**B_{Lim} /**	**$B_{F0.1}$ / B_{pa}**	**$B_{F0.1}$ / B_0**	**B_{Lim} / B_0**	**B_{cur} / $B_{F0.1}$**	**B_{cur} / B_{Lim}**	**F_{cur} / $F_{0.1}$**
ARA01	hs.blim	0.292	529	1374	120	241	0.79	0.227	2.20	0.385	0.088	0.101	0.443	5.746
ARA06_07	hs.blim	0.286	1542	3924	263	525	1.01	0.170	2.94	0.393	0.067	0.350	2.056	2.985
ARA09_10_11	gm.0.25	0.294	649	1532	162	325	0.92	0.250	2.00	0.424	0.106	0.376	1.505	5.716
ARS09_10_11	gm.0.25	0.462	711	1713	178	356	1.50	0.250	2.00	0.415	0.104	0.626	2.503	2.129
DPS09_10_11	gm.0.25	1.287	900	3550	225	450	2.38	0.250	2.00	0.253	0.063	1.000	4.002	1.23
HKE01_05_06_07	hs.blim	0.444	59561	223391	4138	8276	1.26	0.069	7.20	0.267	0.019	0.024	0.339	4.369
HKE08_09_10_11	hs.blim	0.168	43255	103666	4316	8633	0.60	0.100	5.01	0.417	0.042	0.108	1.087	2.998
MUT01	hs.blim	0.607	419	1294	205	410	0.62	0.489	1.02	0.324	0.159	0.252	0.514	2.13
MUT06	gm.0.25	0.317	3307	7811	827	1653	0.87	0.250	2.00	0.423	0.106	0.649	2.596	2.837
MUT07	hs.blim	0.456	455	1416	128	256	0.87	0.282	1.77	0.321	0.091	1.062	3.768	1.369
MUT09	gm.0.25	0.52	1812	4385	453	906	1.40	0.250	2.00	0.413	0.103	1.076	4.305	0.721
MUT10	gm.0.25	0.401	954	2493	239	477	0.99	0.250	2.00	0.383	0.096	1.518	6.073	0.784
NEP06	gm.0.25	0.228	2013	6500	503	1007	0.41	0.250	2.00	0.31	0.077	0.253	1.013	1.132
NEP09	gm.0.25	0.297	812	2893	203	406	0.55	0.250	2.00	0.281	0.07	1.397	5.587	0.504

1.5 STECF conclusions on EWG-22-03

STECF concludes that, in addressing the TORs, EWG 22-03 has carried out extensive work before and during the EWG. STECF concludes that the EWG outcomes are a major step forward for the data quality checking of Mediterranean stocks.

Regarding TOR 1, STECF concludes that while not all Priority 2 combinations could be directly checked during the EWG itself, all the developed data checking routines are operational and available and can now be used by Member States to check their data before fulfilling the EU data call (MED&BS, FDI, AER).

Regarding ToR 2, STECF endorses the general approach for calculating biomass reference points. STECF concludes that the framework developed and tested during the EWG should be used by EWG 22-09 to estimate biomass reference points for western Mediterranean stocks.

STECF concludes that an overarching general benchmarking strategy for the regular updating of reference points and stock assessment methods needs to be developed with realistic timelines and methodologies.

1.6 STECF-references

ICES. 2022. Workshop on ICES reference points (WKREF1). ICES Scientific Reports. 4:2. 70 pp. http://doi.org/10.17895/ices.pub.9822

Kell, L. T., Mosqueira, I., Grosjean, P., Fromentin, J.-M., García, D., Hillary, R., Jardim, E., et al. 2007. FLR: an open-source framework for the evaluation and development of management strategies. ICES Journal of Marine Science, 64: 640-646.

Kristensen, K., Nielsen, A., Berg, C.W., Skaug, H., 2015. Template Model Builder TMB. J. Stat. Softw. 70, 1–21.

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[1] - Information on STECF members' affiliations is displayed for information only. In any case, Members of the STECF shall act independently. In the context of the STECF work, the committee members do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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REPORT TO THE STECF

EXPERT WORKING GROUP ON Quality checking of MED & BS data and reference points (EWG-22-03)

Virtual meeting, 02-06 May 2022

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1 INTRODUCTION

1.1 Organisation of the meeting

The meeting was held online from 2-6 May with 23 experts of which 3 were members of JRC, and 2 were members of STECF. The meeting ran from 0900 on Monday to 1800 daily finishing at 1700 on Friday 6 May.

The ToR 1 and 2 were allocated to two sub-groups, 14 dealing with data checking, and 9 concentrating on reference points with JRC staff assisting as required.

For ToR 1: all the priority stocks under ToR 1 along with 8 from priority 2 were allocated initially and where time permitted additional stocks under ToR 1 Annex II were allocated. Altogether a total of 25 from ToR 1 Annex 2 were checked for quality. In addition, also included were *Chamelea galina* (Venus Clam) in GSA 17 & 18 *Aristaeomorpha foliacea* (Giant Red shrimp) in GSA 18-19&20 and *Aristeus antennatus* (blue and red shrimp) in GSA 18,19 & 20 based on data needs for STECF EWG 22-16. Some of these, but not all, are also included in ToR 1 Annex II as priority II stocks. Prior to the meeting JRC had further developed a data inconsistency checking R script based on the analysis carried out in 2021 at EWG 21-02. This was used before and during the meeting to prepare pdf documents that describe the data and its inconsistencies by MS, GSA and species. The pdfs produced by the script are provided as Annex 1 to the report. Following the meeting the main issues were collated and entered into the DTMT and communicated to the MS National correspondents.

For ToR 2: Prior to the meeting JRC developed a series of routines to explore stock dynamics and fitting of S-R functions to 2021 assessment output data for the 13 stocks with assessments. The remaining 5 stocks without assessments were explored separately. The stocks were allocated amongst the 8 participants by species with between 2-4 stocks per participant. The results from the assessed stocks were compared for consistency, and used to develop a framework for setting reference points for the available stocks. Having explored the S-R relationships and completed the framework, preliminary values of B_{Lim}, Bpa and Fpa were estimated. Some short lived early maturing species are difficult to obtain Flim values without some additional assumptions for modelling, so Flim was not provided.

1.2 Organisation of the report

Section 5 contains the full set of observation for data checking under ToR 1 and a copy of the DTMT entries communicated to MS. It is organised by Member State/GSA/species for all data sets checked. Additional section (5.11, 5.12 and 5.13) address data preparation for previously un-assessed stocks that may be required for STECF EWG 22-16 (Assessment in Adriatic, Ionian and Aegean Seas). Section 6 documents the data, exploratory analysis and results for ToR 2. Section 6 is organised by species/stock for ToR 2.

Section 2 provides a summary of the work and results from both ToRs. Section 3 details some future work requirements and suggestions for organisation of future activities. Section 4 details the methodology applied in the work. Section 4.1 gives background and methodology followed for data checking. Section 4.2 presents the basis and methods used for reference points. Section 4.3 examines temporal consistency and sensitivity of the chosen methodology to some of the decisions.

1.3 Terms of Reference for EWG-22-03

STECF EXPERT WORKING GROUP (EWG) 22-03n Quality checking of MED & BS data and reference points 02 May – 06 May 2022

Chair: John Simmonds

DG MARE focal persons: TOR 1: Venetia Kostopoulou (MARE C3); TOR 2: Anne-Cecile Dragon (MARE D1).

Background TOR 1 - Quality checking of MED & BS data

In recent years, STECF Expert Working Groups (EWG) on stock assessment have mainly focused on stocks in the Western Med, Adriatic and Ionian/Aegean Seas; for the remaining areas and stocks there is no information on the quality of the collected data. With regards to the Med & BS data call, the Regional Coordination Group (RCG) Med & BS[9] end user subgroup[10] considered that quality checks by EWGs on stock assessments only cover stocks to be assessed and not the whole set of data reported in the data call. This creates unbalanced reporting on data issues among MS and puts some MS in an unfavourable position[11]. In addition, not all stocks are assessed in the year following data collection, so some potential problems in data submitted in response to a data call during year N will be spotted by end-users in years N+2, N+3, N+4 etc. Such a situation is not ideal, if one takes into account that other end-users (projects etc.) may eventually use these data.

The RCG Med & BS end user subgroup discussed several possible ways to improve data quality before the operational deadline of data calls, including a specific ad-hoc EWG on data quality, accuracy and completeness with a focus to improve data quality before data use in the EWGs for stock assessments. The **EWG 21-02**[12] served this purpose. This EWG was requested to check and assemble Length Frequency Distribution (LFD) data for the stocks identified as target for assessment activities in 2020. The EWG checked underlying data sets and defined the correct procedures to deal with missing data, raising procedures (specifically for survey data), wrong length measurements, and proposed standardized procedures to be followed from then on.

As a follow up to EWG 21-02, COM proposed an ad hoc EWG to quality check the Med & BS data not currently scrutinized in STECF stock assessments. This EWG should use the outcomes of the EWG 21-02 and apply them to, at least, the priority stocks for each country, as well as agree on other possible quality checks to describe the level of completeness of data submitted to the DG MARE Med & BS data call.

Following COM proposal, STECF[13] considered that it could be beneficial to have a general overview of the quality of the data collected by the MS under the Mediterranean and Black Sea data call. Given the large number of species, GSA and country combinations, STECF considered that the number of data quality checks and number of species/GSA should be proportionate to the duration and workload of the EWG and therefore subject to some prioritization.

To this end, the RCG Med & BS held a joint meeting with all involved parties[14] to identify the priority stocks/GSA to be tackled by this EWG. As an outcome of this meeting, the MS - using the CFP monitoring exercise as a basis - proposed a list of stocks not assessed by STECF[15], based on landings and income/value, averaged over 3 years, including data availability as an additional factor (Annexes I and II).

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[9] https://www.fisheries-rcg.eu/rcg-medbs/

[10] Regional Coordination Group Med & Black Sea Subgroup on 'Meeting with End-users of Scientific Data' (12-14 March 2019, Rome). The report is available on the DCF website (https://datacollection.jrc.ec.europa.eu/docs/rcg).

[11] Due to the fact that specific stocks are assessed, only the relevant Member States that collect data on these stocks receive data issues from STECF EWGs.

[12] EWG 21-02: Methods for supporting stock assessment in the Mediterranean, 12 - 16 April 2021 (Report)

[13] STECF Plenary 21-02: 5.1 EWG 21-02 Methods for supporting stock assessment in the Mediterranean (Report).

[14] Joint meeting of the RCG Med & BS, DG MARE, JRC & STECF on data quality and availability, 16 December 2021, online.

[15] previous STECF EWGs.

TOR 1

The EWG is requested to check the coverage and quality of the data hosted in the JRC database for the stocks of Annex I. If time allows, the EWG is invited to repeat the same exercise for (as many of) the remaining stocks proposed by Member States, as listed in Annex II. For this purpose, the EWG is invited to use the outcomes of the EWG 21-02, as well as additional relevant tools that may be available from other sources, such as other STECF EWGs, GFCM, checks developed and used by JRC, work under projects and grants etc. The EWG may also develop new tools. The consolidated checks used under the EWG should be clearly listed and described, to allow their use by the Member States in the future.

The EWG may contact the National Correspondents of Member States to request clarifications on the data sets during the meeting, if needed. Relevant reports of working groups from STECF and GFCM may also be used as background documents.

One of the main outcomes will be to produce a report per MS, where the results of the data checks will be described. In addition, the EWG is requested to propose possible actions to improve the data sets, as well as improvements to the future data collection activities of the MS. The EWG should clearly highlight cases where the applied and available checks may not be adequate/ relevant for specific data sets and propose ways forward.

All unresolved data issues encountered during the EWG meeting should be reported on line via the Data Transmission Monitoring Tool (DTMT) available at https://datacollection.jrc.ec.europa.eu/web/dcf/dtmt (with restricted access). All output should clearly indicate that issues come from this specific EWG ('EWG 22-03'). Further guidance on precisely what should be inserted in the DTMT, log-on credentials and access rights will be provided separately by the STECF Secretariat focal point for the EWG.

Following the preliminary outcomes of this EWG[16], and if time permits, the Member States will be requested to re-upload corrected historic data sets during the official data calls.

Background TOR 2- reference points

These ToRs deal with the methodology and estimation of conservation reference points for demersal stocks in the Western Mediterranean.

The Western Mediterranean multiannual management plan (West Med MAP) was adopted in 2019. It encompasses a fishing effort regime and various technical and conservation measures to address the overexploitation of demersal stocks, in particular of six main target species listed in Article 1(2).

The main objective and legal obligation (Article 7(3)b) of the West Med MAP is to achieve fishing mortality securing Maximum Sustainable Yield (Fmsy) for all demersal stocks by 1 January 2025 at the latest.

Article 5 of the West Med MAP specifies which Conservation reference points are to be used for the management decisions:

"the following conservation reference points shall be requested, in particular from STECF, or a similar independent scientific body recognised at Union or international level, on the basis of the plan:

(a) precautionary reference points, expressed as spawning stock biomass (BPA); and

(b) limit reference points, expressed as spawning stock biomass (BLIM)."

And Article 2 of the West Med MAP provides the following legal definitions:

[16] before the outcomes are discussed at STECF Plenary.

(5) 'FMSY point value' means the value of the estimated fishing mortality that, with a given fishing pattern and under current average environmental conditions, gives the long-term maximum yield;

(10) 'BLIM' means the limit reference point, expressed as spawning stock biomass and provided for in the best available scientific advice, in particular by STECF, or a similar independent scientific body recognised at Union or international level, below which there may be reduced reproductive capacity;

(11) 'BPA' means the precautionary reference point, expressed as spawning stock biomass and provided for in the best available scientific advice, in particular by STECF, or a similar independent scientific body recognised at Union or international level, which ensures that the spawning stock biomass has less than 5 % probability of being below BLIM;

The safeguard mechanisms under the West Mediterranean EU MAP7 demersal plan can thus be triggered by levels of SSB falling below given thresholds. For stocks for which targets relating to MSY are available, and for the purpose of the application of safeguards, it is necessary to establish conservation reference points, expressed as precautionary reference points (B_{pa}) and limit reference points (B_{Lim}).

Appropriate safeguards should be provided for in order to ensure that the targets are met and to trigger, where needed, remedial measures, inter alia, where stocks fall below the conservation reference points.

TOR 2

In preparation for the Expert Working Group on stock assessments in the western Mediterranean Sea (EWG 22-09) and the Expert Working Group on fishing effort regime for demersal fisheries in the western Mediterranean (EWG 22-11), EWG 22-02 is requested to estimate preliminary B_{Lim} and B_{pa} biological reference points, as well as other reference points that could be estimated (e.g. Bmsy), for the 6 main target species under the West Med MAP. The preliminary values and the approach should be presented to STECF summer plenary with the aim of giving final values in EWG 22-11.

Using existing stock assessments, EWG 22-02 is requested to define an appropriate practical framework for deriving the conservation reference points (i.e. B_{pa} and B_{Lim}) for the demersal stocks in the West Mediterranean listed in Annex III. The proposed values shall be related to long-term high yields and low risk of stock/fishery collapse and ensure that the exploitation levels restore and maintain marine biological resources at least at levels which can produce the maximum sustainable yield. The supplied approach should draw on the experience with other approaches (e.g. ICES and GFCM) where applicable. Where other approaches are needed specifically for species with short time series, alternatives should be proposed.

ToR ANNEX I

List of stocks for TOR 1

Member State	Area (GSA)	Scientific name
Spain	GSA 1	*Sardina pilchardus*
Spain	GSA 5	*Engraulis encrasicolus*
Spain	GSA 6	*Engraulis encrasicolus*
France	GSA 7	*Sparus aurata*
France	GSA 8	*Sparus aurata*
Malta	GSA 15	*Scomber colias*
Malta	GSA 15	*Boops boops*
Italy	GSA 16	*Engraulis encrasicolus*
Italy	GSA 19	*Engraulis encrasicolus*
Slovenia	GSA 17	*Merlangius merlangus*
Slovenia	GSA 17	*Eledone moschata*
Croatia	GSA 17	*Sardina pilchardus*
Croatia	GSA 17	*Engraulis encrasicolus*
Greece	GSA 20	*Sepia officinalis*
Greece	GSA 22	*Sepia officinalis*
Greece	GSA 23	*Sepia officinalis*
Cyprus	GSA 25	*Boops boops*
Cyprus	GSA 25	*Spicara smaris*
Bulgaria	GSA 29	*Engraulis encrasicolus*
Bulgaria	GSA 29	*Merlangius merlangus*
Romania	GSA 29	*Engraulis encrasicolus*
Romania	GSA 29	*Merlangius merlangus*

ToR ANNEX II

List of additional stocks for TOR 1

Member State	Area (GSA)	Scientific name
Spain	GSA 1	Engraulis encrasicholus
Spain	GSA 1	Sardinella aurita
Spain	GSA 1	Trachurus mediterraneus
Spain	GSA 1	Trachurus trachurus
Spain	GSA 1	Octopus vulgaris
Spain	GSA 1	Lophius budegassa
Spain	GSA 1	Micromesistius poutassou
Spain	GSA 1	Scyliorhinus canicula
Spain	GSA 5	Octopus vulgaris
Spain	GSA 5	Sardina pilchardus
Spain	GSA 5	Raja clavata
Spain	GSA 5	Trachurus mediterraneus
Spain	GSA 5	Loligo vulgaris
Spain	GSA 5	Lophius budegassa
Spain	GSA 5	Sepia officinalis
Spain	GSA 6	Sardina pilchardus
Spain	GSA 6	Sardinella aurita
Spain	GSA 6	Trachurus mediterraneus

Spain	GSA 6	Trachurus trachurus
Spain	GSA 6	Octopus vulgaris
Spain	GSA 6	Lophius budegassa
Spain	GSA 6	Eledone cirhosa
Spain	GSA 6	Sepia officinalis
Spain	GSA 6	Micromesistius poutassou
France	GSA 7,8	Octopus vulgaris
France	GSA 7,8	Scomber scombrus
France	GSA 7,8	Eledone cirrhosa
France	GSA 7,8	Lophius budegassa
France	GSA 7,8	Trachurus mediterraneus
Malta	GSA 15	Mullus surmuletus
Italy	GSA 16, 19	Aristeus antennatus
Italy	GSA 16, 19	Aristaeomorpha foliacea
Italy	GSA 16	Parapenaeus longirostris
Italy	GSA 16	Merluccius merluccius
Italy	GSA 16, 19	Mullus surmuletus
Italy	GSA 16, 19	Mullus barbatus
Italy	GSA 16, 19	Sardina pilchardus
Slovenia	GSA 17	Sparus aurata
Slovenia	GSA 17	Solea solea
Slovenia	GSA 17	Loligo vulgaris
Slovenia	GSA 17	Mullus barbatus
Slovenia	GSA 17	Pagellus erythrinus
Slovenia	GSA 17	Dicentrarchus labrax
Slovenia	GSA 17	Mugilidae
Slovenia	GSA 17	Sardina pilchardus
Croatia	GSA 17	Scomber colias
Croatia	GSA 17	Trachurus mediterraneus
Croatia	GSA 17	Trachurus trachurus
Croatia	GSA 17	Eledone moschata
Croatia	GSA 17	Octopus vulgaris
Greece	GSA 20, 22, 23	Boops boops
Greece	GSA 20, 22, 23	Mullus surmuletus
Greece	GSA 20, 22, 23	Pagellus erythrinus
Greece	GSA 20, 22, 23	Panaeus kerathurus
Greece	GSA 20, 22, 23	Spicara smaris
Greece	GSA 20, 22, 23	Scomber japonicus
Cyprus	GSA 25	Mullus surmuletus
Cyprus	GSA 25	Mullus barbatus
Cyprus	GSA 25	Siganus rivulatus
Cyprus	GSA 25	Siganus luridus
Cyprus	GSA 25	Diplodus sargus
Bulgaria	GSA 29	Mullus barbatus
Bulgaria	GSA 29	Rapana venosa
Bulgaria	GSA 29	Scophthalmus maximus
Bulgaria	GSA 29	Sprattus sprattus
Bulgaria	GSA 29	Squalus acanthias

Bulgaria	GSA 29	Trachurus mediterraneus
Romania	GSA 29	Mullus barbatus
Romania	GSA 29	Rapana venosa
Romania	GSA 29	Scophthalmus maximus
Romania	GSA 29	Sprattus sprattus
Romania	GSA 29	Squalus acanthias
Romania	GSA 29	Trachurus mediterraneus

ToR ANNEX III

List of stocks for TOR 2

Area	**Common name**	**Scientific name**
GSA 1-5-6-7	Hake	*Merluccius merluccius*
GSA 1-5-6-7	Deep-water rose shrimp	*Parapenaeus longirostris*
GSA 1	Red mullet	*Mullus barbatus*
GSA 5	Striped red mullet	*Mullus surmuletus (*)*
GSA 6	Red mullet	*Mullus barbatus (*)*
GSA 7	Red mullet	*Mullus barbatus (*)*
GSA 5	Norway lobster	*Nephrops norvegicus*
GSA 6	Norway lobster	*Nephrops norvegicus*
GSA 8-9-10-11	Hake	*Merluccius merluccius*
GSA 9-10-11	Deep-water rose shrimp	*Parapenaeus longirostris*
GSA 9	Red mullet	*Mullus barbatus*
GSA 10	Red mullet	*Mullus barbatus*
GSA 9	Norway lobster	*Nephrops norvegicus*
GSA 11	Norway lobster	*Nephrops norvegicus*
GSA 1-2	Blue and red shrimp	*Aristeus antennatus*
GSA 5	Blue and red shrimp	*Aristeus antennatus* (*)
GSA 6-7	Blue and red shrimp	*Aristeus antennatus* (*)
GSA 8-9-10-11	Giant red shrimp	*Aristaeomorpha foliacea*
GSA 8-9-10-11	Blue and red shrimp	*Aristeus antennatus*

(*) if feasible, explore the possibility to merge red mullet in GSAs 5-6-7 and blue and red shrimp in GSAs 5-6-7.

(2 or 8) to be discussed by experts whether data of GSA 2 and 8 can be added to the assessment.

2 SUMMARY OF MAIN OUTCOMES

This section provides a summary of the outcomes of the EWG. The two ToRs are reported in turn.

2.1 Data Quality

The results of the data quality checks were completed for all priority 1 stocks, and 21 priority 2 stocks (Table 2.1.1). Two additional stocks (4 GSA species combinations) required for EWG22-16 but not noted in ToR 1 Annex II are also included in the table. In addition to checking, data preparation was also carried out for three potential stocks for EWG 22-16. For Venus clam GSA 17-18 only catch data are available, limiting the assessment options to a surplus production model. However, in the absence of tuning data a surplus production approach will only be possible with other strong assumptions (e.g. CMSY). No model has yet been investigated. Data were prepared by length and by sex for giant red shrimp in GSA 17 and 18, for GSA 20 no catches are reported. The growth curves from giant red shrimp provided show clear sexual dimorphism. The results of an initial model suggest significant differences in the selectivity of age 1 for the two sexes. The shift implied by the growth curves supplied is such that combined sex model may cause issues with cohort identification. A separate sex model has not been tested. The models imply that immature growth is particularly different between sexes, this should be checked before proceeding. For blue and red shrimp (GSA 18, 19 &20) the data has been checked and it was found that sex specific growth functions were unavailable. This information is likely to be needed for an age based assessment approach to work. Some work on length age conversion was attempted, but further analyses are required for both the two crustacean species before assessment approaches can be considered.

The results of the data checking (reported in Section 5) for the species given in Table 2.1.1 were collated after the EWG; entered into the DTMT tool and transmitted to MS national correspondents by 17 May 2022.

Table 2.1.1 list of MS/GSA/species data checked (priority 1 species black; lower priority species blue)

Slovenia	GSA 17	*Merlangius merlangus*	Cyprus	GSA 25	*Boops boops*
	GSA 17	*Eledone moschata*		GSA 25	*Spicara smaris*
	GSA 17	*Sparus aurata*		GSA 25	*Mullus barbatus*
	GSA 17	*Venus gallina*	Malta	GSA 15	*Scomber colias*
Croatia	GSA 17	*Sardina pilchardus*		GSA 15	*Boops boops*
	GSA 17	*Engraulis encrasicolus*		GSA 15	*Mullus surmuletus*
	GSA 17	*Scomber colias*	Greece	GSA 20	*Sepia officinalis*
	GSA 17	*Atlantic horse mackerel*		GSA 22	*Sepia officinalis*
	GSA 17	*Mediterranean horse mackerel*		GSA 23	*Sepia officinalis*
	GSA 17	*Venus gallina*		GSA 20	*Boops boops*
Bulgaria	GSA 29	*Engraulis encrasicolus*		GSA 22	*Boops boops*
Romania	GSA 29	*Engraulis encrasicolus*		GSA 23	*Boops boops*
Bulgaria	GSA 29	*Mullus barbatus*		GSA 20	*Aristeus antennatus*
Bulgaria	GSA 29	*Merlangius merlangus*		GSA 20	*Aristaeomorpha foliacea*
Romania	GSA 29	*Merlangius merlangus*	Italy	GSA 16	*Engraulis encrasicolus*
Romania	GSA 29	*Mullus barbatus*		GSA 19	*Engraulis encrasicolus*
France	GSA 7	*Sparus aurata*		GSA 16	*Aristeus antennatus*
	GSA 8	*Sparus aurata*		GSA 18	*Aristeus antennatus*
	GSA 7	*Octopus vulgaris*		GSA 19	*Aristeus antennatus*
Spain	GSA 5	*Engraulis encrasicolus*		GSA 18	*Aristaeomorpha foliacea*
	GSA 6	*Engraulis encrasicolus*		GSA 19	*Aristaeomorpha foliacea*
	GSA 1	*Sardina pilchardus*		GSA 17	*Venus gallina*
	GSA 1	*Engraulis encrasicolus*		GSA 18	*Venus gallina*
	GSA 6	*Sardina pilachardus*			

2.2 Reference points

Based on the requirements of the Western Med MAP, efforts were concentrated on determining biomass limit reference points (B_{Lim}) for the currently assessed stocks. Additional management reference points obtained were computed from the models consistent with the B_{Lim} resulting from this process.

The 14 stocks with accepted assessments were evaluated for stock-recruitment (S-R) relationships. Beverton-Holt (BH), Ricker (RK), Hockey-stick (HS) and geometric means (GM) were fitted to the SSB and recruitment data. It was not possible to obtain good sensible parameterisation for any stock using BH or RK models. due to the short time series available and the range of biomass levels observed. For 8 of the 14 stocks plausible HS breakpoints could not be established within the data to represent B_{Lim}. A framework for evaluating the data was developed. This was based on the perception that there would be a region around MSY where recruitment would be expected to be variable with a consistent mean, and a region at lower biomass where recruitment would be expected to decline. The final form of the framework had several main guiding principles:

A decline in recruitment would exist but only below 20% of unexploited biomass (B_0).

If a breakpoint below 20% of B_0 was observed within the data it should be accepted and stock dynamics would be assumed to follow a HS model

Stocks with SSB showing no point of inflection below 20% of B_0 it could be assumed to have flat GM recruitment over the range of observations.

If no breakpoint was observed a default value 25% of the B_{MSY} proxy $B_{F0.1}$ should be used for B_{Lim}. Stock dynamics would be assumed to follow a HS model with the breakpoint at default B_{Lim} and asymptotic recruitment equal to the GM.

These criteria, and their basis, are discussed in detail Section 4.2. A discussion of sensitivity is provided in section 4.3.

Using the estimated SSB and Recruitment time series from the assessments and the above concepts, all the stocks were evaluated. $F_{0.1}$ was computed and the corresponding biomass $B_{F0.1}$ and B_{Lim} derived from the corresponding HS and GM model. The stock dynamics based on a Hockey-stick model was assumed for all Of the 14 stocks six were found to have numerically determinable breakpoints and the fitted Hockey-stick model parameters used. Some sensitivity tests (jitter of fitting and retrospective checks) were carried out to ensure breakpoints detected were not spurious. The remaining 8 were assigned R_0 based on the Geometric Mean recruitment and then a breakpoint at 25% of $B_{F0.1}$. The average of the six estimated breakpoints was 22% of $B_{F0.1}$, suggesting that the choice of 25% in the absence of observable values was not inappropriate. It was considered preferable to try to place B_{Lim} in an appropriate place for these stocks rather than use just the lower limits to data, which would have been an alternative option. Four of the six stocks, where estimates were obtained, had breakpoints at less than 25% of $B_{F0.1}$ and two above. The input data and resulting S-R functions and how these are placed in the selected framework can be seen on a relative SSB/R scale in Figure 2.2.1. Species are denoted by different colours and GSA stock units by symbol. It is important to note that in almost all cases an individual stock occupies only a small range if biomass, e.g. Hake stocks are seen only at low biomass, and in contrast deepwater rose shrimp are found at biomasses only close to $B_{F0.1}$. The placement of each stock is based on the observed biomass relative to $B_{F0.1}$ and recruitment relative to the stocks full recruitment potential at biomass levels larger than B_{LIM}.

These estimated B_{Lim} values are conditional on the assessments and will need final update in September. Several stocks (e.g. Deepwater rose shrimp in 9, 10 & 11, Blue and red shrimp in 6&7 and Nephrops in 9) require some revision to the input data from EWG 21-09 at EWG 22-09 and then checks on fitted models.

Where data are uninformative regarding estimating B_{Lim} directly and some assumptions are necessary before reference points could be specified. Such assumptions could have been in terms of slope to the origin of the S-R function, or in relative biomass. The instability of slope values for fitted models and the relative stability of Geometric Mean recruitment (Section 4.3) meant the biomass option was more stable for advice and therefore preferable. The EWG considers that the approach selected appears to provide a fairly consistent framework to evaluate stock status across all the stocks examined. The sensitivity of B_{Lim} estimates to the assumptions of this approach have in part been inferred from the work described in Section 4.3. It is anticipated that the approach will evolve over time as more data becomes available.

Based on these selected values of B_{Lim}, B_{pa}, and F_{pa} were calculated. B_{pa} was based on a factor of 2 from B_{Lim}; this is equivalent to a stock estimation error (sigma) of approximately 40%. The relatively high value was chosen to reflect the considerable uncertainty in the Western Med assessments and the fact that B_{Lim} is in all cases sensitive to some of the assumptions regarding stock productivity and in many cases outside the range of biomass observed. In contrast ICES has used a factor of 1.4 based on sigma of 20%; however, evaluations carried out by ICES (WKREF1 2021) suggest this value leads to rather higher than 5% risk of $B< B_{Lim}$, possibly because it underestimates the real uncertainty in the assessments. The EWG considered the stock estimation in the Western Med is generally more uncertain than for the typical ICES stock based on data sampling intensity, length of time series of available data and the process of converting lengths to ages, for particularly the crustaceans. The higher safety margin chosen reflects both the increased uncertainty in the assessments but also the uncertainty in B_{Lim}.

The selected reference points and their relationship to the other biomass and F parameters are given in Figure 2.2.1. Current stock status relative to BLim and Bpa based on Fcur and Bcur from the assessments is included in Table 2.2.1 and summarised in Figure 2.2.2

The resulting stock status B_{cur} relative to B_{Lim} by stock shows that three stocks are estimated to be below BLim (hake 1-5-6&7, red mullet GSA 1, and blue & red shrimp GSA 1) Figure 2.2.2 and Table 2.2.1. Three stocks are between BLim and Bpa (hake 8-9-10-11, Nephrops 6, and blue & red shrimp 9-10-11) and the remaining eight stocks are above Bpa (red mullet 6, 7, 9, 10, blue & red shrimp 6-7, giant red shrimp 9-10-11, Deep water rose shrimp 9-10-11, and Nephrops 9). Of these five are at or above the B_{MSY} proxy of $B_{F0.1}$

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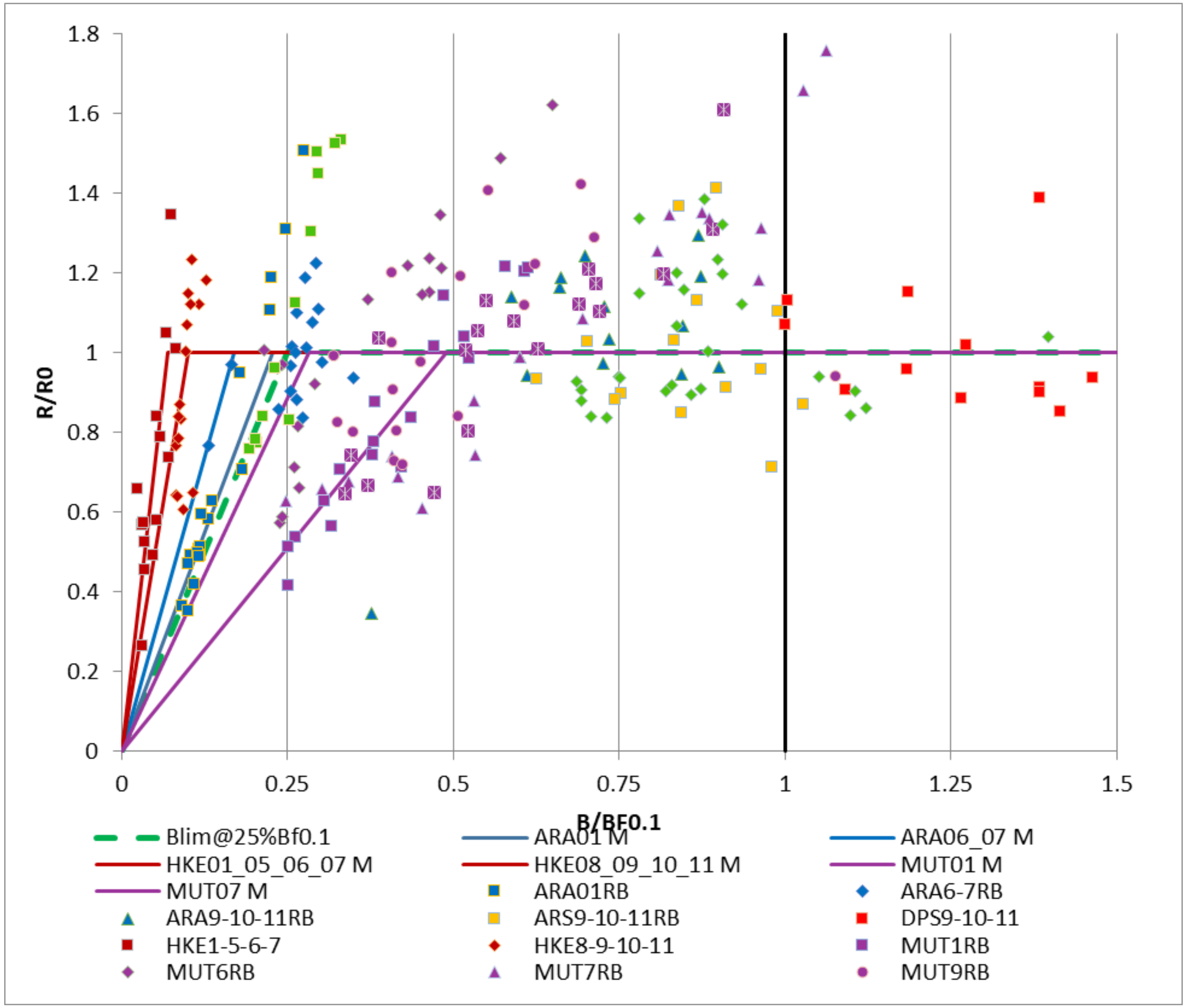

Figure 2.2.1: Summary Plot of input data, fitted and assumed point of inflection in HS stock recruit relationships. The points represent relative recruitment and SSB by species and stock. There have been placed relative to $B_{F0.1}$ (proxy for B_{MSY}) and full recruitment R_0. Solid lines show fitted values for 6 stocks; the dotted line shows the assumed point of inflection for the 8 remaining stocks.

Table 2.2.1: Summary of reference points results and status by stock. Recruitment model either Hockey-stick (hs) or Geometric Mean (gm) recruitment. The basis of B_{Lim} (B_{Lim} basis) is the fitted point of inflection in the Hockey Stick (hs. B_{Lim}) or 25% of B at $F_{0.1}$ (gm.0.25). where $B_{F0.1}$ derived from is the MSY F proxy used in the EWG ($F_{0.1}$) and is the estimated SSB at $F_{0.1}$. Un-fished biomass (B_0). Value of B_{Lim} (B_{Lim}). Value of B_{pa} (B_{pa}) based on factor of 2 from B_{Lim}, equivalent to a sigma of approximately 40%. F_{pa} is the F that will give B_{pa} on average. A number of ratios are provided to indicate where the stock parameters are located: Ratio of B_{Lim} to $B_{F0.1}$ (B_{Lim} / $B_{F0.1}$); Ratio of $B_{F0.1}$ / B_{pa} ($B_{F0.1}$ / B_{pa}) which represents the region below B_{MSY} where risks of reduce recruitment are less than 5%; Ratio of B_{Lim} to the un-fished biomass (B_{Lim} / B_0), the region where it is considered R is not depleted. Ratio of B_{Lim} to BMSY (B_{Lim} / $B_{F0.1}$). Current stock status is also indicated relative to BMSY (B_{cur} / $B_{F0.1}$) and relative to B_{Lim} (B_{cur} / B_{Lim}). Current F status relative to F_{MSY} (F_{cur}/F0.1)

Stock	S-R / B_{Lim} Basis	$F_{0.1}$	$B_{F0.1}$	B_0	B_{Lim}	B_{pa}	F_{pa}	B_{Lim} / $B_{F0.1}$	$B_{F0.1}$/ B_{pa}	$B_{F0.1}$/ B_0	B_{Lim} / B_0	B_{cur}/$B_{F0.1}$	B_{cur}/ B_{Lim}	F_{cur}/$F_{0.1}$
ARA01	hs.blim	0.292	529	1374	120	241	0.79	0.227	2.20	0.385	0.088	0.101	0.443	5.746
ARA06_07	hs.blim	0.286	1542	3924	263	525	1.01	0.170	2.94	0.393	0.067	0.350	2.056	2.985
ARA09_10_11	gm.0.25	0.294	649	1532	162	325	0.92	0.250	2.00	0.424	0.106	0.376	1.505	5.716
ARS09_10_11	gm.0.25	0.462	711	1713	178	356	1.50	0.250	2.00	0.415	0.104	0.626	2.503	2.129
DPS09_10_11	gm.0.25	1.287	900	3550	225	450	2.38	0.250	2.00	0.253	0.063	1.000	4.002	1.23
HKE01_05_06_07	hs.blim	0.444	59561	223391	4138	8276	1.26	0.069	7.20	0.267	0.019	0.024	0.339	4.369
HKE08_09_10_11	hs.blim	0.168	43255	103666	4316	8633	0.60	0.100	5.01	0.417	0.042	0.108	1.087	2.998
MUT01	hs.blim	0.607	419	1294	205	410	0.62	0.489	1.02	0.324	0.159	0.252	0.514	2.13
MUT06	gm.0.25	0.317	3307	7811	827	1653	0.87	0.250	2.00	0.423	0.106	0.649	2.596	2.837
MUT07	hs.blim	0.456	455	1416	128	256	0.87	0.282	1.77	0.321	0.091	1.062	3.768	1.369
MUT09	gm.0.25	0.52	1812	4385	453	906	1.40	0.250	2.00	0.413	0.103	1.076	4.305	0.721
MUT10	gm.0.25	0.401	954	2493	239	477	0.99	0.250	2.00	0.383	0.096	1.518	6.073	0.784
NEP06	gm.0.25	0.228	2013	6500	503	1007	0.41	0.250	2.00	0.31	0.077	0.253	1.013	1.132
NEP09	gm.0.25	0.297	812	2893	203	406	0.55	0.250	2.00	0.281	0.07	1.397	5.587	0.504

*Blue and red shrimp (ARA) in GSA 6 & 7 was found to have potential catch errors in the first two years and the evaluation was carried out 2004-2020 (17 years) (see section 6.5.3) ; ^ Deepwater rose shrimp in GSA 9, 10 & 11 has a value of fraction mature of 0.45 at age 0. This is not thought to have significant influence on the state of the stock, but it appears high and should be checked. # Nephrops (NEP) in GSA 9 was found to have a mistake in the mean weights age 1 in 2018 and 2019, and more importantly the maturity ogive was incorrectly set by age in all years (see section 6.4.2). Nephrops (NEP) GSA 6 was found to have a miss-specified plusgroup that slightly changed F0.1. These were corrected and the analysis completed with the corrected values. Both data sets will be checked again before final values are computed in September.

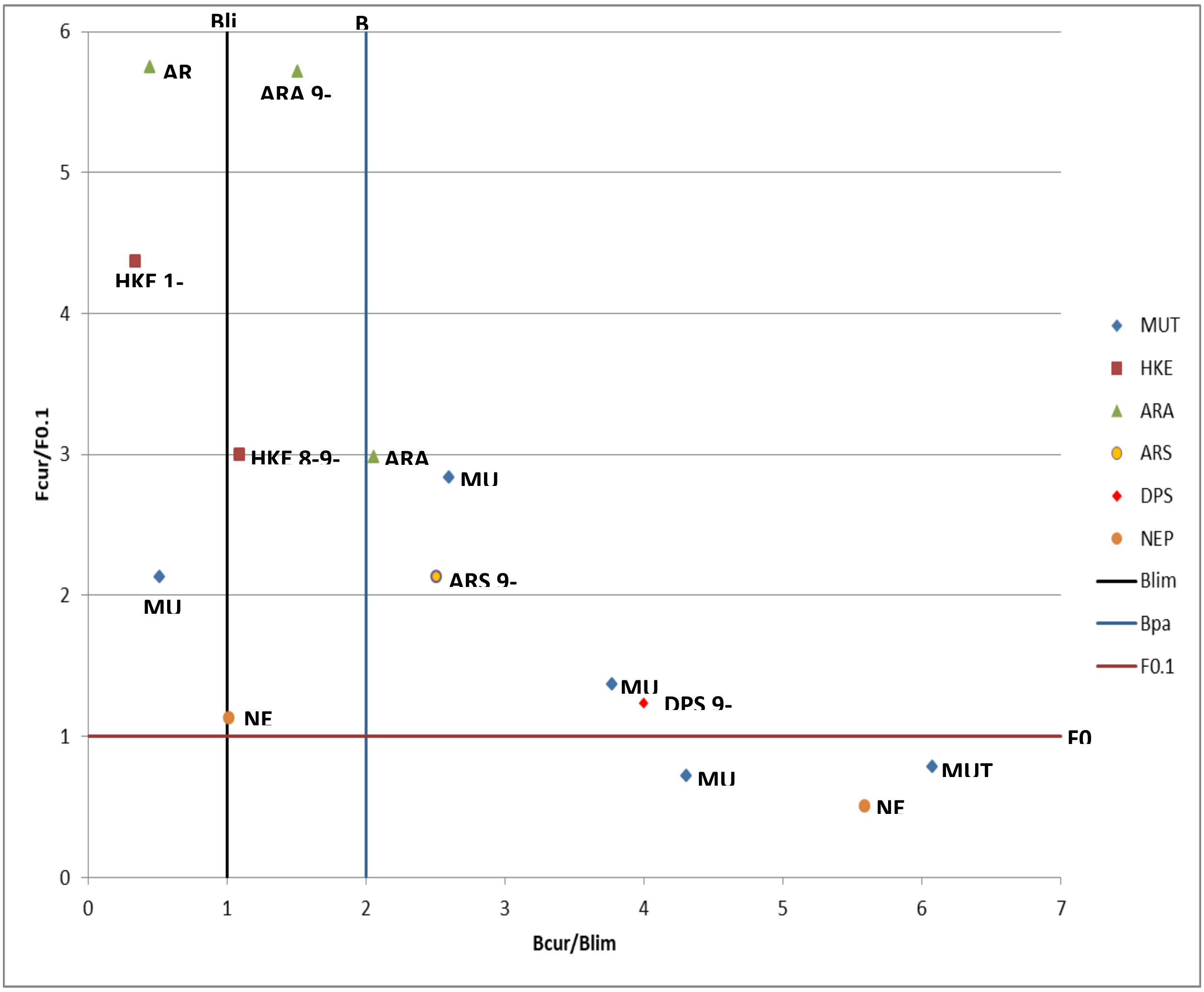

Figure 2.2.2: Summary of current stock status for 14 stocks evaluated relative to BLim, Bpa and F0.1 based on estimated values of BLim and proposed margin for Bpa.

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influencing advice only in the three stocks considered to be below B_{Lim}. The sensitivity analyses (Section 4.3) support the use of HS and GM models over BH and RK, due to the instability of either the slope to the origin or R_0, and sometimes both if these models are used.

There is one stock (red mullet in GSA 1 see Section 6.3.1) with a high estimated breakpoint compared to the other stocks, and the reference points for this stock should be considered particularly carefully as the status of this stock depends is sensitive to the estimation of the HS break point. The data cloud provides a relatively stable value for the point of inflection for the HS model, however, this value is the highest observed for the 14 stocks at 0.49* $B_{F0.1}$ and results in the assignment of current stock status as well below B_{Lim}, and B_{pa} close to the B_{MSY} proxy $B_{F0.1}$. If this fitted value was rejected as too high, then the GM recruitment would be assumed, the values of R_0 and $B_{F0.1}$ would reduce and B_{Lim} would be at 25% of a lower value, and the stock would be considered to lie between B_{Lim} and B_{pa} and B_{pa} would be located at 50% of $B_{F0.1}$ Is should be noted that F/F0.1 for red mullet in GSA 1 is lower than that for red mullet in GSA 6 but this stock is classed as in a poorer biomass state due to the relatively high value for B_{Lim}. Nevertheless, the data red mullet in GSA 1 does support the breakpoint, whereas for red mullet in GSA 6 no estimable breakpoint in the range of data is found.

At the other extreme, low breakpoints that deviate from the central value of 25% $B_{F0.1}$ are found for both hake stocks. Both these stocks show high values of steepness in the rising S-R function, strongly supporting impaired recruitment over the range of SSB observed. The alternative option to estimate B_{Lim}, GM recruitment as a flat S-R function through the data, seems implausible. Such an approach would revert to the assumption of B_{Lim} at 25% of $B_{F0.1}$ which would places these stocks further below B_{Lim} but imply lower expectations for increases in biomass, which are barely compatible with observed history catches. Importantly, it is possible however, that the true breakpoint is higher than the estimated values (e.g. at highest observed R or above) resulting in higher B_{Lim} estimates. It will only be possible to assess this once the stocks recover to higher SSB with reduction in F irrespective of the assumption used for B_{Lim}. For these stocks the relationship between R and SSB should regularly be examined to ensure the values of B_{Lim} remain plausible.

Reference points for non-assessed stocks

Only limited resources were available to evaluate these stocks. Currently there are no conclusions to stock status for these stocks. Several ideas have been suggested: Comparison of harvest rates across areas within species to indicate if exploitation rates are better or worse. Evaluation of catch curves to compare exploitation rates using catch alone. It is suggested that first the survey based method for providing catch advice be inspected again at the EWG, and consideration of stock status be evaluated based on the conclusions at the EWG. Since data is available for several mullet stocks the consistency of the approach could be tested on this species to provide some guidance on the shrimp stocks.

3 FUTURE DEVELOPMENTS

The EWG briefly addressed future development for both data checking and setting of reference points. Following these discussions the main point are collated below.

3.1 Data checking

3.1.1 Developments of scripts

During the meeting a number of additional checks were added to the MEDITS checking scripts, dealing with missing or duplicate haul data and looking for implausible start and finish haul positions. These additions will be added to the main scripts.

It was not easy to produce the pdf outputs on different PCs; some effort is needed to track down the issues so that these scripts can be run by most people.

The web-based scripts linked to the regional data base will be developed further, and these may provide the long term solution as the Regional Database comes into us.

The comparison of the JRC and RDBqc data tools was useful, both in terms of comparing routines, but also a chance to compare standardisation across user platforms.

It was noted that some standardisation is still need within the data analysis tools some use GSA designation for the ‘Area’ variable just by number (22) and some by GSA and number combined (GSA22) it would be helpful to ensure that all tools use a harmonised approach to these types of parameter.

3.1.2 Organisation of data checking

While the current STECF based data checking of data already in the JRC databases is useful as a way to improve data consistency, it is recognised that checking the data prior to the entry into the database is preferable.

Current scripts can provide assistance with this process but do not appear to be being used, as errors, which should be found before submission, are still appearing in the submitted data. This is the case both for commercial and survey data. It is recognised that along with better dissemination of the types of errors that occur, there is a need to organise training for the staff involved in the data calls. The training needs to cover tools applied in this EWG, but also tools such as ROME which are available but do not seem to be being used to detect data inconsistencies for the MEDITS data in some cases.

It is considered that responsibility for data checking and corrections should be part of the upload process, and the responsibility of the MS and the current approach of checking by STECF EWG is probably not the best approach for improving data quality. It is expected that local data experts would be much better placed to notice errors than STECF EWG members who may not be familiar with the local situation. As errors need to be corrected by MS it is preferable that the process includes the type of data checks used by the EWG as a standard part of the upload process.

3.1.3 Data availability for Adriatic, Aegean and Ionian Seas

It is important to note that several assessments that are candidates for EWG 22-16 involve catches from GSA 18, and ideally would use MEDITS survey data from the whole of this region. Data from Albania and Montenegro, both catches and MEDITS hauls, are important for stock assessment to be complete. Specifically giant red shrimp and blue and red shrimp, but also stocks like hake and deepwater rose shrimp also have important catches. In addition data from Solemon survey is integral to assessments of sole and mantis shrimp.

It is important that DGMARE try to obtain these data prior to the EWG in October.

3.2 Reference points

3.2.1 Reference points

The framework developed during this meeting is preliminary, and based specifically around the 14 stocks evaluated here. In particular, the testing and use of continuous S-R functions such as Beverton and Holt to obtain BLim values has not been fully explored, as none of the stocks had suitable data from the assessments. Therefore, this framework must be regarded as a good start but will need refinement as more data becomes available or more stocks are evaluated.

The routines developed were extensive and used a number of standard library routines as well as those developed in the JRC for this EWG. It is important that as far as reasonably possible the routines used should be added to the FLR library this ensuring good maintenance and verification.

The framework development and analysis for these stocks took the full extent of the EWG and a few weeks to fully resolve numerical issues. It was considered that updating these specific stocks with the data from with updated assessments should be feasible within a 7 day assessment EWG. However, if there is a need to develop reference points for a different set of stocks or assessment results change substantively, then it is likely that around a 5 day period will be needed for a similar number of new stocks. Also this may require an extension of the hockey-stick / Geometric mean approach used here to include Beverton and Holt relationships included in the upper level of the decision making process. Approaches using these models have not yet been tested with respect to the appropriate criteria of robustness as no stocks were considered to fall into this category.

It is clear from this meeting there are considerable benefits to a framework focused on developing biomass points in a separate EWG post assessment. This approach should be considered if STECF is to propose reference points for other stocks. At some point it will be necessary to re-evaluate the reference points for these stocks, particularly for the hake stocks. The need to fully explore the data and methodologies as well as assurance of consistency and robustness of advice strongly suggest a specific group focused on this is necessary.

3.2.2 Improvements in assessments

Estimation of stable reference points is a long-term objective. It relies on different aspects of stock assessment and data characteristics than short-term objectives such as estimating F and identifying effort or TAC allocations. Especially where model choice has been driven by consistency in recent F and state of stock for a short term forecast. The latter involves aspects that are also necessary for reference point estimation such as stable retrospective patterns but in some cases such as choice of model smoothing and model structure may be less helpful where time series are so limited. The predominant purpose of the current assessments at time of development has been focused on assessment advice so it is not entirely unsurprising that the suitability of assessment is still limited for stable reference point objectives. Appendix 4 includes a prioritised list of investigations that should be considered in the development of future assessments to ensure greater consistency and reliability with respect to long-term objectives. What is less clear who or how such information can find its way into the stock assessment process as currently implemented through STECF EWGs. There is insufficient time at the assessment EWGs and insufficient ownership of the process outside the EWG system. It is highly recommended that STECF considers if and how improvements to stock assessments and more reliable results for both short-term and long-term objectives can be implemented within a reasonable timeframe.

3.2.3 Catch options and advice

The EWG notes that the framework results in a preliminary classification of the 14 stocks into three categories: above B_{pa}, between B_{Lim} and B_{pa} and below B_{Lim}. The assessment EWG currently prepares advice sheets with catch options for F_{MSY}, and $F_{MSY\ Transition}$, which assume that no additional measures to increase biomass are required. The latter two classes ($<B_{pa}$) imply the possible requirement for more restrictive management to increase biomass. It is suggested that additional catch options for the two cases when SSB$<B_{pa}$ may be required from the assessment EWG. ICES provides exploitation advice under the following basis:

1. F = F_{MSY} when the spawning–stock biomass is at or above MSY $B_{trigger}$; and
2. F = F_{MSY}× spawning–stock biomass/MSY $B_{trigger}$ when the stock is below MSY $B_{trigger}$ and above B_{Lim};
3. If the F following from applying rule 2 is insufficient to bring the stock above B_{Lim} in the short term ICES advice will be based on bringing the stock above B_{Lim} in the short term. This may result in advice of zero catch.

In the context of the framework defined in the Western Med Map $B_{trigger}$ can be considered to be B_{pa}. Option 1 also includes substitution of F_{MSY} with $F_{MSY\ Transition}$ if the stock is expected to be in transition to MSY, as is the case for these stocks.

The EWG considers that this rule would provide a basis to give advice for stocks with biomass at risk of > 5% of being below B_{Lim}.

4 METHODS

The methods used in both data checking (Section 4.1) and in reference point calculation (Section 4.2) are provided below. In addition a further section exploring sensitivity of approach is provided in order to explore how the reference points are affected by the choices taken (Section 4.3)

4.1 Data Quality

4.1.1 JRC Script on quality checks

General introduction

The quality checks on commercial data, provided through the Official Mediterranean and Black Sea Data Calls, were based on a suite of R scripts initially developed during the EWG2102 (https://stecf.jrc.ec.europa.eu/ewg2102) but reorganized and extended before and during this EWG to provide a single pdf output structure.

Listed below the R scripts used during the EWG2102
1) Check_landings.R
2) Check_discards.R
3) Cumulative.R
4) Quality checks.R
5) Landings_LFgaps_metier.R
6) Discards_LFgaps_metier.R
7) Relative weights.R

For the EWG2202 all these R scripts have been just saved as an rmd file named "Checking_DCF.rmd" which when knitted produces a pdf output as Rmarkdown output. All the outputs produced in running the script chunks (plots and csv) are still saved in a dedicated folder as in the EWG2102 (see below) but adding as a main output a pdf document by stock which would be expected to be easier to check. The Checking_DCF.rmd file and all the pdf files produced for the ToR1 list of stocks have been attached as Annex 1 to this report (Annex 1 – Rscript, pdfs and main outputs on commercial quality checks"). The Rcode has been tested under R version 4.2.0 (64bit) and RStudio 2002.02.2 environments. The data sets are in the MEDBS DCF output formats which are shared with the STECF EWGs (by using output files it ensures that the data checked is the uploaded data, but *it means that columns headers and number of fields are not exactly the same of the ones used in the input templates*).

The quality checks on survey data provided through the Official Mediterranean and Black Sea Data Calls were based on an R script developed during the EWGs on stock assessments (https://publications.jrc.ec.europa.eu/repository/handle/JRC119776).

4.1.1.1 Main settings in running the code for fisheries dependent data

Figure 4.1.1.1: Input sub-folder structure

Checking_DCF.rmd file and the data sets provided through the Official EU Mediterranean and Black Sea Data Calls [(https://datacollection.jrc.ec.europa.eu/dc/medbs)](https://datacollection.jrc.ec.europa.eu/dc/medbs) have been stored in two dedicated sub-folders (script and data) under a main folder named as prefer (for example EWG2102). This architecture was the main input structure (Figure 4.1.1.1) for which the script sub-folder have to be set as working directory. The Checking_DCF.rmd file works at stock level so the user must set Country, GSA and species values for which the analyses have to be run (Figure 4.1.1.2).

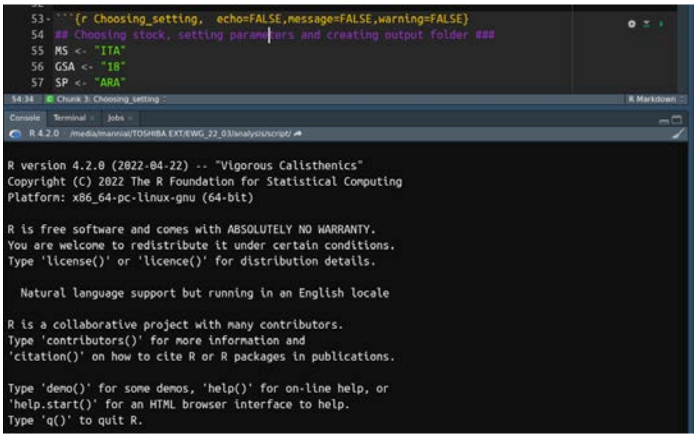


Figure 4.1.1.2: Setting stock name

There are some others settings to be declared (Figure 4.1.1.3). Excluding the "last" and "first" year values all the others are the same already used in the EWG2202. For many details please refer to the Guidelines in the electronic Annexes of the EWG2102 meeting [(https://stecf.jrc.ec.europa.eu/ewg2102).](https://stecf.jrc.ec.europa.eu/ewg2102) Indeed the first and last year's default values are set as 2002 and 2020. If a Member State enter in the DCF framework later than 2002 just change "fy" value accordingly.

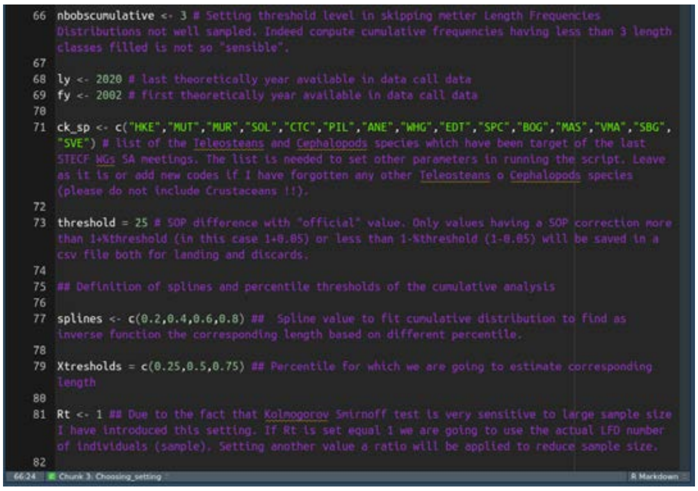


Figure 4.1.1.3: Setting parameters and time range

Finally, at the beginning of the script the pdf main settings must be declared. The "title" and the "knit output_file" settings **must** be changed according to the stock to be checked. "Subtitle", "author" and "date" could be changed according to the user needs Figure 4.1.1.4).

All scripts outputs (plots and csv files) are saved in another sub-folder created automatically according to the underneath general path**:**

```
---
title: "Blue and red shrimp (ARA) in GSA 18 (ITA)"

subtitle: "Quality checks"

author: "STECF EWG 22-03"

date: "`r format(Sys.time(), '%d %B, %Y')`"

output: pdf_document

knit: (function(inputFile, encoding) {
  rmarkdown::render(inputFile, encoding = encoding, output_file = "ITALY_GSA18_ARA", output_dir = "../pdf/ITA") })
```

Figure 4.1.1.4: Setting title and knit options

output/COMMERCIAL/country/GSA/species

The next sub folders level will be created as listed below (Figure 4.1.1.5):

1) Landing for Check_landings.R
2) Discard for Check_discards.R
3) Cumulative for Cumulative.R
4) Quality_checks for Quality checks.R
5) Length frequencies/Landings for Landings_LFgaps_metier.R
6) Length frequencies/Discards for Discards_LFgaps_metier.R
7) Landing and Discard for Relative weights.R

Figure 4.1.1.5: Main folders output structure

4.1.1.2 Catch data errors / quality checks

In the following sections the main checks performed are summarized. For more details please refer to EWG2102 Guidelines in Annexes (https://stecf.jrc.ec.europa.eu/ewg2102) while for the rmd file in EWG2202 Annex I (https://stecf.jrc.ec.europa.eu/ewg2203)

Checking landings and discards data

The two landings and discards by length datasets are evaluated in similar ways. The most important checks are listed below:

1) Looking for duplicated rows;
2) Looking if any shift in the length distribution was applied;
3) Looking for landings/discards in weight “NULL” (i.e. equal to 0 or -1) having length classes filled in with numbers;
4) Looking for landings/discards in weight more than zero but with no abundance in number. This check is actually aimed to explore the coverage of the samples;
5) Computing landings/discards in weight values by year, gear and fishery looking for possible outliers;
6) Checking for any “double” reporting of landings/discards in weight;

7) Computing mean weight looking for possible outliers and/or coverage issues.

Maturity at length/age, sex ratio at length/age, VB growth rates, length weight relationships and age length keys are provided.

Below are listed the main data visualizations run by the scripts:

1) Landings in weight by gear in catch at age file;
2) Landings in weight by gear in landings at length file;

These two plots should be compared to the ones obtained checking landings by length data.

3) Discards in weight by gear in catch at age file;
4) Discards in weight by gear in discards at length file;

These two plots should be compared to the ones obtained checking discards by length data.

5) Maturity by length plotting data by starting year;
6) Maturity by age plotting data by starting year;
7) Sex ratio by length plotting data by starting year;
8) Sex ratio by age plotting data by starting year;
9) von Bertalanffy Growth Functions (VBGF);
   a) plot by year and sex
   b) plot by each sex
   c) boxplot of the Linf, k and t0 parameters
   d) trend in time of the Linf, k and t0 parameters

Von Bertalanffy Growth curves are plotted looking for outliers values

10) Length Weight relationships (LW)
   a) plot by year and sex
   b) plot by each sex
   c) boxplot of a and b parameters
   d) trend in time of a and b parameters

Length weight relationships are plotted looking for outliers values

11) Age Length Key (ALK)
   a) ALK and boxplot by sex

Age length key data are plotted looking for outliers values

12) Sum Of Product (SOP) landings and discards
   a) Based on data in number and mean weight by age provided in the catch file a Sum Of Product is computed to compare estimated landings/discards weight with the reported ones.
   SOP = $\sum_{i=0}^{i=max(age)} numberatage[i] * meanweightatage[i]$

13) Checking VBGF units

a) Units of measures of all available set of von Bertalanffy Growth parameters will be displayed looking for inconsistency in values and units reported

14) Checking LW parameters units along the years

a) Units of measures of all available set of length weight relationships parameters will be displayed looking for inconsistency in values and units reported

Exploring length frequencies distributions and catch values.

The last section of the rmd code explores length and weight data available in landings and discards by length templates. The analysis could be considered as a preliminary data exploration to check the possibility in trying an assessment for the stock in charge.

Basically, the cumulative Rcode section analyses landings and discards by length data to compute the main length indicators. The analysis is carried out at combined year, gear and fishery level. For each combination the following indicators have been estimated:

1) total number of individuals in the length distribution;
2) the minimum size observed;
3) the mean size;
4) the maximum size observed;
5) the standard deviation;
6) for each splines and percentile thresholds set at the beginning of the code the corresponding length size value

A Kolmogorov-Smirnov test is run to compare length frequencies obtained by different year, gear and fishery combinations.

Three main plots will be stored in the output folder: I) cumulative frequencies distributions by gear and fishery combinations, II) mean length by gear and fishery combinations and III) median length by gear and fishery combinations. The plots should help in detecting trend in time and/or difference in length structure among different gear/fishery combinations. These are useful for detecting errors, but also informing the choice of fill-in strategy if any length data is missing or badly under sampled.

Finally, the Landings_Lfgaps_metier and the Discards_Lfgaps_metier Rcode sections extract the available length frequencies distributions (LFD) at métier level (gear/fishery) to be plotted. Moreover, the last code section explores landings and discards in weight data provided in the landings and discards by length files.

Two plots (one for landings and another one for discards) will be produced showing the percentage ratio between landings and discards in weight by gear/fishery combinations on the annual landings/discards total weight. These two plots should help in understanding better which are the main gear/métier exploiting the stock and for which of them a reconstruction (if something is missing) would be useful. It also documents the extent of the reconstruction applied.

For more details and some examples of the main outputs please refer to Annex I of the EWG2102.

4.1.1.3 Main settings in running the code for survey data

What has to be set before launch the script.

Before launch the script the user have to set folders and store the main input files

The Rscript (Checking_Survey.rmd) have to be stored in a subfolder for example called “scripts” while data and supporting files in another one called for example “Data”. Both subfolders have to be place in the same main folder for example called “MEDITS” (Figure 4.1.1.6)

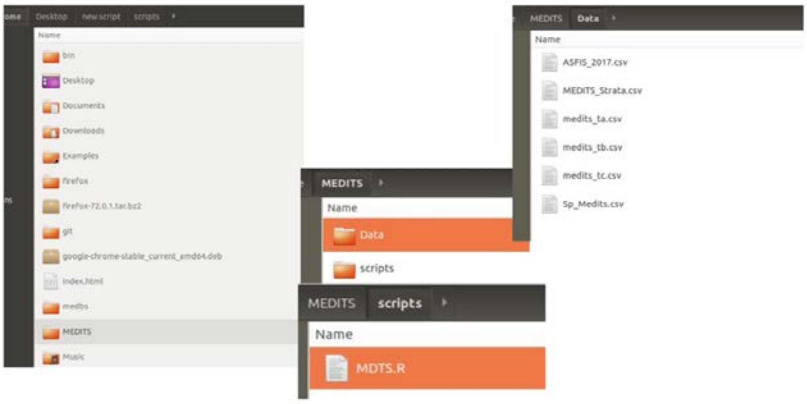


Figure 4.1.1.6: Setting up the folder structure

The data files are the MEDITS file (TA, TB and TC) in one of the format: MEDITS Handbook version 9 or DCF database output, while supporting csv files are MEDITS_strata, Sp_Medits and ASFIS_2020.

MEDITS_strata.csv contains strata information as reported in Annex II of the MEDITS handbook version 9 (Stratification scheme (by stratum number)

Sp_MEDITS.csv contains the MEDITS code to identify species and the corresponding scientific name.

ASFIS_2020.csv contains the species three FAO alpha code and other information.

Figure 4.1.1.7: Assigning title, subtitle and output file name and folder

Opening the script the first section deals with assigning title, subtitle and in particular output file name and in which folder the pdf will be saved (Figure 4.1.1.7). After the above section the libraries needed to run the script and default settings are declared.

The following section (Figure 4.1.1.8) is the most important one. Indeed, here the user has to be set the file path where the output will be saved (must be the same of the previous one declared in title section), the stock to be analyse, the data format, the survey name, and others settings which will be used in checking data.

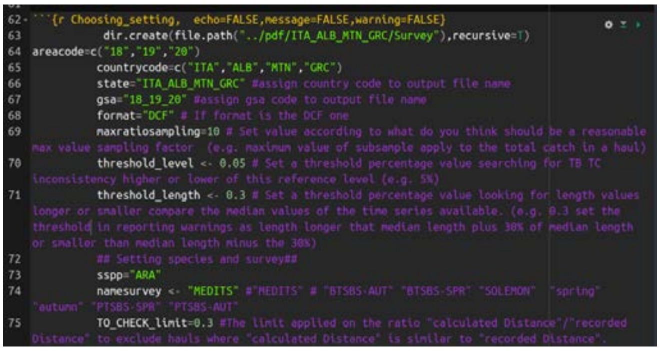


Figure 4.1.1.8: Main user settings

<u>Where output are stored.</u>

All the outputs files (csv, images) are stored in a folder called "MEDITS_output" which will be create by the code as subfolder of the main one. This folder contains recurrent subfolders which are created to identify in a unique way the GSA, the Country and the Species just analysed. In the last one are stored the main outputs (Figure 4.1.1.9).

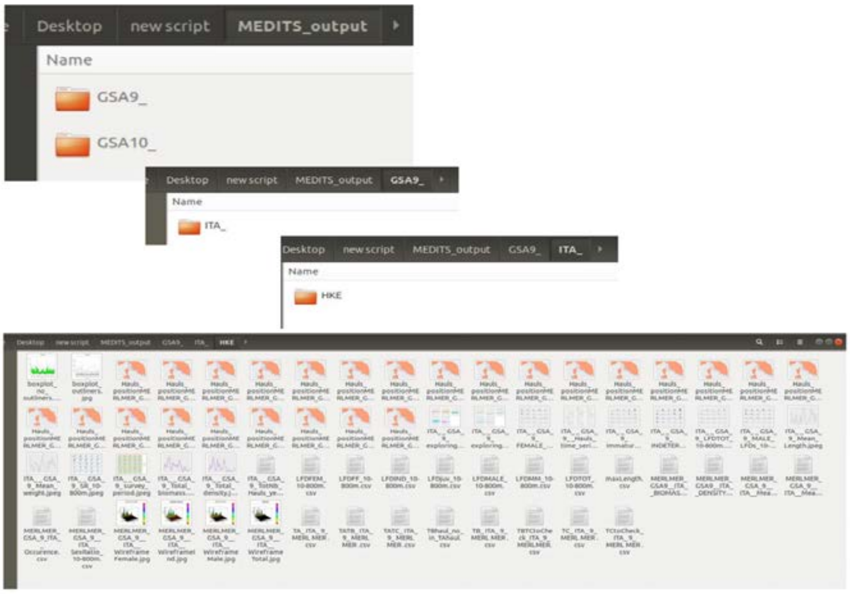


Figure 4.1.1.9: Output folders and main products

<u>Data checks</u>

The scripts provided a lot of quality checks (please have a look in the JRC technical document attached as Annex for more information). Below some of the main output and or checks are illustrated.

1) Checking hauls position by year (Figure 4.1.1.10)

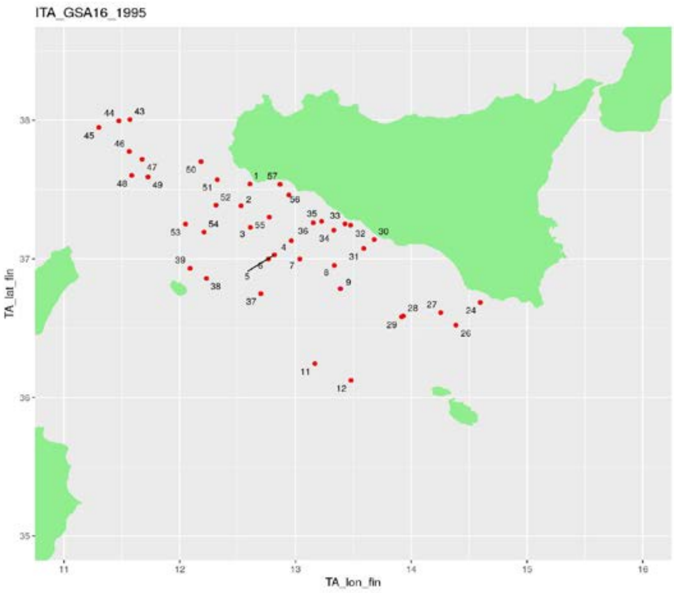


Figure 4.1.1.10: Hauls position by year and GSA (shown for GSA18 in 1995)

Haul distance is estimated according to the geographical positions (latitude and longitude) declared in the TA file. The estimated distance is then compared with the one already declared in the file to verify possible inconsistencies. A tolerance of 30% has set as default in the script (TO_CHECK_limit=0.3).

2) Checking survey period

3) The script checks whether there are hauls reported in TB file (catches) or in TC file (biology) which are not in TA file (hauls)

File: TBhaul_no_in_TAhaul.csv

File: TChaul_no_in_TAhaul.csv

4) If there are hauls for which total weight and number values are inconsistent between TB (catches) and TC (biology)

File: TBTCtoCheckcsv

5) If there are TC hauls in which the weight of the sample is more than a prefixed threshold (see R code: *maxratiosampling=10*). According to MEDITS protocol sub samples of catches and/or target species is allowed. Usually a reference sample ratio shouldn't be very high to guarantee that the sub sample applied represent properly the whole catch of the haul.

File: TCtoCheck.csv

This check is quite important because raising factor apply to TC file number is computed according to the ratio between weight of the sample measure and weight of the fraction caught.

Figure 4.1.1.11: Time series of survey dates

Misreporting weight could affect the raising procedure generating the standardized length frequency distributions.

6) Maximum and minimum length observed/reported by year by sex.

File: Range_length.csv

Additional information

The R-script uses also data available for the selected species producing a lot of outputs. Below are shown some of these

1) Biomass and density indexes.

To estimate the mean, variance, standard deviation and coefficient of variation of the abundance indices in number and weight by square kilometre with a stratified random sampling, the following formulations are used (Cochran, 1977 and Souplet, 1996):

Stratified mean

$$\bar{x}_i = \frac{\sum_{j=1}^{n_i} x_{i,j}}{\sum_{j=1}^{n_i} A_{i,j}}$$

$x_{i,j}$ is the weight of individuals caught in the individual hauls of the stratum and $A_{i,j}$ is the corresponding swept area. The variance is calculated by the following formulas:

$$S_{x_i^2} = \frac{1}{n_i - 1}\sum_{j=1}^{n_i} A_{i,j}\left(\frac{x_{i,j}}{A_{i,j}} - \bar{x}_i\right)^2$$

Abundance index of the main strata (shelf, slope and total) is computed according to the following formula (cfr. Pennington e Brown, 1981):

$$I = \sum_{i=1}^{N} W_i \bar{x}_i$$

W_i is the weight of each individual stratum calculated as the ratio between the area of the stratum and the total area of the study area. The variance in this case is given by the formula:

$$\text{var}(I) = \sum_{i=1}^{N} \frac{W_i^2 S_{x_i^2}}{\sum_{j=1}^{n_i} A_{i,j}}(1 - f_i)$$

as f_i is the ratio between the swept area and the area of the stratum, i.e. the correction factor for finite populations (fpc).

Standard deviation is:

$$\text{s.d.} = \sqrt[2]{\text{Var}(I)}$$

and Coefficient of Variation is:

$$CV\% = (s.d./I)*100$$

In the following figure (Figure 4.1.1.12) for example biomass and density index of European Hake in the GSA9

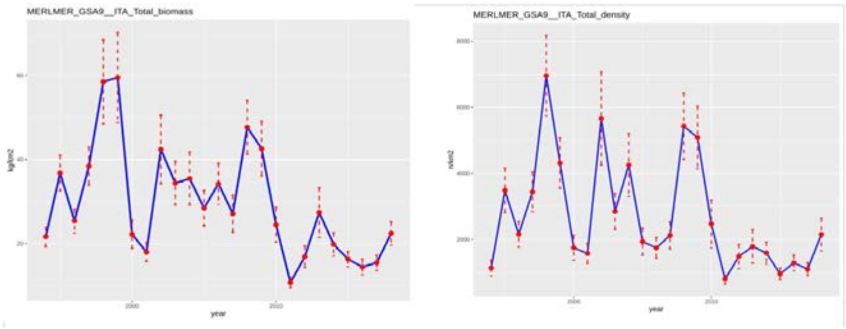


Figure 4.1.1.12: total biomass (left) and density (right) indexes by square kilometre

2) Length frequency distributions (LFDs)

Length distributions are standardized by square kilometre applying to each length classes the formulas used for abundance indexes. Length distributions are computed by sex (female, male, not sexed) and by total individuals. Since, almost all the individuals not sexed are smaller (juveniles) to create final female and male distributions the indeterminate distribution is split between sexes according to a ratio of 50% by each length classes. Female and male distribution computed according to sex assignment in TC file are saved as LFDFEM and LFDMALE while the ones created splitting not sexed individuals are saved as LFDFF and LFDMM. Figure 4.1.1.13 shows an example of LFDs output.

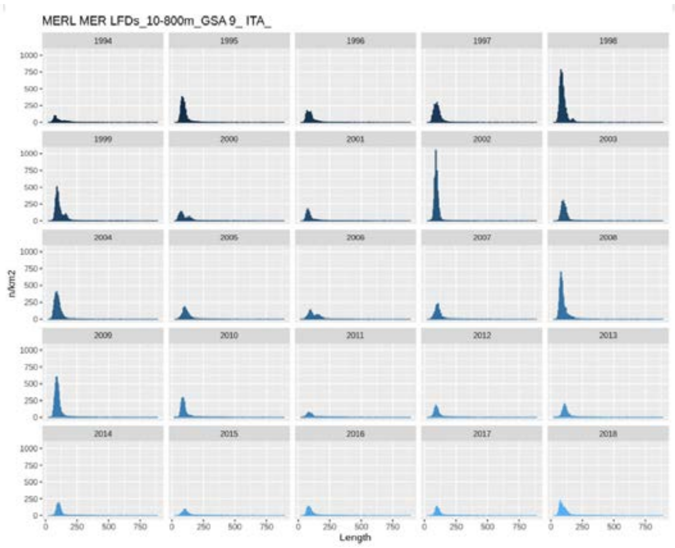


Figure 4.1.1.13: Annual length frequency distributions standardized by square kilometre

3) Occurrence

Occurrence is computed as ratio between the total number of positive hauls (e.g. total number of hauls a species was caught) and the total number of hauls carried out during the survey. The main output is a csv file.

4) Sexratio

Having standardized length distribution by sex ratio vector by length classes and year is computed as ratio by each length classes between female and female plus male

SR=FF/(FF+MM). Figure 4.1.1.14 shows the sex ratio by year.

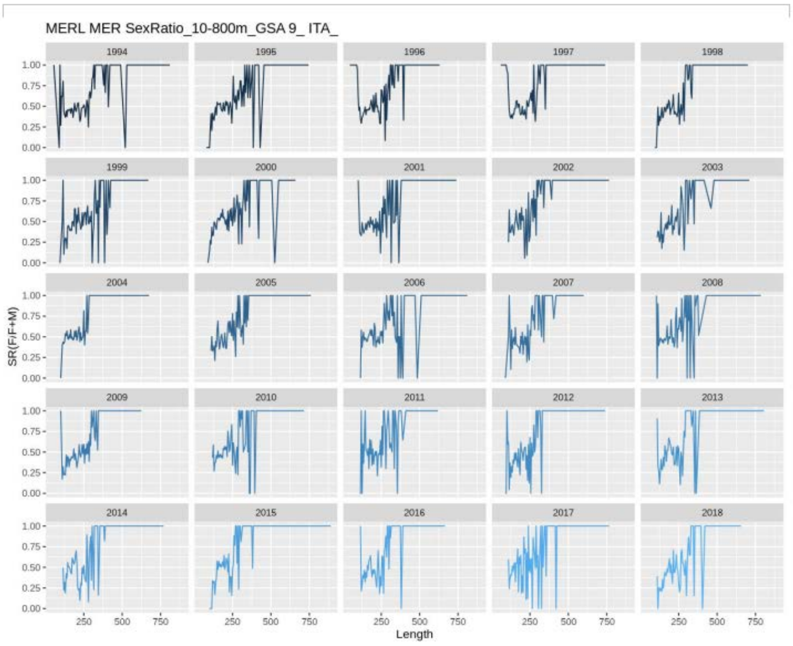


Figure 4.1.1.14: Sex ratio by year

5) Mean weight

Mean weight is computed by hauls and by year, In the first case is the ratio by biomass and density by hauls, in the latter case the same ratio is applied at yearly level. In the following figures results of the two computations are shown (Figure 4.1.1.15). Data needs to plot mean weight by year are also saved in a csv file.

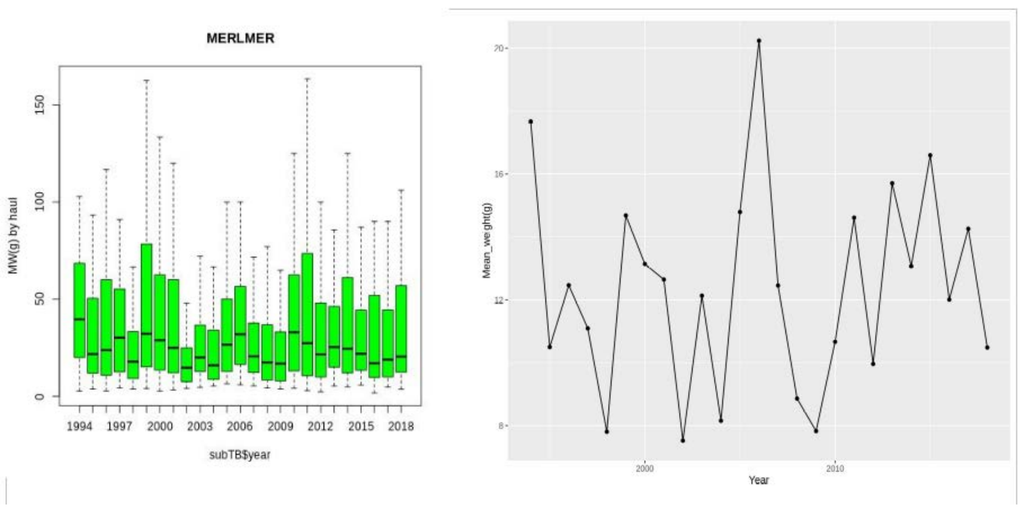


Figure 4.1.1.15: Boxplot of the mean weight by haul (left side) and yearly mean weight (right) as ratio between biomass and density indexes

6) Mean length

Mean length value is computed by year on the standardized length distribution calculated on the total area explored and with sex combined (Figure 4.1.1.16).

7) Swept area

The swept area is computed according to the following formula:

swept area in square kilometre =TA$wing_opening/10000000*TA$distance

indeed, in the TA file are stored distance covered and net wing opening. While the assignment of each haul to one of the five stratification MEDITS depth strata (A=0-50m, B=51-100m, C=101-200m, D=201-500m and E=501-800m) is done according to the haul mean depth

meandepth=(TA$shooting_depth+TA$hauling_depth)/2

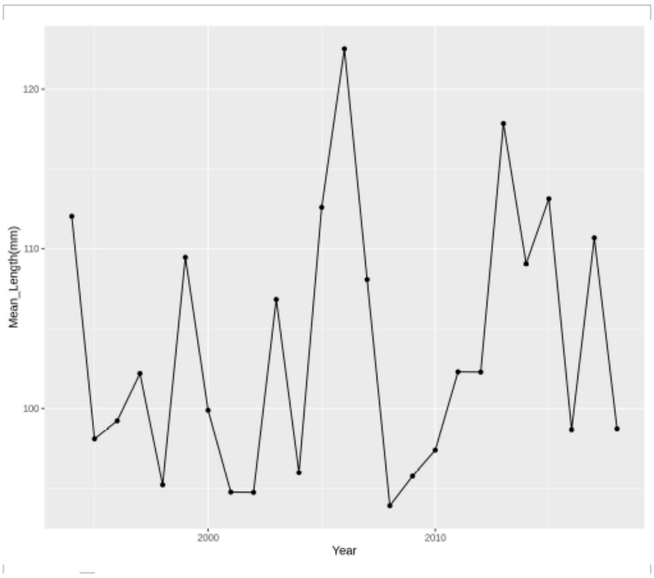


Figure 4.1.1.16: Yearly mean length based on the standardized length frequencies distributions

4.1.2 RDBqc package

RDBqc is an R package that is being developed within RDBFIS project. Under the umbrella of the MARE/2020/08 "Strengthening regional cooperation in the field of data collection" the construction of a Regional Database (RDB) for the Mediterranean and Black Seas was funded (https://ec.europa.eu/fisheries/press/call-proposals-mare202008-strengthening-regional-cooperation-area-fisheries-data-collection_en). The RDBqc package will be embedded in the RDBFIS system, in order to allow the check of the data in the uploading phase and in the phase of conversion from detailed to aggregated data, before the storing of the data in the regional data base.

The package supports the following input data formats:

RCG (CS, CL);

FDI;

Med&BS;

GFCM.

It is noted that RDBqc works directly with 'input' data files making this particularly suited to error/inconsistency checks prior to data submission to JRC.

During this meeting a cross check test of the package was carried out only on the functions related to the Med & BS datacall formats and specifically on the functions reported in Table 4.1.2.1: List of the quality checks implemented in RDBqc package, with a brief description and the basis for each check (EWG 21-02 or STREAM project).

Table 4.1.2.1: List of the quality checks implemented in RDBqc package, with a brief description and the basis for each check (EWG 21-02 or STREAM project).

Quality check	Table	Check description	Based on
Catch_coverage	Catch	Summary tables and plot of landing and discards by year, Country, quarter, GSA, LOA, gear, mesh size range and fishery.	STREAM
Discard_coverage	Discard	Summary table and plot of discards by year, Country, quarter, GSA, LOA, gear, mesh size range and fishery.	STREAM
check_duplicates	Landing/Discard	Check duplicats in landing at length table	EWG 21-02
comp_disc_YQ	Discard	Comparison of discards aggregated by quarters and by year	EWG 21-02
comp_disc_YQ_fishery	Discard	Comparison of discards aggregated by quarters and by year and fishery	EWG 21-02
comp_land_Q_VL	Landing	Comparison of landings aggregated by quarters accounting for the presence of vessel length	EWG 21-02
comp_land_Q_VL_fishery	Landing	Comparison of landings aggregated by quarters and fishery accounting for the presence of vessel length	EWG 21-02
comp_land_YQ	Landing	Comparison of landings aggregated by quarters and by year	EWG 21-02
comp_land_YQ_fishery	Landing	Comparison of landings aggregated by quarters and by year and fishery	EWG 21-02
disc_mean_weight	Discard	Consistency of mean mean discard: plot of the discards weight by year, gear and fishery	EWG 21-02
ks	Landing/Discard	Kolmogorov-Smirnov test on cumulative landing and discard function at length	EWG 21-02
land_mean_weight	Landing	Consistency of mean weight: plot and data frame of mean weight by year, gear and fishery	EWG 21-02
length_ind	Landing/Discard	Consistency of length data: Main length size indicators	EWG 21-02

lengthclass_0	Landing/Discard	Detection of the records with null individuals in landings and discards	EWG 21-02
plot_disc_vol	Discard	Consistency of time series of discard: Plot of total discards by gear and fishery.	EWG 21-02
plot_discard_ts	Discard	Consistency of time series of discard: plot by year or by quarter.	EWG 21-02
plot_land_vol	Landing	Consistency of time series of landing: Plot of total discards by gear and fishery.	EWG 21-02
plot_landing_ts	Landing	Consistency of time series of landing: plot by year or by quarter.	EWG 21-02
weight_0	Landing/Discard	Consistency of weight in landing and discard at length tables: weight 0 in landings and discards	EWG 21-02
weight_minus1	Landing/Discard	Consistency of weight in landing and discard at length tables: weight -1 in landings and discards	EWG 21-02
yr_missing_length	Landing/Discard	Detection of records with years with missing length distributions	EWG 21-02
GP_check	GP	Consistency of growth parameters in GP table	STREAM
Landing_coverage	Landing	Summary table and plot of landings by year, Country, quarter, GSA, LOA, gear, mesh size range and fishery.	STREAM
LW_check_MED_BS	GP	Consistency of length-weight relationship parameters in GP table	STREAM
MA_tab_check	MA	Consistency of maturity ogives at age across the years	STREAM
ML_check	ML	Consistency of maturity ogives at length across the years	STREAM
SA_tab_check	SRA	Consistency of sex ratio at age across the years	STREAM
SL_tab_check	SRL	Consistency of sex ratio at length across the years	STREAM

The RDBqc package is developed with R version > 4.1 and it is located on GitHub: https://github.com/COISPA/RDBqc/tree/main/RDBqc . It can be installed on Windows using these 2 commands directly in R console:

```
library(devtools)
install_github("COISPA/RDBqc/RDBqc", build_manual = TRUE,  build_vignettes = TRUE)
```

The Vignette describing the functioning of the checks and how they can be run is available on GitHub and consultable also from the R console.

For the installation on Linux, the tar.gz file (available on the GitHub) can be installed from the R console, with their dependencies.

4.2 Reference points Methods

4.2.1 Stock assessment data

The final stock assessment outputs for the Western Mediterranean Sea 2021 (STECF-EWG 21-11) were sourced in the form of **FLStock** objects from https://stecf.jrc.ec.europa.eu/reports/medbs. All 14 available stock assessments (Table 4.2.1.1) were conducted with statistical catch age model **a4a** (Jardim et al. 2015). The time series of available data for the Western Mediterranean Sea assessment are typically ranged from 12-19 years, with the exception of one longer time series of NEP09 of 27 years (Table 4.2.1.1).

Table 4.2.1.1: Summary of available stock assessment outputs for the Western Mediterranean Sea 2021 from STECF (EWG 21-11). Years shows the first and last years of the assessment, and n is the number of years of assessed stock data available.

Species	Stock	Model	Years	n
Aristeus antennatus	ARA01	a4a	2002 - 2020	19
Aristeus antennatus*	ARA06_07	a4a	2002 - 2020	19
Aristeus antennatus	ARA09_10_11	a4a	2006 - 2020	15
Aristeomorpha foliacea	ARS09_10_11	a4a	2005 - 2020	16
Parapenaeus longirostris^	DPS09_10_11	a4a	2009 - 2020	12
Merluccius merluccius	HKE01_05_06_07	a4a	2007 - 2020	14
Merluccius merluccius	HKE08_09_10_11	a4a	2005 - 2020	16
Mullus barbatus barbatus	MUT01	a4a	2003 - 2020	18
Mullus barbatus barbatus	MUT06	a4a	2003 - 2020	18
Mullus barbatus barbatus	MUT07	a4a	2002 - 2020	19
Mullus barbatus barbatus	MUT09	a4a	2003 - 2020	18
Mullus barbatus barbatus	MUT10	a4a	2002 - 2020	19
Nephrops norvegicus	NEP06	a4a	2009 - 2020	12
Nephrops norvegicus#	NEP09	a4a	1994 - 2020	27

*Blue and red shrimp (ARA) in GSA 6 & 7 was found to have potential catch errors in the first two years and the evaluation was carried out 2004-2020 (17 years) (see section 6.5.3)

^ Deepwater rose shrimp in GSA 9, 10 & 11 has a value of fraction mature of 0.45 at age 0. This is not thought to have significant influence on the state of the stock, but it appears high and should be checked.

Nephrops (NEP) in GSA 9 was found to have a mistake in the mean weights age 1 in 2018 and 2019, and more importantly the maturity ogive was incorrectly set by age in all years (see section 6.4.2). These were corrected and the analysis completed with the corrected values. Both data sets will be checked again before final values are computed in September.

4.2.2 Glossary

A summary of definitions of abbreviations of key biological quantities and reference points used throughout this report are listed below.

Biological quantities:

N_a: Numbers at age

w_a: weight at age quantifying the somatic growth

mat_a: proportion of mature specimens at age

M_a: natural mortality at age

F_a: fishing mortality at age

F: here the average F_a over exploited age classes ($fbar$)

SSB: spawning stock biomass being a function of N_a, w_a and mat_a

SPR_0: un-fished spawning biomass per recruit at $F = 0$ at equilibrium being a function of w_a, mat_a and M_a

SPR_F: equilibrium spawning biomass per recruit at a specific F

SPR: spawning potential ratio of SPR_F/SPR_0

R_0: average recruitment of un-fished stock at $F = 0$

B_0: un-fished spawning stock biomass being a function of $B_0 = R_0 SPR_0$

Reference points:

B_{lim}: A deterministic biomass limit below which a stock is considered to have reduced reproductive capacity.

B_{pa}: A precautionary deterministic biomass reference point intended to represent a spawning stock size that is associated with low risk of impaired recruitment potential. B_{pa} is typically estimated as a function of B_{lim}.

F_{lim}: Fishing mortality corresponding to B_{lim}. Fishing at levels above

F_{pa}: Fishing mortality corresponding to B_{pa}. Fishing at levels above F_{pa} will result in a decline in the stock to levels below B_{pa}.

F_{MSY}: The fishing mortality rate that maximises the long-term catch (or surplus production) corresponding the Maximum Sustainable Yield (MSY)

B_{MSY}: Expected biomass of a stock that is exploited at F_{MSY}

F_{max}: The fishing mortality at which the yield-per-recruit is maximized. F_{max} remains relevant in many cases where segmented regression is assumed for stock recruitment relationship, because a direct estimate of F_{MSY} would be the same as

$F_{0.1}$: The fishing mortality at which the slope of the yield-per-recruit curve is 10% of that at the origin. Accepted here as robust proxy for F_{MSY}

$B_{F0.1}$: Spawning Biomass reference point corresponding to $F_{0.1}$

4.2.3 Fisheries reference points

Central to most fisheries advice frameworks are the reference points, which are used to classify current status of the resource, but are ultimately designed for advising on fishing opportunities, e.g., the total allowable catch (TAC) or effort (TAE) in managed fisheries. The stock assessment model is often considered the starting point for the scientific advice, although, in reality, the process starts with the processing of imperfect observations for use in the assessment model, which are typically associated with large observation and systematic sampling errors. The assessment model itself relies on many assumptions about the model structure in the form of the underlying deterministic relationships (e.g. the stock-recruitment function) and key population parameters (e.g. growth and natural mortality M). All these contribute to the uncertainty associated with the stock assessment output (Patterson et al., 2001; Carruthers et al., 2017), where uncertainty can be seen as a plausible range of differences between the model outcomes and reality. Accounting for these uncertainties is one of the key challenges for defining and parameterizing reference point systems so they provide consistent and robust scientific advice on catch limits (Ralston et al., 2011). Despite of common commitments to maintain or restore stocks at levels capable of producing maximum sustainable yield (MSY) and the Precautionary Approach to fisheries (FAO, 1995; UN, 1995), international advice standards present a variety of approaches on how this challenge is addressed with respect to estimating the corresponding target- (F_{MSY} for Western Med MAP), limit (Lim) and precautionary (Pa) reference points.

4.2.3.1 Limit and Precautionary reference points

B_{Lim} is the central biomass limit reference point used for North-East Atlantic stocks by ICES, which is defined as the biomass below which recruitment is impaired so that reduces with SSB. The other reference points (B_{Lim}, F_{Lim}, and F_{pa}) used in the context of the precautionary approach are all estimated from B_{Lim}. In ICES, the empirical relationship between B_{pa} and B_{Lim} is given by

$$B_{pa} = B_{lim}e^{(1.645*\sigma)}$$

where σ is intended to reflect the assessment uncertainty, but is most cases set to a fairly low value with the intention to represent the overall assessment error sigma = 0.2 (c.f. Raltson et al. 2011), such that B_{pa} = 1.4B_{Lim}.

The most direct approach for estimating B_{lim} is to identify the break point of a segmented regression (Hockey-Stick) that is fitted to Stock-Recruitment (S-R) observations (Type 2; Figure 4.1). Applying this approach requires adequate contrast in the S-R data to distinguish between the slope where recruitment decreases with SSB and the plateau where recruitment fluctuates around some average. The break point of the SSB between slope and plateau in the S–R relationship can then be estimated defined as B_{lim}, while the average recruitment along the plateau represents an estimate of R_0. Within its current approach ICES defines 6 types of S-R observations, the most relevant 4 out shown in Figure 4.2.3.1.

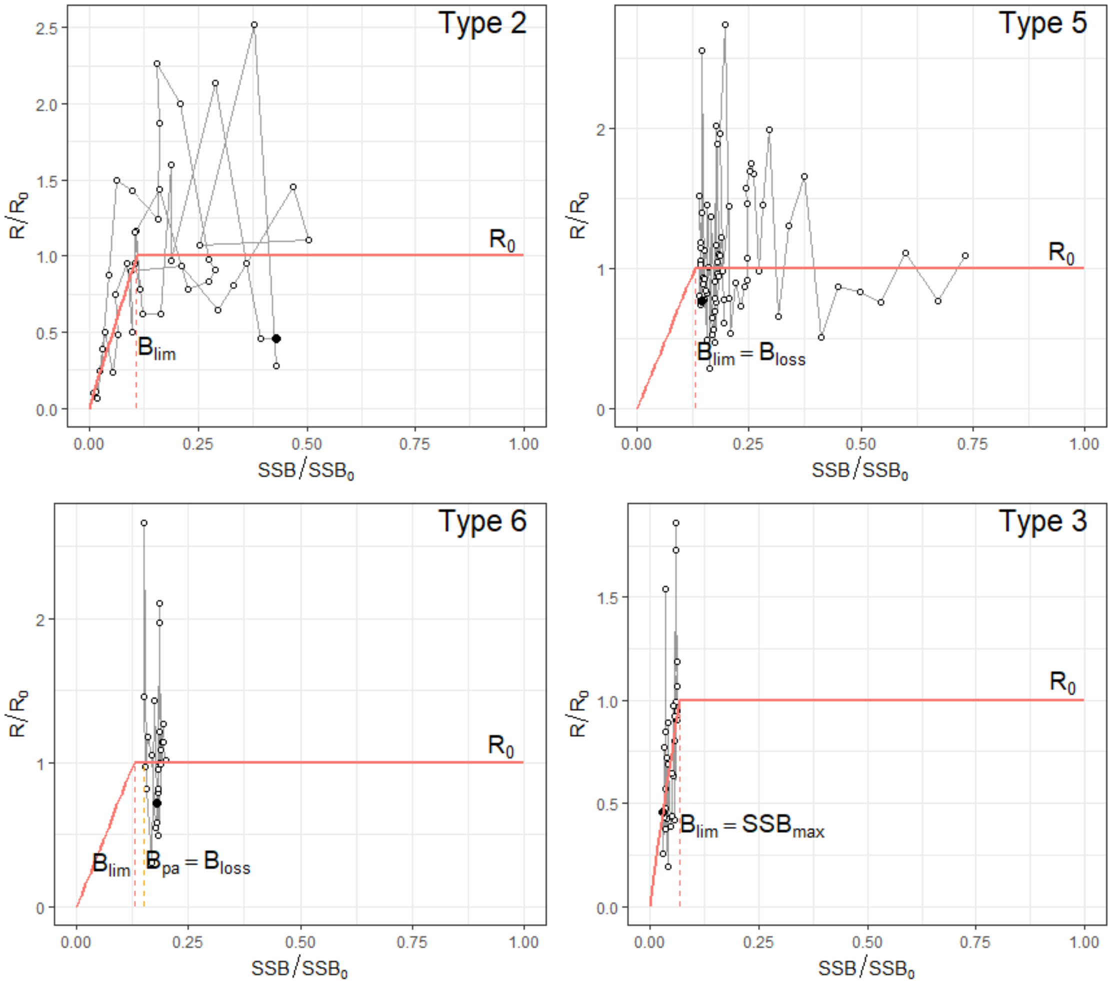


Figure 4.2.3.1: Illustration of four common S-R pattern types that are considered in ICES for deriving estimates of B_{lim}.

A prerequisite for estimating B_{lim} from the S-R data from the data is that the available time series cover periods where the SSB was both below and above B_{lim}. For those stocks that either never decreased to levels where recruitment is measurable impaired or where the entire time series represents severely depleted state below B_{lim} a break point in S-R data is not identifiable and alternative approaches for estimating B_{lim} are required. In practice, direct B_{lim} estimates were only used for 14% of the 77 ICES category 1 stocks analysed by WKREF1 (ICES, 2022).

For this purpose, ICES provides guidelines for characterising different S-R data patterns based scatter plots (Figure 4.2.3.1). These include alternative empirical options for setting B_{lim} in addition to the quantitative segmented approach (Type 2; Figure 4.2.3.1). The most common choice is setting $B_{lim} = B_{loss}$ (41% of ICES stocks), where B_{loss} is the lowest observed SSB (Type 5; Figure 4.2.3.1). This applies to stocks that cover a wider dynamic range of SSB and but all show no evidence of impaired recruitment or with no clear relation between stock and recruitment. In cases where stocks only cover a narrow dynamic range of SSB with no evidence of past or present impaired recruitment (Type 6; Figure 4.2.3.1), B_{loss} may be used instead as a candidate for B_{pa} to then set B_{lim} relative to B_{pa} (e.g. $B_{lim} = B_{pa}/1.4$). On the other end of the spectrum, the Type 3 rule may be used for stocks with clear evidence that stock is severely depleted compared to historical stock levels and the S-R observations a show positive relationship (Type 3; Figure 4.2.3.1). In this case, B_{lim} maybe set at or close to largest observed biomass (SSB_{max}).

Recent ICES workshops (WKREBUILD 2022, WKGMSE3 2021 and WKRP-CHANGE 2020, WKREF1 2022 & WKREF2 2022) have noted several limitations of the current guidelines for setting B_{lim}, with concerns raised about subjectivity in the definition and use of S-R types for reference point estimation in cases where segmented regression fits are unsatisfactory or produce implausible B_{lim} estimates. In particular, conceptual problems for setting reference points related to B_{loss} for Type 5 and 6 stocks and unclear guidance for type 3 stocks that are at low stock sizes were noted (ICES 2022; WKREF1). These problems are amplified for short time series that exhibit a narrow of S-R observations; such is the common case for the majority of age-based assessments in the Mediterranean Sea which have only a few years of assessment (Table 4.2.1.1). As a result, WKREF1 (ICES, 2022) recommended to consider options for determining plausible values B_{lim} as ratios to B_{MSY} or B_0 analytically based on biological principles and the life history of the stock that would be consistent with standards used internationally.

There is already some precedence for setting B_{lim} based on analytically derived ratios of B_{MSY} or B_0 within ICES. For assessments conducted with surplus production models (WKMSYSPICT, ICES 2021), B_{lim} is derived as a fraction of B_{MSY} estimate. The value adopted $B_{lim} = 0.3B_{MSY}$, which is based on the rationale that, under the Schaefer production model, the biomass corresponding to 50% of MSY is obtained at 30% of B_{MSY}. A meta-analysis of 69 ICES stocks, using segmented regression with break-point fixed at B_{lim} benchmark found that median of B_{lim} around 10% of B_0 (WKREF1 2022).

Based on earlier theoretical and empirical work by Goodyear (1977 and 1993) and Clark (1991), Mace and Sissenwine (1993) advocated the use of SPR_{20} as a threshold for recruitment overfishing below which the risk of impaired recruitment is increasing. As a result of these studies, SPR_{20} has become the most common basis for recruitment overfishing reference points in U.S. fishery management plans (Rosenberg et al. 1993). The choice of reference level is usually based on theoretical considerations of the biology and analogy with other stocks. Given that SPR_{20} is considered a minimum acceptable level above which medium resilient stocks are likely to maintain acceptable productivity, SPR_{20} may be considered as the upper limit for B_{lim} and somewhat equivalent to the function that ICES assigns to B_{pa} .

The Harvest Strategy Standard for New Zealand Fisheries (New Zealand Ministry of Fisheries 2008) provides perhaps one of the most unambiguous and transparent frameworks for setting fishery and stock targets and limits and associated fisheries management measures. It consists of three core elements: (1) a specified biomass target about which a fishery or stock should fluctuate; (2) a "soft" biomass limit reference point that triggers a requirement for a formal, time-constrained rebuilding plan (c.f. ICES 2021; WKREBUILD); and (3) a hard limit below which fisheries should be considered for closure. The **soft-limit** (sensu B_{pa}) is defined as $0.5B_{MSY}$ (or its proxy) or 0.2B_0, whichever is higher. The hard-limit (sensu B_{lim}) is set to $0.2B_{MSY}$ or $0.1B_0$, whichever is higher. The hard-limit is considered breached and stock classified as collapsed. Acceptable risk in terms of the probability of breaching the soft limit must not exceed 10% and the probability of breaching the hard limit must not exceed 2%.

In Canada, the stock status zones are defined as the Limit Reference Point (LRP) at the Critical-Cautious zone boundary, and an Upper Stock Reference Point (USR) at the Cautious-Healthy zone boundary and the Removal Reference for each of the three zones (DFO 2009). The LRP represents the stock status below which serious harm is occurring to the stock based on biological criteria and established by Science through a peer reviewed process. There are several stock assessment specific methods used to quantify the LPR, including segmented regressions (**sensu** B_{lim}). However, in the absence of an agreed procedure in the context of the precautionary approach, the Department of Fisheries and Ocean, provides provisional guidance to the LRP to a precautionary value corresponding to $0.4B_{MSY}$.

Principles for deriving reference for data-limited Mediterranean stocks

Considering international practice, biological principles and the characteristics of the fairly short S-R time series, the EWG agreed on two guiding principles for estimating B_{lim}:

- Plausible B_{lim} estimates are assumed to within the range 0.1% - 20% of SSB_0 (equivalent to $0.01 - 0.2SPR_0$) if determined by way of fitting a segmented regression

- If no clear break point can be identified within this range, B_{lim} can be derived analytically as $B_{lim} = 0.25B_{F0.1}$, where $B_{F0.1}$ is the equilibrium SSB corresponding to $F_{0.1}$. In the absence of reliable stock recruitment function, the $B_{F0.1}$ can based on geometric mean of the available recruitment estimates.

It follows that a direct estimate of B_{lim} shall only be derived empirically in cases where there is sufficient contrast in the S-R data to estimate a well-defined break-point that falls within plausible biological limits. Alternatively it is suggested that BLim be specified as a ratio of BMSY or its proxy,

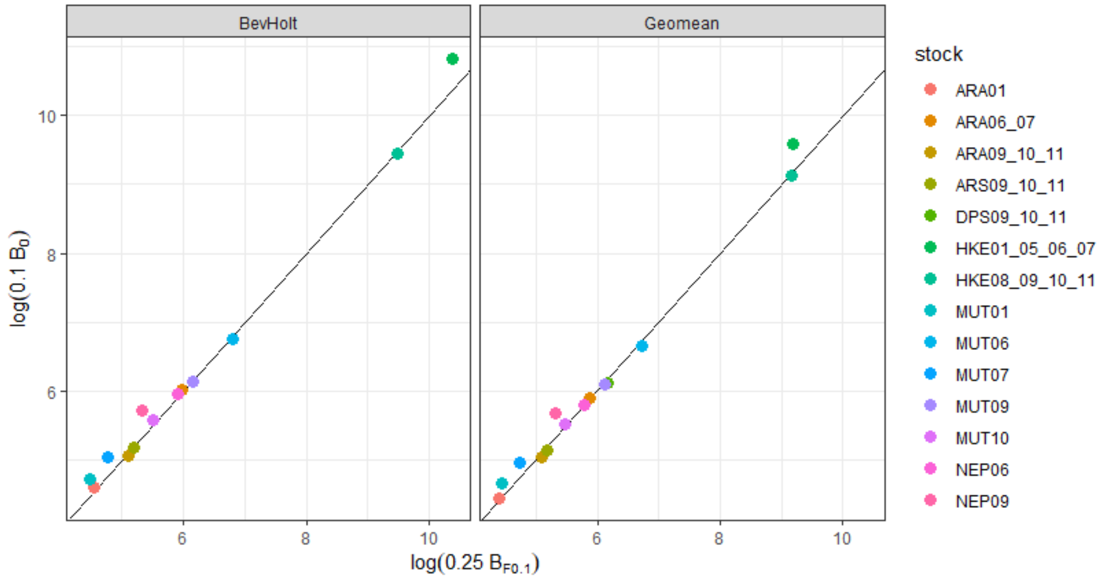


Figure 4.2.3.2: Plots showing the relationship between $0.25B_{F0.1}$ and $0.1B_0$ on log-scale based on Beverton-Holt and a Geometric Mean stock recruitment functions for the 14 Western Mediterranean stocks. The solid dark line denotes the 1:1 line.

which is taken as BF0.1, the SSB corresponding to the agreed FMSY proxy, F0.1.

The EWG discussed implications of using fraction B_{lim} as fraction $0.1B_0$ or as fraction of $0.25B_{F0.1}$. It was noted that under a common stock recruitment function either choice would produce similar B_{lim} estimates (Figure 4.3.1.1). Although a potential caveat of $0.25B_{F0.1}$ is that its location can be affected by changes in selectivity, the EWG agreed to use $0.25B_{F0.1}$ instead of $0.1B_0$, as this required less extrapolation and did not imply an idealised point with zero fishing. This was also based on the consideration that the $F_{0.1}$ is well established as a target reference point and choosing a fraction of the corresponding biomass $B_{F0.1}$ is likely to be less abstract, for stake holders and decision makers in the region, than the concept of an un-fished biomass.

4.2.4 Fitting Stock Recruitment Relationships

Stock recruitment relationships (SSR) were fitted and evaluated with the **FLR** (Fisheries Library in R: Kell et al., 2007) package **FLSRTMB** (Winker and Mosqueira; https://github.com/flr/FLSRTMB), using maximum likelihood estimation in Template Model Builder (**TMB**; Kristensen 2015). The explored candidate SSR's included the following models:

- A conditioned Hockey-Stick (**segreg**)
- Beverton & Holt (**bevholtSV**)
- Ricker (**rickerSV**)

In addition, the geometric recruitment was computed for all stocks, using a simple linear model with a single intercept term, such that:

$$log(R_y) = a$$

where R_y is the number of recruits in year y and the intercept a determines expected mean recruitment $\hat{R} = exp(a)$, which in the absence of a breakpoint is independent of SSB and therefore is taken equal to the un-fished recruitment R_0.

4.2.4.1 Conditioned Hockey-Stick

To estimate the break-point $b = B_{lim}$ within the expected range of 1% - 20% of SSB_0, a new conditional Hockey-Stick formulation was implemented in **FLSRTMB**. The Hockey-Stick function is based on a continuous, quadratic hockey-stick formulation (c.f. Barrowman and Myers, 2000), which is re-parameterized as a function of SPR_0 and a “re-purposed” steepness parameter s^*. In addition, the parameter P_{lim} is introduced, which then determines the lower of the ratio B_{Lim}/B_0, where B_{Lim} corresponds to break point b of the segmented regression and the un-fished B_0 being a function of $B_0 = R_0 SPR_0$.

$$R_y = \frac{s^*}{2P_{lim}SPR0}\left(SSB_{y-a_r} + P_{lim}R_0SPR_0/s^* - \sqrt{\left(SSB_{y-a_r} - P_{lim}R_0SPR_0/s^*\right)^2}\right)$$

where R_y is the number of recruits in year y, SSB_{y-a_r} is the spawning biomass in year y minus minimum age a_{min} defined for the stock (typically age-0 or age-1). The break point b (B_{lim}) and slope a are given by

$$b = P_{lim}R_0SPR_{0,y}/s^*$$

$$a = R_0/b$$

This formulation allows to bound the parameter s^* over an approximately uniform range defined for $0 > s^* \leq 1$ using a truncated logistic prior distribution (Thorson and Cope, 2014)

$$s \sim TrunkLogit(s_{logit}, \sigma_{logit})$$

where σ_{logit} is set by default to 20 and s* can be truncated by specifying the parameter c.

$$s^* = c + 1/\left(1 + exp(-s_{logit})\right)$$

where c is specified by ratio lower to upper fraction of SPR_0. For example, by considering a range bounded between 0.1% - 20% of SPR_0, c is taken a ratio of c = 0.001/0.2, resulting in an approximately uniform parameter space for which the ratio B_{Lim}/B_0, but with soft penalties towards the bounds to facilitate robust convergence (Figure 4.2.4.1).

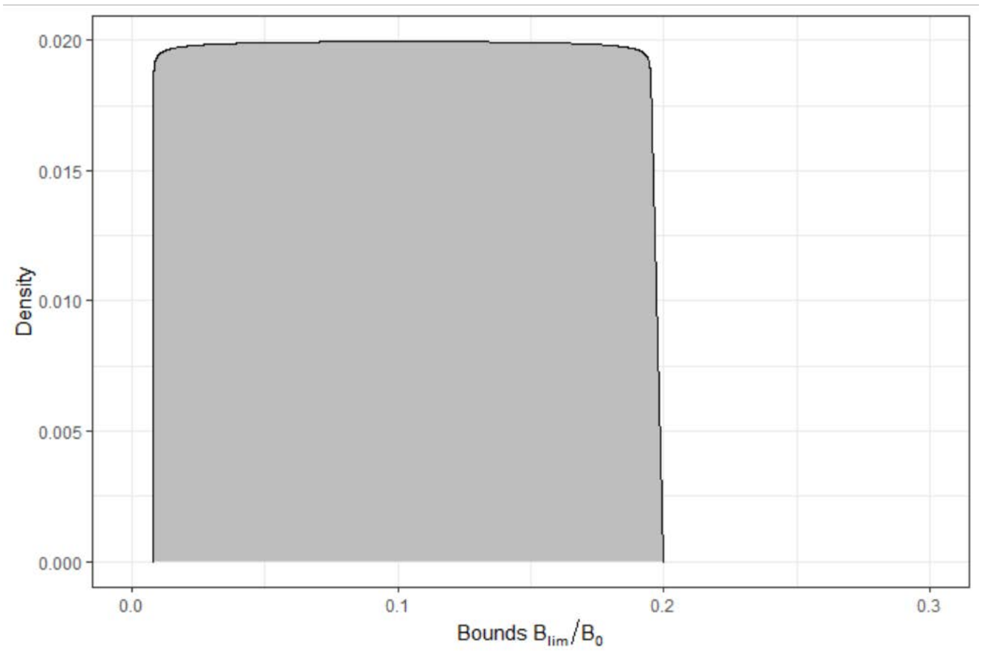


Figure 4.2.4.1: Representation of uninformative prior that constrains the defined range for the breakpoint to BLIM / B0 = 0.001-0.2.

The properties of the conditioning continuous hockey-stick function can be related as follows to the four ICES types of S-R patterns illustrated in Figure 4.2.4.1:

- If a break-point is identifiable within the specified range of $0.01 - 0.2SPR_0$, the estimated break-point $b = B_{lim}$ is consistent with ICES Type 2.
- If S-R data overlap with at least the range $0.1 - 0.2SPR_0$ and there is no positive relationship between SSB and recruitment, B_{lim} will be closely approximated $B_{loss} = SSB_{min}$ (Type 5) and the R_0 estimate is set equal to the geometric mean recruitment.
- If the S-R data overlap with the range $0.01 - 0.2SPR_0$ and there is positive relationship between SSB and recruitment, B_{lim} will typically be located closely to SSB_{min} (Type 3)
- If the S-R data fall outside $0.2SPR_0$ or outside $0.1SPR_0$ with no identifiable break-point between $0.01 - 0.2SPR_0$, B_{lim} will be located just below $0.1SPR_0$ (i.e. mean of range) and the R_0 estimate is equal to the geometric mean recruitment.

4.2.4.2 Beverton-Holt

For reference point estimation with **FLBRP** in **FLR** the Beverton and Holt SRR is formulated as:

$$R_y = \frac{aSB_{y-a_{min}}}{b + SBB_{y-a_{min}}}$$

where R_y is the number of recruits in year y, SSB_{y-a_r} is the spawning biomass in year y minus minimum age a_{min} defined for the stock (typically age-0 or age-1).

However, to provide flexibility for exploring alternative assumption about the steepness parameter, the Beverton-Holt equation in **FLSRTMB** is re-parameterised as function of steepness s and annual un-fished spawning biomass per-recruit SPR_0 (Mace and Doonan, 1988), such as routinely used in, e.g., Stock Synthesis (Methot and Wetzel, 2013):

$$R_y = \frac{4sSB_{y-a_{min}}R0}{R_0SPR_{0_y}(1-s) + SBB_{y-a_{min}}(5s-1)}$$

where steepness s is defined as the ratio of recruitment when SSB equals 20% of the un-fished SSB_0 to the virgin recruitment R_0 at SSB_0. This formulation enables, for example, integration of available prior information on the steepness s of the SSR from a recent meta-analysis (Thorson 2020) or fix s for range of values to be explored (e.g.for sensitivity analysis of reference point estimation or operating model conditioning).

To account for the property that s is bounded by definition of the Beverton Holt between 0.2 and 1. The prior distribution for s is generated from truncated logit distributions ($TrunkLogit$).

$$s = 0.2001 + 0.7999/\left(1 + exp(-s_{logit})\right)$$

such that

$$s \sim TrunkLogit(s_{logit}, \sigma_{logit})$$

where s_{logit} and $sigma_{logit}$ correspond to the input of species-specific predictions for the distribution of s from the hierarchical taxonomic FishLife model (Thorson, 2020).

The FLSRTMB estimates of $R0$ and s are then converted into the parameters a and b of the Beverton-Holt formulation in **FLR**, such that

$$a = \frac{4sR_0SPR_0}{5sSPR_0 - 1}$$

$$b = \frac{R_0SPR_0(1-s)}{5s-1}$$

where the reference for SPR_0 to predict a and b was taken the average SPR_{0_y} over the last three years of the assessment model.

For an unconstrained estimation of s an approximately uniform prior (Figure 4.2.4.2) distribution over a wide range of s is assumed by setting S_{logit} to 20.

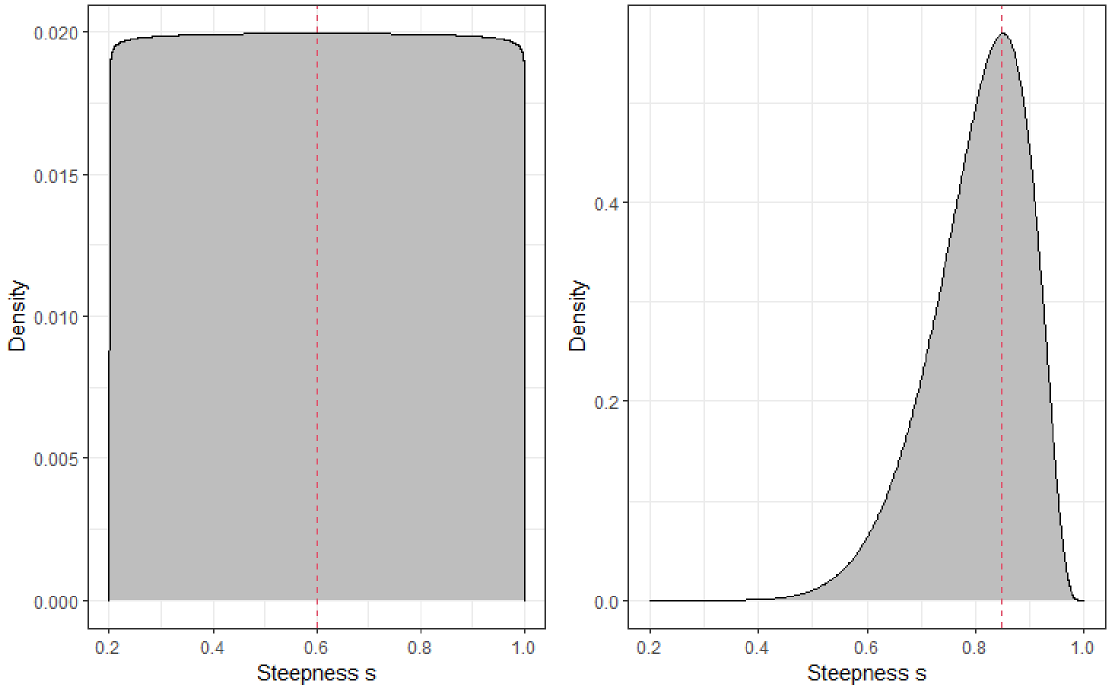


Figure 4.2.4.2: Illustration of the default setting in FLSRTMB for a mostly uninformative steepness s with a mean $s = 0.6$ and $\sigma_{logit} = 20$ (left) and an example of an informative s prior with a mean $s = 0.85$ and $\sigma_{logit} = 0.7$ (right)

4.2.4.3 Ricker

Like the Beverton-Holt SRR, the Ricker SRR is formulated as function of the parameter a and b in FLR when used reference point estimation in **FLBRP**, such that:

$$R_y = aSB_{y-a_{min}} e^{-bSBB_{y-a_{min}}}$$

For consistency of parameterization within **FLSRTMB**, the Ricker function parameters a and b are derived as a function of the estimable parameters s, R_0 and SPR_0, given by:

$$b = log(5.0 * s)/(0.8R_0SPR_0);$$

$$a = \frac{e^{bR_0SPR_0}}{SPR_0}$$

This formulation also enables fixing s or using informative priors for s for the Ricker SRR. Like the Beverton-Holt SRR s is bounded by definition at 0.2, but the Ricker model the upper bound can be set to very large value (here 20) to permit various degrees density dependence as SSB approaches SSB_0.

*4.2.5 Reference point estimation in **FLRef***

For the estimation and evaluation reference points, the R package **FLRef** (Winker) was developed and is available on https://github.com/Henning-Winker/FLRef. This package is implemented with **FLR** and makes of the optimization routine for estimating fisheries reference points at equilibrium that is available in **FLBRP**. **FLRef** requires the stock data as **FLStock** objects and the stock recruitment functions in the form of **FLSR** objects, which were produced with the package **FLSRTMB** (Winker and Mosqueira). The EWG Expert Henning Winker (JRC) developed tested the package on the stock data prior to the meeting with the support of the FLR Core Team Members Iago Mosqueira (Wageningen University) and Laurence Kell (Imperial College).

Main features of **FLRef** include:

- Automation of estimating and visualizing a wide range of limit and target plots
- New plotting options for illustrating reference points both as relative or absolute quantities
- New plotting options for compare the impact of various stock recruit model assumptions on the estimated reference points
- Newly designed fisheries advice plots

FLRef user guidelines are provided in Annex 2 and reproducible R code and results based worked example for Mediterranean stocks are available in Annex 3.

4.2.6 Summary of final protocol adopted by the EWG.

The EWG discussed the overall approach built round a) the S-R model fit to the data described above; b) the option of a default value of B_{Lim} = 25% $B_{F0.1}$; and c) method of estimating R_0 for non-depleted recruitment. A decision tree to establish B_{Lim} was laid out and followed (Figure 4.2.6.1). This consisted of an initial consideration of model fit between Beverton-Holt or Ricker on one side Hockey-stick and Geometric mean on the other. In practice in all 14 cases the unconstrained B-H or Ricker models were rejected (See section 4.3) and HS/GM approach selected. Where the HS fitted both within the data and the defined range (0.01 to 0.20 B_0 Section 4.2.5) and gave plausible yields compared with historic data, the fitted breakpoint was selected for B_{Lim}. This was the case for six of the 14 stocks. For the remaining eight stocks it was not possible to obtain fits within the data and the defined range, either because there was no fit or because the data available lay outside (above) the defined range. In all eight of these cases, the Geometric mean recruitment was checked to see if the results gave plausible yields, $B_{F0.1}$ calculated and the default value of 25% $B_{F0.1}$ assigned as B_{Lim}.

The EWG selected a basis for B_{pa} set to 2* B_{Lim}, equivalent to a sigma of 0.4 on the estimate of terminal year SSB. This is the value the EWG has recommended to give greater than 95% probability of B> B_{Lim} in accordance with the Western Med MAP. It should be noted that this probability needs to account for uncertainty in both B_{Lim} and the annual assessment of $B_{current}$. For these stocks B_{Lim} is particularly uncertain, because in in the majority of cases it set to a default value without informative data, and in the cases a fitted value is used this is often sensitive to the specific years of data used. However, the ToRs give a requirement to select a B_{pa} value "*which ensures that the spawning stock biomass has less than 5 % probability of being below BLIM*" not just meet 5% but exceed it. The high levels of uncertainty for Mediterranean stocks are recognised by the EWG; the assessment models often suffer from over parameterisation so analytical levels of uncertainty are considered a poor representation of precision. Parameterisation using retrospective analyses is of poor quality, they often struggle to give more than 2 or 3 years because the data series are short. In a review of ICES reference point (WKREF1 2022) it was noted that that the default 1.4 often lead to greater than 5% probability of B<B_{Lim}, and it is clear the situation here is substantially worse in terms of length of time series and quality of assessment. Therefore, the EWG considered that a factor of 2 is a good option.

For all 14 stocks the model applied in the subsequent calculations for B_{pa} and F_{pa} were based on HS model with the breakpoint at B_{Lim}. It was noted that for very some short lived stocks with early maturation and very low catches of immature fish, use of an annual model for the calculation of F_{lim} could give what looked like high spurious values as the annual model assumed SSB from the un-fished mature individuals could not be easily depleted. It's thought that for such very short lived species seasonal models that implement maturation and the fishery in a more realistic manner may be more appropriate. Due to these methodological issues and because F_{lim} is not used in the Western Med Map no values of F_{lim} are proposed.

Sensitivity to all these decisions is discussed in Section 04.3

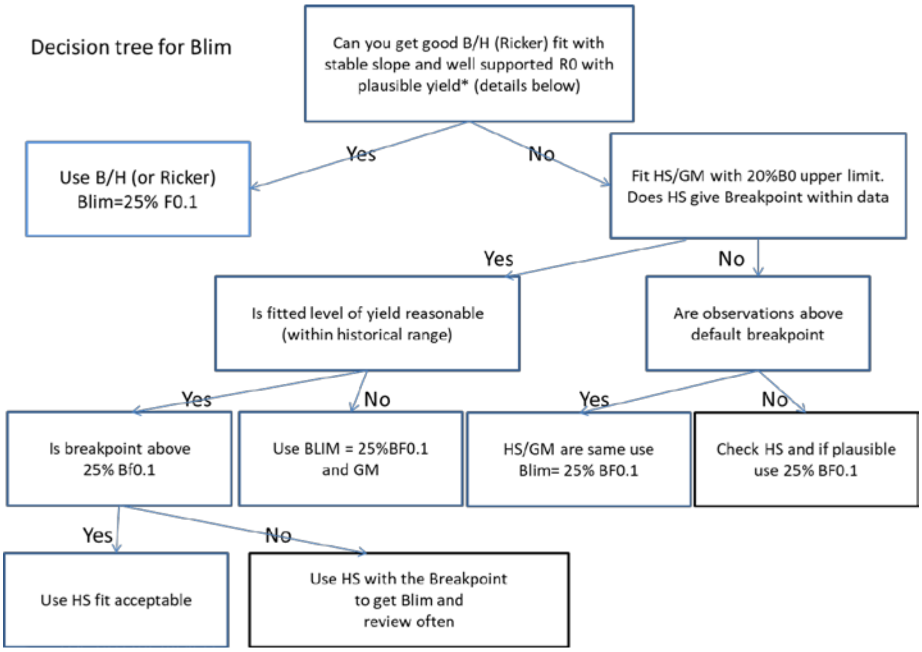


Figure 4.2.6.1: Approach to establishing BLim and S-R relationship. Decision tree applied for 14 stocks with assessments in EWG 22-03.

4.3 Sensitivity of reference points

4.3.1 Retrospective evaluation of reference points for MED assessments

The EWG considered methods and decision-making processes regarding the development of biomass reference points for Western Mediterranean Stocks specifically but with a view of applying such methods more widely in Med and Black Sea assessments as part of the development of advisory processes in support of management. An important consideration in the process is the consistency and utility of such reference points. A working document (Annex 4) compared the temporal stability of reference points based on various methodologies used by the EWG through retrospective analysis of reference point estimation to investigate the causes of variation and the implications for management at the annual level. The results are qualitatively summarised in the section below (Table 4.3.1.1: Qualitatively summarised results of fitting the five stock-recruit-relationships examined through the retrospective peels along with some stock / assessment characteristics relevant to the impact on reference point estimation.Table 4.3.1.1)

Table 4.3.1.1: Qualitatively summarised results of fitting the five stock-recruit-relationships examined through the retrospective peels along with some stock / assessment characteristics relevant to the impact on reference point estimation.

Stock	biomass trend	recruitment trend	SSB relative to YPR B0	Fmax	predominant parameter revision	Recruitment assumption	selectivity	geomean* YPR	BH unconstrained	BH steepness constrained	Ricker	Hockey-Stick
HKE01_05_06_07	decreasing	decreasing	<10%	defined	F, recruitment	factor	stable	variable	variable	variable	variable	variable
HKE08_09_10_11	decreasing	decreasing	<10%	defined	SSB, recruitment	factor	small changes as terminal ages	stable	variable	variable	variable	variable
MUT01	variable, recent decrease	variable, recent decrease	20%	defined	F,SSB, recruitment	spline	small changes as terminal ages	stable	variable	variable	variable	variable
MUT06	increasing	variable, recent decrease	20%	defined	SSP, recruitment	spline	stable	stable	variable	stable	variable	stable
MUT07	increasing	increasing	40%	infinite	F,SSB, recruitment	GM	stable	stable	variable	variable	variable	variable
MUT09	increasing	variable, recent increase	50%	infinite	recruitment	GM	stable	stable	variable	stable	variable	stable
MUT10	variable, sharp recent increase	variable	50%	defined	F,SSB, recruitment	GM	small changes as terminal ages	stable	variable	stable	variable	variable
NEP06	declining	declining	20%	defined	SSB, recruitment	Spline	variable	variable	variable	variable	variable	variable
NEP09	variable, increasing recently	variable	30%	defined	SSB, recruitment	GM	variable	variable	variable	variable	variable	variable
ARA06_07	variable	variable	15%	infinite	F, SSB	GM	stable	stable	variable	stable	variable	variable
ARA09_10_11	variable, recent decline		30%	infinite	SSB, recruitment	Factor	variable	variable	variable	variable	variable	variable
ARS09_10_11	variable	variable	30%	infinite	F, SSB	GM	stable	stable	variable	variable	variable	stable
DPS09_10_11	variable	variable	40%	infinite	recruitment	GM	variable	variable	variable	variable	variable	variable

The estimation of reference points based on biological feasible stock recruit relationships (Beverton and Holt, Ricker) was in all cases likely to lead to frequent and substantial revision of reference points (examples of the type of variability observed are shown in Figure 4.3.1.1). This approach seems currently not feasible for the stocks examined. Although the most recent stock assessments did provide somewhat stable estimates (see EWG report) the retrospective analysis concluded that due to a combination of a largely flat posterior likelihood along with substantial revisions in SSB and recruit estimates lead to differences in the reference point estimates in individual retrospective peels. Multiple other factors (described below) likely contributed to these results, but the major cause of this ultimately seems to be the short and range restricted time series in SSB and recruitment for these stocks.

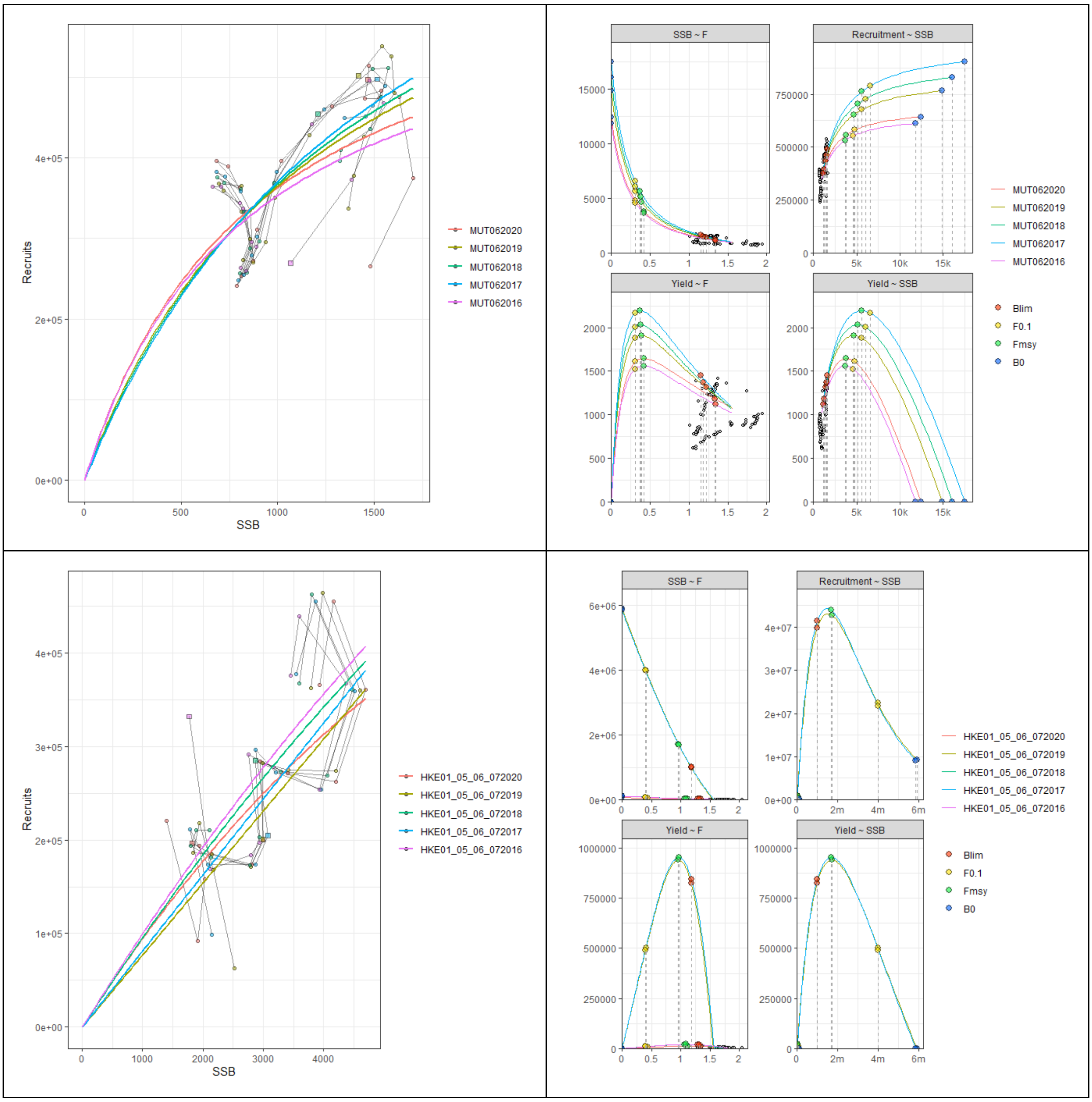


Figure 4.3.1.1: Two examples of the type of variability observed in unconstrained biological stock-recruitment relationships through retrospective peels (left top Beverton and Holt for MUT06 bottom Ricker for HKE 1 ,5, 6& 7) and the impact on revisions of scaling biological reference points. Note that for HKE01_05_06_07 three of the fits lie near the x-axes.

Yield-per-recruit (YPR) based estimates using geometric mean recruitment (complete independence of recruitment from SSB), or hockey-stick (partial linear relationship between SSB and recruitment changing to independence at an inflection point) were more robust than biological SR relationships. Though the variation in reference points was much reduced compared to biologically based reference points these estimates could still vary due to either revision of the geometric mean or in the case of the hockey stick the estimate of the inflection point in different retrospective peels (examples of the type of remaining variability encountered are shown in Figure 4.3.1.2). The hockey stick scenarios consistently provided the most appropriate reference points as compromise between information available and precaution. Some unavoidable variation remained due to changes in the geometric mean on the SSB independent part of the curve, but also through the variability in the inflection point caused by small shifts in the data points affecting what is a flat likelihood. Some additional considerations of the current stock status are necessary as also suggested by the EWG (Figure 4.2.5) are necessary to make such reference points effective management tools at least in the short-term. During the WG a modified procedure for starting values for the S-R model fit procedure was developed that took account of stock status (SSB/B0) (not used here) that provided additional stability to overcome implausible scenarios.

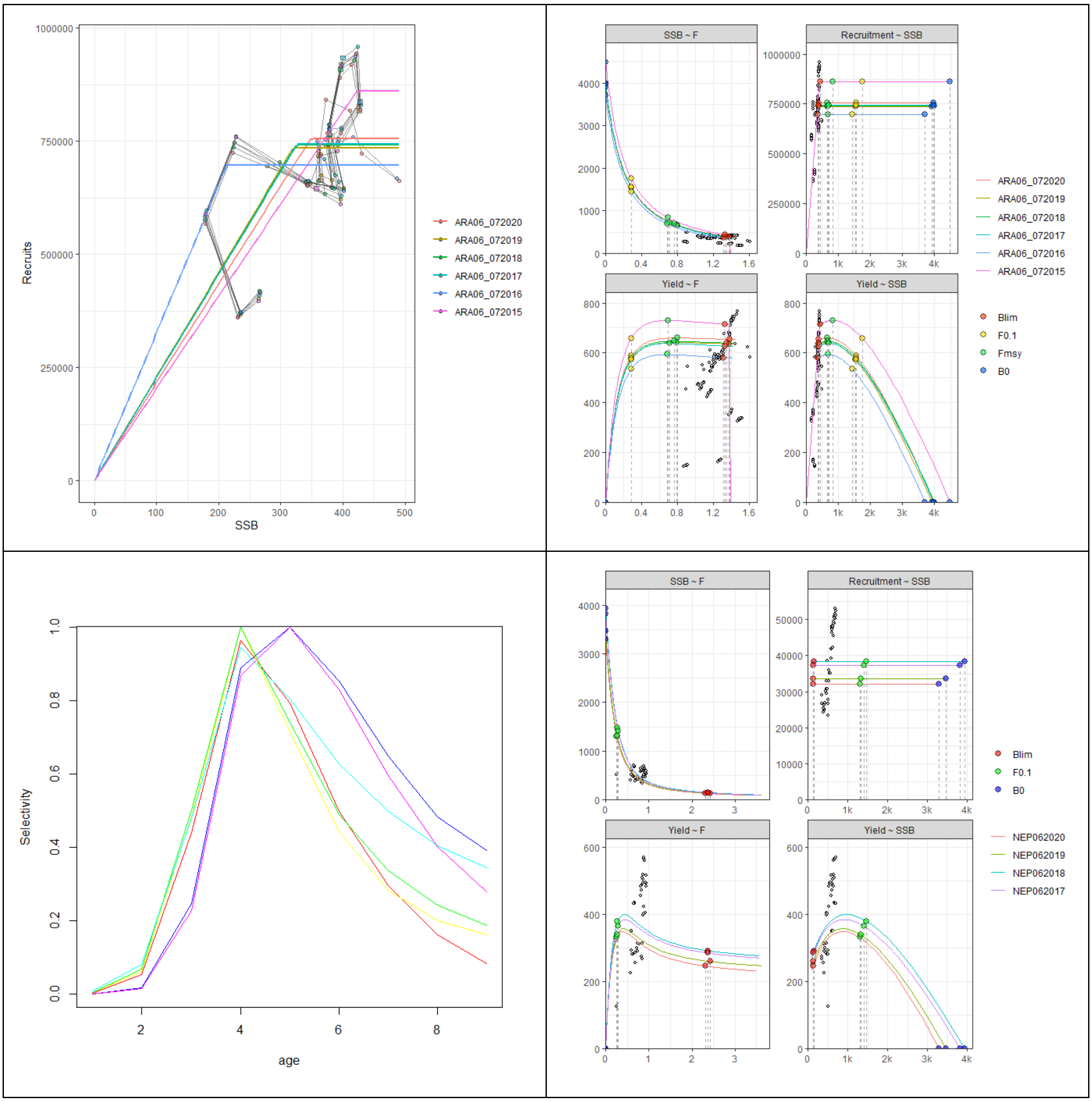


Figure 4.3.1.2: Two examples of the types of variability observed in the YPR-based biological reference points estimates through the retrospective peels (top ARA06_07, left variability in the inflection point of the hockey-stick and top right its impact on reference p

Other factors assessed to be causing variation in reference points were inconsistencies between the assumption in the assessment model and the stock recruit relationship (e.g. constraints on recruitment trends), heavy parameterisation of the F-model leading to poor predictability of recruitment and selection estimates, low cohort consistency in age based information particularly in the shellfish stocks associated with age slicing methodology, and inconsistencies in the stock input data.

Reference point estimations relies to some extent on different aspects of stock assessment and data characteristics than short-term objectives such as estimating current F, and estimating effort / TAC allocation. The predominant purpose of these assessments at time of development has been the later so it is not entirely unsurprising that the suitability of assessment is still limited for the former objectives. This is discussed in more detail in Section 3.2.2

4.3.2 Sensitivity methodological choices

In developing the procedures and methods described above (4.2), a number of decisions were taken on how to proceed; these have some influence on the values of the reference points. The sensitivity of the results to these different methodological choices is discussed below.

B_{Lim} **Criteria with no fit:** The criteria chosen for B_{Lim} where a point of inflection could not be found in the data was set at a fraction of $B_{F0.1}$ (25%). An alternative criteria based on a fraction of B_0 was considered by the EWG. Overall it was thought that basing the selection on a fraction of $B_{F0.1}$ was preferred as this implied a smaller extrapolation in SSB. However, the sensitivity of B_{Lim} estimates to this decision is negligible for all stocks except for thee stocks, Deepwater rose shrimp in GSA 9,10,11 and Nephrops in GSA 9 and GSA 6 (Figure 4.2.3.1).For two of these although Blim is higher, for Deepwater rose shrimp and Nephrops and GSA 9 SSB is already near or above $B_{F0.1}$ and as these changes to Blim have little influence. Only Nephrops in GSA 6 is sensitive to this decision.

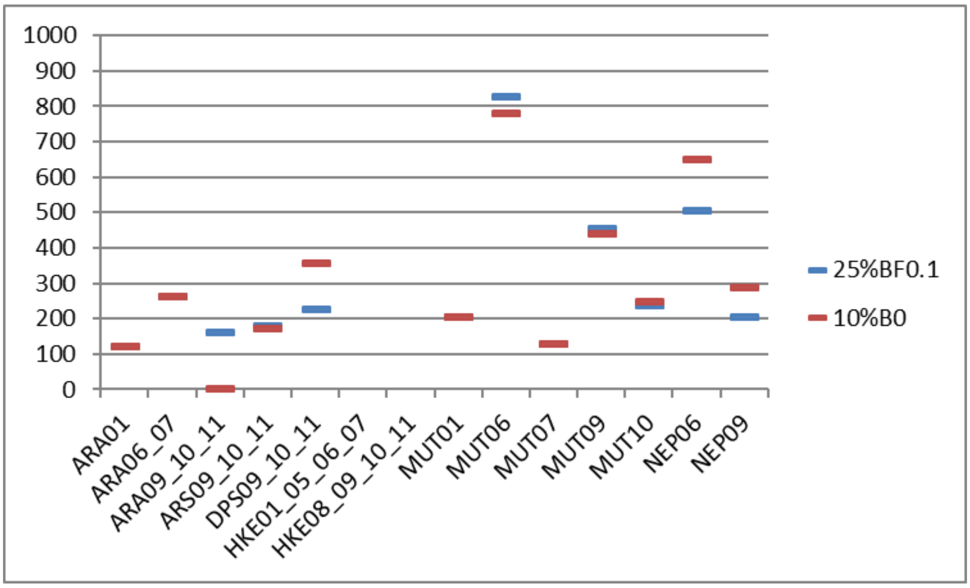


Figure 4.3.2.1 Changes to B_{Lim} if 10% B_0 was applied instead of EWG choice of 25%F0.1. The differences for all stocks except Nephrops in GSA 9 are negligible, for this stock B_{Lim} would increase from 203 to 289. Values for hake 1-5-6&7 (4,138) and hake 8-9-10&11 (4,316) are off the scale but are unaffected.

Sensitivity to upper limit for B_{Lim}**:** An upper limit to B_{Lim} was set to 20% B_0 and applied in the fitting procedure for the HS stock recruit relationships. Two of the stocks are particularly sensitive to this upper limit criteria red mullet in GSA 1 and red mullet in GSA 10. An increase in this limit would result in an increase in B_{Lim} for Red Mullet in GSA 10 from 238 (based on 25% B_{Lim}) to 666 tonnes because with a higher limit a HS fit to the data is obtained. This higher value is 70% of $B_{F0.1}$ which would be very high value for B_{Lim}. It's assumed that the fit is spurious, and the upper limit is intended to protect against such spurious fits. In contrast if upper limit constraint was reduced, the B_{Lim} on red mullet in GSA 1 would be reduced, from the fitted value of 205 to a value of 84 tonnes. In this case there fit would be excluded (classed as spurious) and replaced with the standard value of 25% B_{Lim}. The change to B_{Lim} for MUT GSA 1 is perhaps the greatest change resulting from the proposed process. A revision of this upper limit applied to B_{Lim} would deliver a reduction in B_{Lim} for this stock. The current results seem consistent with the data, there is a fit to a point of inflection, it is recognised that this fitted value of B_{Lim} is high and the lower value could be considered. In this case, the GM recruitment would be assumed, R_0 and $B_{F0.1}$ would reduce and B_{Lim} would be at 25% of a lower value of giving B_{Lim} =84 tonnes. In this case the stock would be considered to lie between B_{Lim} and B_{pa}, not below B_{Lim}. It should be noted that $F/F_{0.1}$ for red mullet in GSA 1 is lower than that for red mullet in GSA 6 but based on a B_{Lim} at 25% of $B_{F0.1}$ red mullet in GSA 6 is classed as above B_{pa}. Nevertheless, the data for does support the breakpoint, whereas for GSA 6 no breakpoint is found.

Sensitivity to lower limit for B_{Lim}**:** Lower limit to B_{Lim} was set near zero, at 0.1% of $B_{F0.1}$. Both hake stocks have observations at low biomass and show reduced recruitment with reduced biomass. The fitted values of B_{Lim} are at 7% and 10% of $B_{F0.1}$, well below the central value of 25%. These fitted B_{Lim} values, which are at the upper end of the observed recruitments, have been selected for use but if they were to be ignored, then the lowest estimate for $B_{F0.1}$ could be obtained by assuming that recruitment was not depleted and use GM model to give R_0 and then apply 25% of $B_{F0.1}$ to set the B_{Lim}. This approach would result in more than doubling the value of B_{Lim} for both these stocks. Hake 1-5-6&7 changing from 4138 to 9754 and Hake 8-9-10&11 changing from 4316 to 9543. Both these higher values are well above the maximum biomass observed in the current assessments (4848 and 5499 respectively). Even higher values of $B_{F0.1}$ could be postulated based on highest observed recruitment; this would result in even higher values of B_{Lim}. Both these situations involve extrapolating stock data upwards to B_{Lim} from the observed biomass data and imply some further increases in R are possible. Choosing higher values of B_{Lim} that imply a potential for higher than observed recruitment is not really supported by reported historic catches, though it is accepted that reporting of historic catch is uncertain. On balance the fitted values seem more coherent approach, supporting the use of low values for B_{Lim} for these stocks.

Choice of the 25% factor from $B_{F0.1}$ **to define** B_{Lim}**.** Any direct change to this 25% criterion would similarly influence the 8 (out of 14) stocks where this default value is used. For example a 20% factor would reduce these B_{Lim} values by $1/5^{th}$ and 30% would increase B_{Lim} by $1/5^{th}$. It was noted that for the 6 stocks for which the fitted values were obtained and used, the mean value was 24% of $B_{F0.1}$ suggesting that 25% provides a plausible value in the absence of data to the contrary.

Margin for B_{pa}: The EWG selected a basis for B_{pa} set to 2* B_{Lim}, equivalent to a sigma of 0.4 on the estimate of terminal year SSB. This is the value the EWG has recommended to give greater than 95% probability of B> B_{Lim}. The high levels of uncertainty for Mediterranean stocks are recognised by the EWG; the assessment models often suffer from over parameterisation so analytical levels of uncertainty are considered a poor representation of precision. In many cases it is not possible to carry out retrospective analyses for more than 2 or 3 years, so quantifying uncertainty through this method is not practical. The chosen value of 2 compares with ICES values that are mostly 1.4* or greater (WKREF1); the ICES value is used for stocks where B_{Lim} is mostly within the data, time series are much longer, and assessments are more precise as aging of individuals is usually more reliable than for the Mediterranean. ICES has recently reviewed their criteria and as part of that review concluded that 1.4 is likely to be too low for most of their cases (WKREF1). Taking all these aspects together there is clear support for a substantially higher value that 1.4, but no basis for a specific number. The sensitivity to this decision (decreases or increases to this factor) will directly affect B_{pa}, but not B_{Lim}.

5 RESULTS OF DATA QUALITY EVALUATIONS

The issues found during the evaluation of data quality issues are reported below by MS. It is intended to communicate the issues list to MS soon after the meeting to allow for the possibility for corrections prior to the 2022 data call. The list of issues provided here documents both errors/inconsistencies within the data, and also where high levels of variability are found. These could be due either to variable results from the sampling program or recording errors. The main data analyses using the JRC script (Section 4.1) by Country, GSA and Species are reported in Annex 1 to this report. This annex provides a summary of the commercial and MEDITS survey data provided under the DCF. Where possible this annex reports the data by MS, year and by fleet and where length/age data are available or missing. Indications of variability of length and weight at length data can also be found in these outputs. It is considered that these outputs may be useful as a starting point if data are to be considered for stock assessments in the future.

5.1 Slovenia

*5.1.1 Musky Octopus (EDT) in GSA 17**

EDT – data checks (related to the report ''Horned octopus (E) in GSA 17 (SVN) Quality checks, STECF EWG 22-03, 12. April, 2022)

LANDINGS AT LENGTH

Page 7; Missing year landings

"Years for which data are expected but are not provided" 2002 2003 2004

Answer; SVN was not member of EU in this period. The data are available from year 2006 onwards.

Page 11; Checking if there are landings in weight >0 having length class not filled in

"233_cases_in which_length_class_number_are_zero_if_landing>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

DISCARDS AT LENGTH

Page 18; discards - Checking if there are discards in weight equal to zero having length class filled in

"1_cases_in which_length_class_number_differ_from_zero_if_discard=0"

Answer; very small value of landing - presented on the sixth decimal place. The data sent to the data call is rounded to five decimal places.

Page 18; Checking if there are discards in weight >0 having length class not filled in

"41_cases_in which_length_class_number_are_zero_if_discards>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

Page 31; MATURITY AT AGE

"No maturity at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 34; SEX RATIO AT AGE

"No sex ratio at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 41; GROWTH PARAMETERS

Von Bertalanffy Growth functions

"No VBGF parameters are available for this stock"

Von Bertalanffy Growth Functions by sex and year

"No VBGF data by sex are available for this stock"

Von Bertalanffy Growth Functions by sex and year comparison

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters time series

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters boxplot

"No VBGF data are available for this stock"

Checking Von Bertalanffy Growth Functions units

"No VBGF data are available for this stock"

Length weight relationships

"No LW data are available for this stock"

Length weight relationships by sex and year

"No LW data are available for this stock"

Length weight relationships by sex and year comparison

"No LW data are available for this stock"

Time series of the length weight relationships parameters

"No LW data are available for this stock"

Boxplot of the length weight relationships parameters

"No LW data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 55; AGE LENGTH KEYS (ALKs)

ALKs by sex

"No age length available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

*5.1.2 Whiting (WHG) in GSA 17**

X WHG – data checks (related to the report ''Whiting (WHG) in GSA 17 (SVN) Quality checks, STECF EWG 22-03, 12. April, 2022)

LANDINGS AT LENGTH

Page 7; Missing year landings

"Years for which data are expected but are not provided" 2002 2003 2004

Answer; SVN was not member of EU in this period. The data are available from year 2006 onwards.

Page 10; Checking if there are landings in weight >0 having length class not filled in

"507_cases_in which_length_class_number_are_zero_if_landing>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

DISCARDS AT LENGTH

Page 17; discards - Checking if there are discards in weight equal to zero having length class filled in

"5_cases_in which_length_class_number_differ_from_zero_if_discard=0"

Answer; very small value of landing - presented on the sixth decimal place. The data sent to the data call is rounded to five decimal places.

Page 19; Checking if there are discards in weight >0 having length class not filled in

"340_cases_in which_length_class_number_are_zero_if_discards>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

Page 35; MATURITY AT LENGTH

"No maturity at length data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 37; MATURITY AT AGE

"No maturity at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 39; SEX RATIO AT LENGTH

"No sex ratio at length data available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 40; SEX RATIO AT AGE

"No sex ratio at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 41; GROWTH PARAMETERS

Von Bertalanffy Growth functions

"No VBGF parameters are available for this stock"

Von Bertalanffy Growth Functions by sex and year

"No VBGF data by sex are available for this stock"

Von Bertalanffy Growth Functions by sex and year comparison

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters time series

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters boxplot

"No VBGF data are available for this stock"

Checking Von Bertalanffy Growth Functions units

"No VBGF data are available for this stock"

Length weight relationships

"No LW data are available for this stock"

Length weight relationships by sex and year

"No LW data are available for this stock"

Length weight relationships by sex and year comparison

"No LW data are available for this stock"

Time series of the length weight relationships parameters

"No LW data are available for this stock"

Boxplot of the length weight relationships parameters

"No LW data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 61; AGE LENGTH KEYS (ALKs)

ALKs by sex

"No age length available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

5.1.3 Gilthead seabream (SGB) in GSA 17

SBG – data checks (related to the report ''Gilthead seabream (SBG) in GSA 17 (SVN) Quality checks, STECF EWG 22-03, 02. May, 2022)

LANDINGS AT LENGTH

Page 7; Missing year landings

"Years for which data are expected but are not provided" 2002 2003 2004

Answer; SVN was not member of EU in this period. The data are available from year 2006 onwards.

Page 10; Checking if there are landings in weight >0 having length class not filled in

"509_cases_in which_length_class_number_are_zero_if_landing>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

DISCARDS AT LENGTH

Page 17; discards - Checking if there are discards in weight equal to zero having length class filled in

"1_cases_in which_length_class_number_differ_from_zero_if_discard=0"

Answer; very small value of landing - presented on the sixth decimal place. The data sent to the data call is rounded to five decimal places.

Page 17; Checking if there are discards in weight >0 having length class not filled in

"112_cases_in which_length_class_number_are_zero_if_discards>0"

Answer; There are only three metiers in the SVN sampling scheme. For others, only landing data are available.

Page 30; MATURITY AT LENGTH

"No maturity at length data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 32; MATURITY AT AGE

"No maturity at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 34; SEX RATIO AT LENGTH

"No sex ratio at length data available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 35; SEX RATIO AT AGE

"No sex ratio at age data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 36; GROWTH PARAMETERS

Von Bertalanffy Growth functions

"No VBGF parameters are available for this stock"

Von Bertalanffy Growth Functions by sex and year

"No VBGF data by sex are available for this stock"

Von Bertalanffy Growth Functions by sex and year comparison

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters time series

"No VBGF data are available for this stock"

Von Bertalanffy Growth Functions parameters boxplot

"No VBGF data are available for this stock"

Checking Von Bertalanffy Growth Functions units

"No VBGF data are available for this stock"

Length weight relationships

"No LW data are available for this stock"

Length weight relationships by sex and year

"No LW data are available for this stock"

Length weight relationships by sex and year comparison

"No LW data are available for this stock"

Time series of the length weight relationships parameters

"No LW data are available for this stock"

Boxplot of the length weight relationships parameters

"No LW data are available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

Page 56; AGE LENGTH KEYS (ALKs)

ALKs by sex

"No age length available for this stock"

Answer; below the threshold - the total annual landings of a Member State of a species is less than 200 tonnes.

*5.1.4 Venus Clam (SVE) in GSA 17**

No data available at all in any table regarding this species (SVE), similar species like *Ruditapes spp.* (in case of misidentification between CLJ and CTG) or higher taxa like family Veneridae (CLV). Most probably this species is of low commercial interest due to low abundance. To be checked.

Table 5.1.4.1: Items identified and noted in DTMT for Slovenia

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Slovenia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_SBG. For year 2012; 1 cases in which length class number differ from zero if discard=0	QUALITY	LOW
2021	Slovenia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_EDT. For year 2018; 1 cases in which length class number differ from zero if discard=0	QUALITY	LOW
2021	Slovenia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_WHG. For years 2011, 2014, 2015, 2016; 5 cases in which length class number differ from zero if discard=0	QUALITY	LOW

5.2 Croatia

*5.2.1 Sardine (PIL) in GSA 17**

Landings by length

Data submitted from 2012 to 2020.

Landings reported from many fishing gears (24) with very small amount (below 1t) but needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL), most of the landings coming from PS SPF (up to 60000t). Data reported by quarter.

There were no duplicate records, no shifting length. In 6 submitted fishing gears, no landing and no lengths were reported.

Lengths distribution was reported only for PS SPF.

Mean weight in landing was reported for each year with no issues.

Discards by length

Data submitted from 2012 to 2020. Discards reported with maximum amount for PS SPF (up to 300t), but also reported as discard in many different gears, needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL). No length data reported.

Catch at age

All landing data were presented in length and in age.

No SoP needed.

Maturity at length and maturity at age

Maturity reported by sex and length with no issues. Maturity by age is not reported by sex.

Sex ratio at length and sex ratio at age

Sex ratio reported by sex and length with no issues. Sex ratio by age is not divided by sex.

Growth parameters

Two different von Bertalanffy growth equations were used. One in the 2013, 2018-2020, and other in 2014-2017.

Length weight relationship was calculated each year and have no issues.

Age-Length key

One ALK was used for entire series and not separated by sex.

Exploring for future assessments

Mean and median length showing same trend. No issues noted.

No issue with missing data in landings.

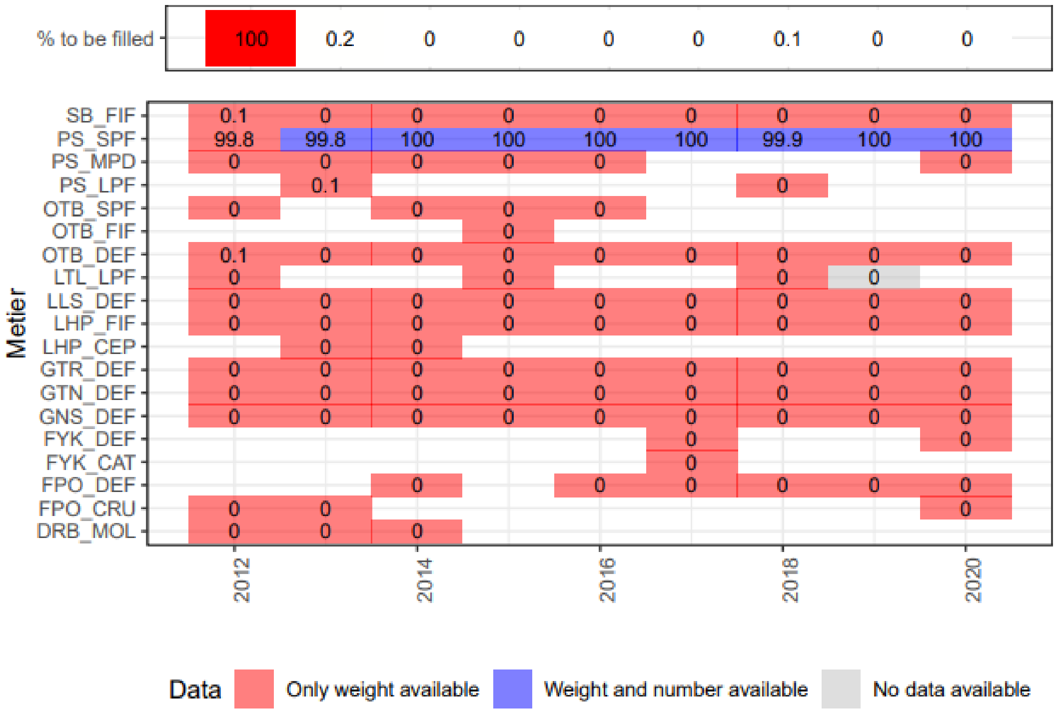


Figure 5.2.1.1: Missing length data in landings, sardine, Croatia, GSA 17

<u>MEDITS data</u>

MEDITS data was checked.

To be checked - recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). There is one haul that is in TB and not in TA (number 505 in 2011). There aren't hauls in TC which are not reported in TA. There aren't inconsistencies between TB and TC weight and/or number. Different number of hauls in different areas throughout years is also noted.

There aren't wrong step length class measures. There aren't length measures by sex. Maximum and minimum length were checked and maximum of 595 mm in 2016 and minimum of 15 mm in 2013 should be corrected.

*5.2.2 European Anchovy (ANE) in GSA 17**

Landings by length

Data submitted from 2012 to 2020.

Many fishing gears (24) reported with very small amount of landings (below 1t) but needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL). However, most of the landings coming from PS SPF (up to 10000t).

Landings reported by quarter. There were no duplicate records, no shifting length.

In 19 submitted fishing gears, no landing and no lengths were reported.

Lengths distribution was reported only for PS SPF.

Mean weight in lending was reported and no issue was detected.

Discards by length

Data submitted from 2012 to 2020. No length data reported.

Discards reported with maximum amount for PS SPF (up to 70t) but also reported as discard in many different gears, needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).

Catch at age

All landing data were presented in length and in age.

No SoP needed.

Maturity at length and maturity at age

Maturity reported by sex and length with no issues. Maturity by age is not reported by sex.

Sex ratio at length and sex ratio at age

Sex ratio reported by sex and length with no issues. Sex ratio by age is not divided ported by sex.

Growth parameters

One von Bartalanfy growth equation was used for entire timeseries.

Length weight relationship was calculated each year and have no issues.

Age-Length key

One ALK was used for entire series and not separated by sex.

Exploring for future assessments

Mean and median length showing same trend.

No issue with missing data in landings.

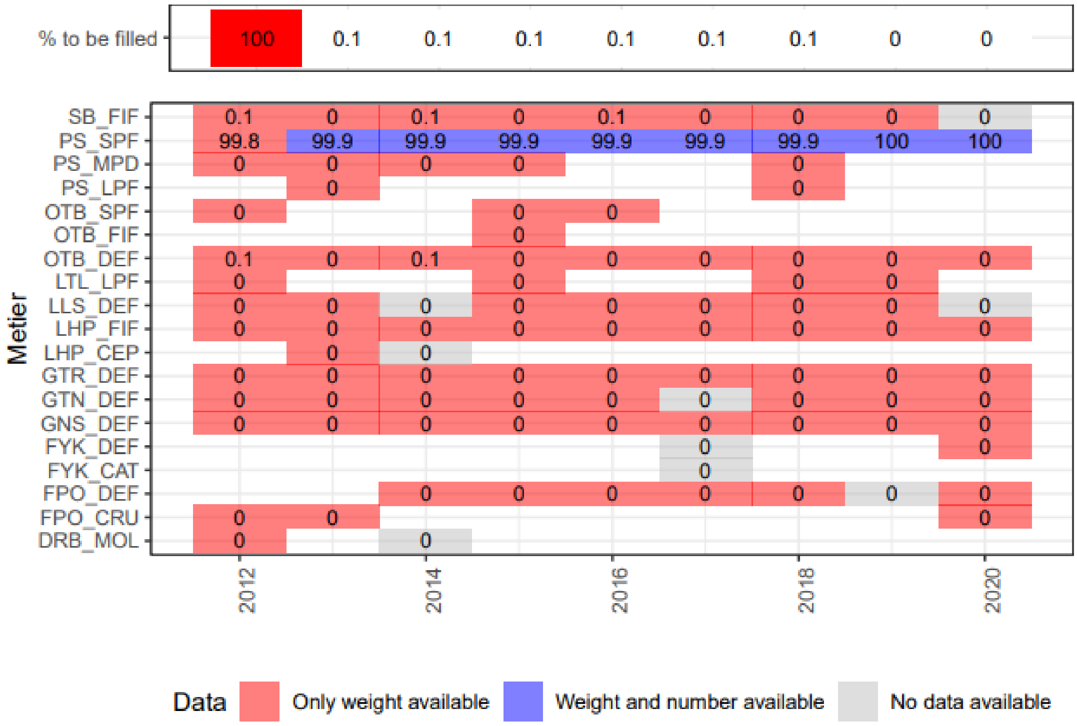


Figure 5.2.2.1: Missing length data for landings, anchovy, Croatia, GSA 17

<u>MEDITS data</u>

MEDITS data was checked. No major issues noted.

To be checked - recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). One haul is in TB but not in TA (2002, haul 677). There aren't hauls in TC which are not reported in TA. There aren't inconsistencies between TB and TC weight and/or number. Different number of hauls in different areas throughout years is also noted.

There aren't wrong step length class measures. There aren't length measures by sex. Maximum and minimum length need be checked (maximum 385 mm in 2020, minimum 20 mm in 2013).

5.2.3 Chub mackerel (VMA/VMS) in GSA 17

Landings by length

Data submitted from 2014 to 2020. Landings reported by quarters except in 2014 and 2018 (by year).

Landings reported from PS SPF. No issues observed.

There were no duplicate records, no shifting length.

Lengths distribution was reported for PS SPF.

Comparison between landings in weight by quarter and -1 (year aggregation) by gear/métier. "Check if ratio values are equal (or close) to 1."

year	gear	Tot_q	Toto_yr	ratio
2016	PS	1833.	2.62	701.
2020	PS	1919.	15.6	123.

Mean weight in landing was reported and showed no issues.

Discards by length

Data submitted from 2014 to 2020 only. No length data reported. Two cases in which discards are reported 0 and no length data.

Comparison between discards in weight by quarter and -1 (year aggregation) by gear/metier. "Check if ratio values are equal (or close) to 1. "

year	gear	Tot_q	Toto_yr	ratio
2016	PS	1.07	0	Inf
2020	PS	0.687	0	inf

Discards reported with maximum amount for PS SPF (up to above 3t).

Catch at age

All landing data were presented in length and in age.

No SoP needed.

Maturity at length and maturity at age

Maturity reported by sex and length with no issues. Maturity by age is not reported by sex.

Sex ratio at length and sex ratio at age

Sex ratio reported by sex and length with no issues. Sex ratio by age is not divided by sex.

Growth parameters

One von Bartalanfy growth equation was reported (in 2020).

Length weight relationship was reported in only one year (in 2020).

Age-Length key

One ALK was used for entire series and not separated by sex.

Exploring for future assessments

Mean and median length showing same trend.

No issue with missing data in landings.

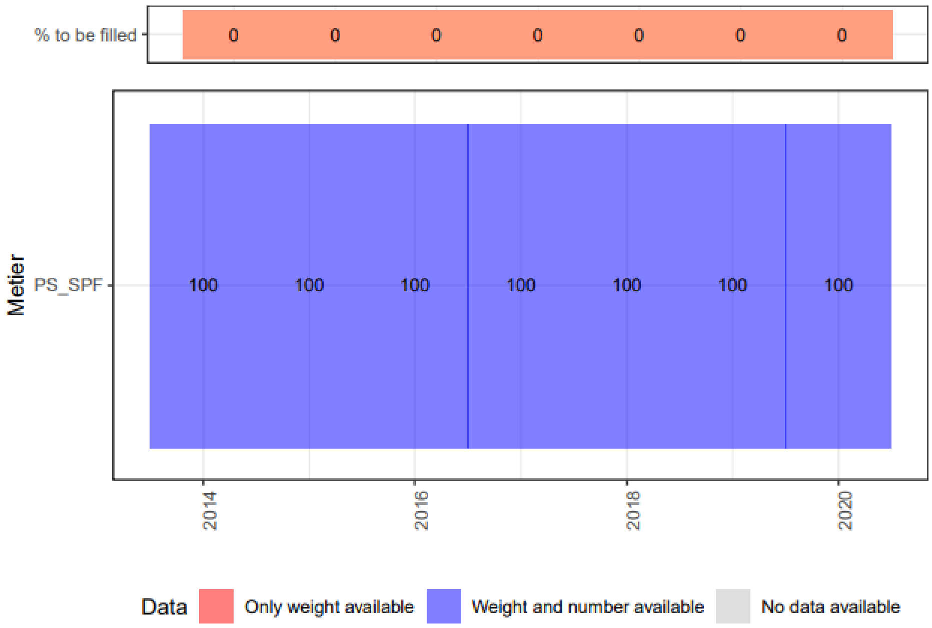


Figure 5.2.3.1: Missing length data in landings, chub mackerel, Croatia, GSA 17

MEDITS data

To be checked - recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). There aren't hauls in TB which are not reported in TA. There aren't hauls in TC which are not reported in TA. There aren't inconsistencies between TB and TC weight and/or number. There aren't hauls in TC in which an higher sampling ratio has been applied. Different number of hauls in different areas throughout years is also noted.

Length data were not separated by sex. Minimum and maximum length were checked, and no issue found.

5.2.4 Atlantic horse mackerel (HOM) in GSA 17

Landings by length

Data submitted from 2012 to 2020.

Most of the landings coming from PS SPF (up to little above 900t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL). Landings reported by quarter.

There were no duplicate records, no shifting length.

8 cases in which landings are zero. No lengths reported in those cases.

475 cases in which length class number are zero if landing is >0.

Lengths distribution was reported for PS SPF.

Comparison between landings in weight by quarter and -1 (year aggregation) by gear "Check if ratio values are equal (or close) to 1. "

year	gear	tot_q	tot_yr	ratio
2014	OTB	0.042	68.2	0.00061

Comparison between landings in weight by quarter and -1 (year aggregation) by métier. "Check if ratio values are equal (or close) to 1. "

year	gear	fishery	tot_q	tot_yr	ratio
2014	OTB	DEF	0.001	68.2	0.0000147

Mean weight in landing was reported and showed no issues.

Discards by length

Data submitted from 2014 to 2020. No length data reported.

Discards reported with maximum amount for PS SPF (up to above 11t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).

Catch at age

All landing data were presented in length and in age.

No SoP needed.

Maturity at length and maturity at age

Maturity reported by sex and length in some years (2014, 2017, 2018 and 2020) with no issues. Maturity by age is not reported by sex.

Sex ratio at length and sex ratio at age

Sex ratio reported by sex and length in some years (2014, 2017, 2018 and 2020) with no issues. Sex ratio by age is not divided by sex.

Figure 5.2.4.1: Missing length data in landings, Atlantic horse mackerel, Croatia, GSA 17

Growth parameters

No VBGF parameters was reported.

No length weight relationship parameters were reported.

Age-Length key

One ALK was used for entire series and not separated by sex.

Exploring for future assessments

Mean and median length showing same trend.

No issue with missing data in landings.

MEDITS data

To be checked - recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). There aren't hauls in TB which are not reported in TA. There aren't hauls in TC which are not reported in TA.

Checking sampling ratio applied (threshold values define by the user) Table 5.2.4.1: TC hauls in which a higher sampling ratio has been applied

Table 5.2.4.2: Samples in TC table with high raising factors

country	area	vessel	year	haul_number	pfrac	pechan	sex	raise
HRV	17	AND	2012	547	23000	958	N	24.0084
HRV	17	BIO	2014	5	49300	2226	N	22.1474
HRV	17	BIO	2018	31	12750	492	N	25.9146
HRV	17	BIO	2019	12	37200	3451	N	10.7795
HRV	17	AND	2004	536	9000	635	N	14.1732
HRV	17	AND	2004	546	9100	901	N	10.0999
HRV	17	AND	2006	557	8000	617	N	12.9659

Checking if total weight and number reported in TB are consistent with the ones in TC in Table 5.2.4.3: TB and TC consistency as total weight and number reported

Table 5.2.4.3: Samples with inconsistency between TB and TC weights

country	area	year	haul_number	totwgB	totnbB	totwgC	totnbC	wgratio	nbratio
HRV	17	2018	12	1186	6	1186	4.999532	1	1.20011
HRV	17	2018	17	3070	15	3070	14.000000	1	1.07142

Different number of hauls in different areas throughout years is also noted.

Length data were separated by sex.

Minimum length and maximum were checked and maximum value of 460 mm in 2013 should be checked.

5.2.5 *Mediterranean horse mackerel (HMM)* in GSA 17

Landings by length

Data submitted from 2012 to 2020.

Most of the landings coming from PS SPF (up to little above 600t) and OTB DEF (up to 75t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL). Most part of the data reported in quarters, but some at yearly level. No issues observed.

There were no duplicate records, no shifting length. 28 cases with landing zero and no data in length (-1).

Comparison between landings in weight by quarter and -1 (year aggregation) by gear "Check if ratio values are equal (or close) to 1. "

year	gear	tot_q	tot_yr	ratio
2015	OTB	0.603	88.7	0.00680
2014	OTB	0.023	37.5	0.00061

Comparison between landings in weight by quarter and -1 (year aggregation) by Metier "Check if ratio values are equal (or close) to 1. "

year	gear	fishery	tot_q	tot_yr	ratio
2014	OTB	DEF	0	37.5	0

Lengths distribution was reported for OTB DEF.

Mean weight in landing was reported and showed no issues.

Discards by length

Data submitted from 2012 to 2020. Most recorded discards from PS SPF and OTB DEF but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL). Length data reported for OTB DEF.

Issues same as for landings:

Comparison between landings in weight by quarter and -1 (year aggregation) by gear "Check if ratio values are equal (or close) to 1. "

year	gear	tot_q	tot_yr	ratio
2015	OTB	0	0.277	0
2014	OTB	0	0.246	0

Comparison between landings in weight by quarter and -1 (year aggregation) by Metier "Check if ratio values are equal (or close) to 1. "

year	gear	fishery	tot_q	tot_yr	ratio
2014	OTB	DEF	0	0.246	0

Catch at age

All landing data were presented in length and in age.

No SoP needed.

Maturity at length and maturity at age

Maturity reported by sex and length in some years (2014, 2015, 2016, 2020) with no issues. Maturity by age is not reported.

Sex ratio at length and sex ratio at age

Sex ratio reported by sex and length in some years (2014, 2015, 2016, 2020) with no issues. Sex ratio by age is not reported for this stock.

Growth parameters

No von Bartalanfy growth equation was reported.

No length weight relationship parameters were reported for this stock.

Age-Length key

No ALK was reported for this stock.

Exploring for future assessments

Mean and median length showing same trend.

Large amount of data to be filled in landings and discard for stock assessment purposes.

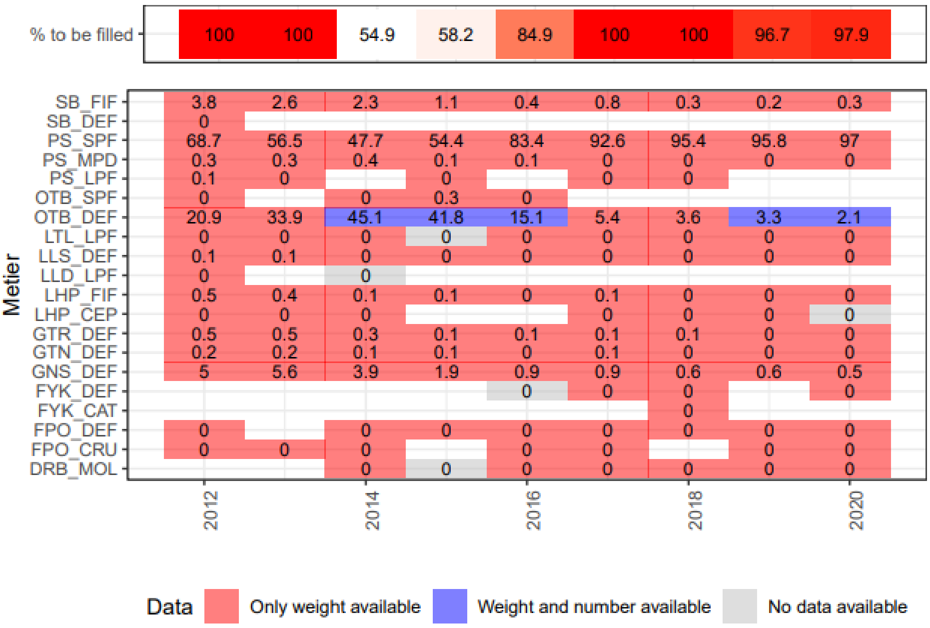


Figure 5.2.5.1: Missing length data in landings, Mediterranean horse mackerel, Croatia, GSA 17.

MEDITS data

To be checked - recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). There aren't hauls in TB which are not reported in TA. There aren't hauls in TC which are not reported in TA. There aren't inconsistencies between TB and TC weight and/or number.

TC hauls in which an higher sampling ratio has been applied:

country	area	vessel	year	haul_number	pfrac	pechan	sex	raise
HRV	17	BIO	2018	65	1400	117	N	11.96581

Length data were separated by sex.

Minimum and maximum length checked and minimum length of 10 mm in 2016 and 30 mm in 2019 should be checked. These may be correct but are rather unusual, this issue has not been added to DTMT, as it is not formally an error.

*5.2.6 Venus Clam (SVE) in GSA 17**

This species has a lower commercial value and limited distribution in the Republic of Croatia, mainly in the infralittoral zone of the northern Adriatic and in some estuaries and bays (e.g. Neretva estuary, Pag and Rab bays). In commercial fisheries, it is mostly caught as bycatch in small quantities by dredges or divers in recreational fisheries (Jukić et al 1998 and Peharda et al 2010).

Although landings data are available for the period from 2012 to 2020, all the facts indicate that this is case of misidentification. The most important fact that indicates this is the landing data reported for gear that is not designed to catch this species, does not have a technical capability, or is not deployed in a populated area.

The noted data issues needs to be clarified and corrected by MS.

Table 5.2.6.1: Landing of SVE in HRV GSA 17 by métier

gear	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
DRB	0.005	0.002						0.006	
FPO			0.001					0.012	
GNS	0.025	0.024	0.023	0.003	0.057	0.02	0.003	0.042	0.136
GTN					0.003				
GTR	0.006	0.002	0.006	0.001	0.011	0.005	0.007	0.008	0.023
LHP								0.009	
LLD		0.002							
LLS	0.006		0.005	0.017	0.175	0.002	0.174	0.004	0.643
OTB	0.102	0.159	0.174	0.009	0.09	0.048	0.005	0.06	0.012
PS								0.01	
SB							0.011		

Due to low abundance and low commercial interest, this species was not selected for sampling, so no length or biological data are available for this stock for Croatia.

Table 5.2.6.2: Items identified and noted in DTMT for Croatia

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_HMM. Data submitted from 2012 to 2020, Most recorded discards from PS SPF and OTB DEF but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_17_HMM. Most of the landings coming from PS SPF (up to little above 600t) and OTB DEF (up to 75t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL)	COVERAGE	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_HOM. Discards reported with maximum amount for PS SPF (up to above 11t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_17_HOM. Most of the landings coming from PS SPF (up to little above 900t) but needs to be checked reporting from other gears as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	MEDITS_TC	GSA_17_ANE. Maximum and minimum length need be checked (maximum 385 mm in 2020, minimum 20 mm in 2013)	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_ANE. Discards reported with maximum amount for PS SPF (up to 70t) but also reported as discard in many different gears, needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_17_ANE. Many fishing gears (24) reported with very small amount of landings (below 1t) but needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL)	QUALITY	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	MEDITS_TC	GSA_17_PIL. maximum of 595 mm in 2016 and minimum of 15 mm in 2013 should be corrected.	QUALITY	LOW

2021	Croatia	STECF EWG	Med and BS	EWG 22-03	MEDITS_TA_TB	GSA_17_PIL. recorded number of hauls in 2011 and 2018 are different in TA (61 and 65) and TB (60 and 64). In 2002, number of hauls in TB (60) was larger than in TA (59). There is one haul that is in TB and not in TA (number 505 in 2011).	COVERAGE	LOW
2021	Croatia	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_17_PIL. Discards reported with maximum amount for PS SPF (up to 300t), but also reported as discard in many different gears, needs to be checked as it seems not reliable (DRB, FPO, FYK, LPH, LLS, LTL).	QUALITY	LOW

5.3 Bulgaria

*5.3.1 European Anchovy (ANE) in GSA 29**

Catch data of ANE from Bulgaria are usually a small portion of the total catch in the Black Sea which is dominated by catches from Turkey. Higher catches are obtained in 2014 (about 350t) and 2020 (about 400t) due to warmer weather allowing some schools to stay in the coastal waters during the winter instead of migrate into Turkish coastal waters.

Data collection started in 2008, after Bulgaria joined the EU in 2007.

Checking Landings

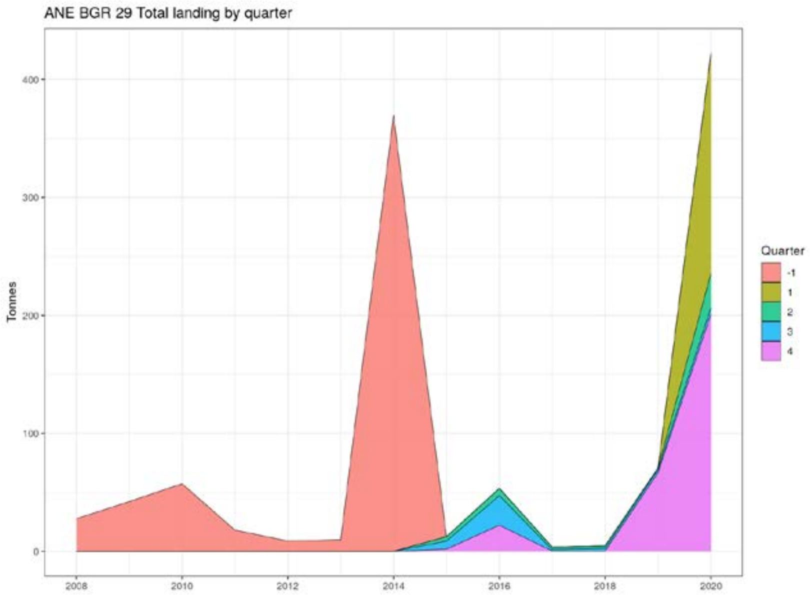


Figure 5.3.1.1: Landings provided by quarter since 2015

Observations about timing of provision of data

- Landings provided by quarter since 2015
- Mean weight is reported since 2016. In 2017-2020 weight is reported only from landings of OTM.
- Sex is determined since 2016.
- Maturity is reported since 2016.
- VBGF is reported since 2016, scale is in cm.
- LW is reported since 2016
- LFD is reported only in 2020

Detected errors (severity of all errors is low, except where noted)

- Metiers need to be correctly defined e.g. catches are registered from pots and traps on small pelagics: FPO should be changed to pound nets FPN

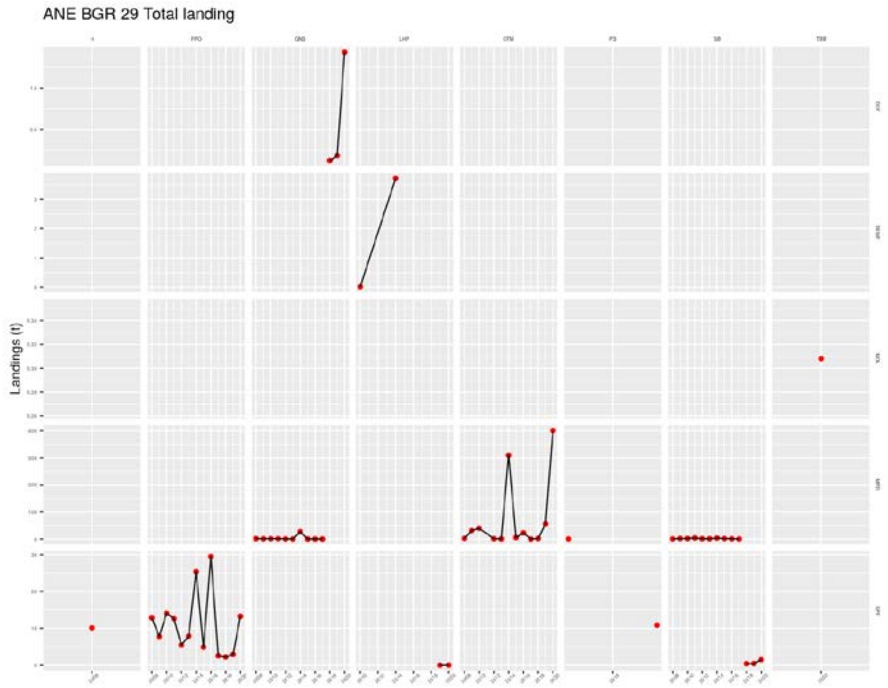


Figure 5.3.1.2: Landings by metier

- In 2008 landings one unknown (-1) Gear type is reported (catch=10t)

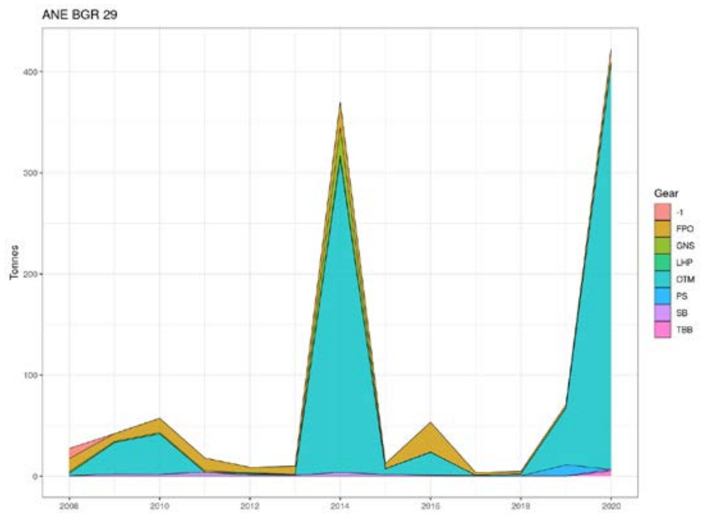


Figure 5.3.1.3: • In 2008 landings one unknown (-1) Gear type is reported (catch=10t)

- Mean weight in landings 7350 g is erroneously reported in 2019 (should be checked or deleted).

- All reported fish are reported as fully mature but this is not plausible as fish of age 0 and bellow 8cm should be juvenile. It seems that maturity is not correctly assessed and reported. **(severity average)**

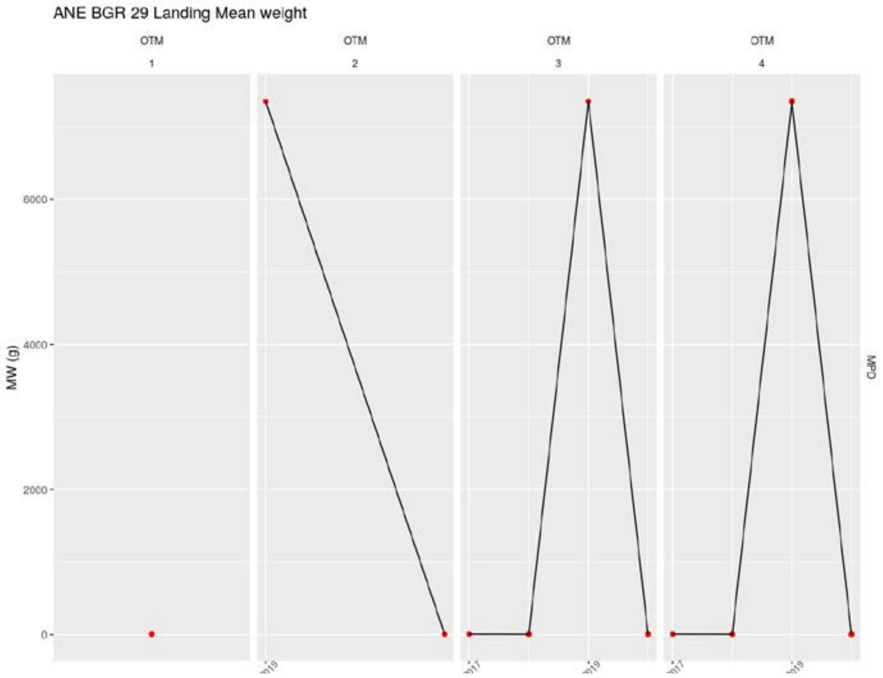


Figure 5.3.1.4: Landings mean weight

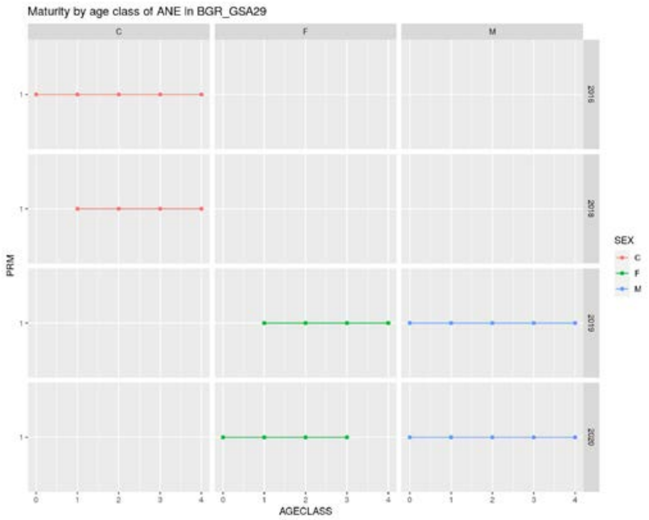


Figure 5.3.1.5: Maturity by age class.

- Sex ratio is reported uniformly as 50% that is not plausible. Sex ratio is not correctly reported.

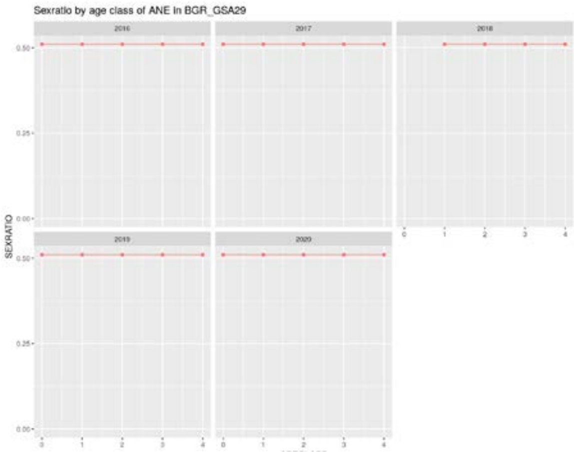


Figure 5.3.1.6: • Sex ratio is reported uniformly as 50%

- VBGF Loo in 2020 is wrong (1.48 cm) possibly because of typo: maybe Loo is meant to be 14.8 cm.

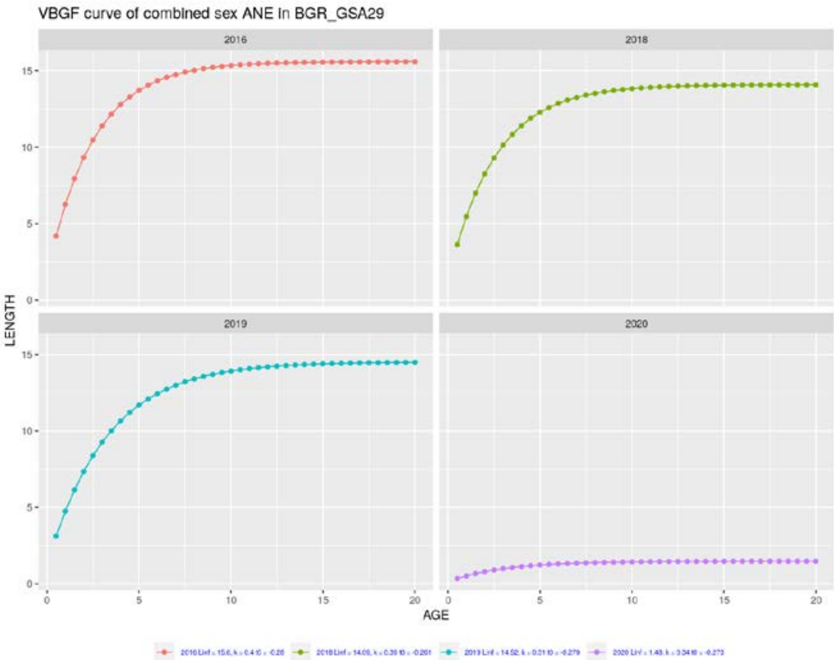


Figure 5.3.1.7: VBGF Loo in 2020 is wrong

- LW relationship in 2018 and 2020 look wrong, there might be issues using wrong units of weight or length

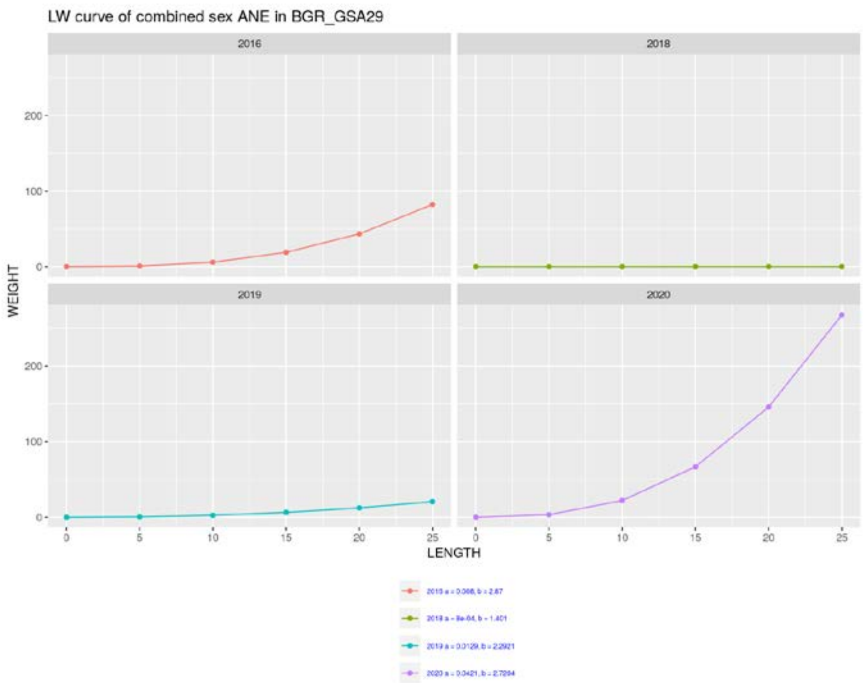


Figure 5.3.1.8: LW relationship in 2018 and 2020 look wrong

Checking Discards

No discards are reported in Bulgaria

Checking research survey

Anchovy is not reported in research surveys in Bulgaria.

*5.3.2 Whiting (WHG) in GSA 29**

The data checks were conducted in regards to the report ''Whiting (WHG) in GSA 29 (BGR) Quality checks, STECF EWG 22-03, 12 April, 2022" (available in Annex 1). Most of the issues presented in the report on Quality checks are due to not planned sampling for most of the metiers with negligible landings.

No major issues were found in the data available for WHG in GSA 29 collected by Bulgaria. The time frame and hauls position of the Surveys were checked. Only the spring survey in 2020 was conducted in the 3rd quarter instead of the 2nd, due to COVID restrictions and lockdown.

The issues found that need clarification by the MS are presented below.

- GSA_29_WHG_Landings length. The values for mean weight in landings in 2019 are extremely high compared to the data for the rest of the years. In addition, eight cases in Landings records in which SOP is needed are found. The cases are for 2019 data where the total number of individuals and mean weight could be mistaken.
- GSA_29_WHG_Growth parameters. Von Bertalanffy Growth functions for 2020 is much lower compared to previous years because the LinF is reported in “mm” instead of “cm”. It is an obvious technical mistake.
- GSA_29_WHG_Landings length. In regards to the plotting landings length frequencies distributions, the total numbers for OTM_MPD in 2019 (0.48304) and 2020 (2937.937) are very low and very high respectively.

MS is requested to revise and resubmit the data during the Med & BS Data Call 2022 or to provide reasonable clarification to the issues above.

In regards to the Data Transmission Monitoring Tool (DTMT) Guidance (version July 2021) all issues listed are related to Quality by type and the severity of the impact of the issue on the work of the EWG is Low. No recurrent issue was found.

5.3.3 Red mullet (MUT) in GSA 29

Catches of red mullet in Bulgaria have remarkably increased after 2008. Largest catches are from OTM (used as a bottom trawl).

Checking Landings

Data coverage

- Landings provided by quarter since 2015

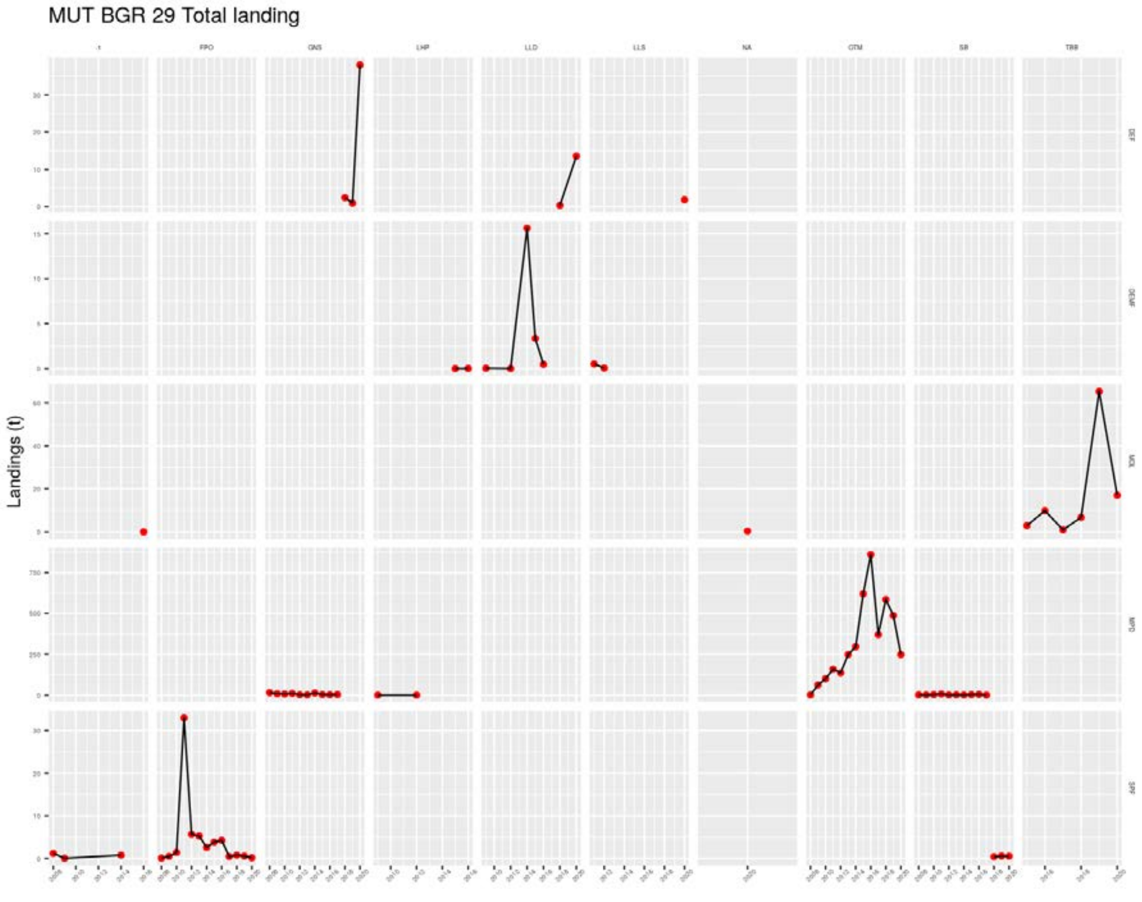


Figure 5.3.3.1: Landings by metier

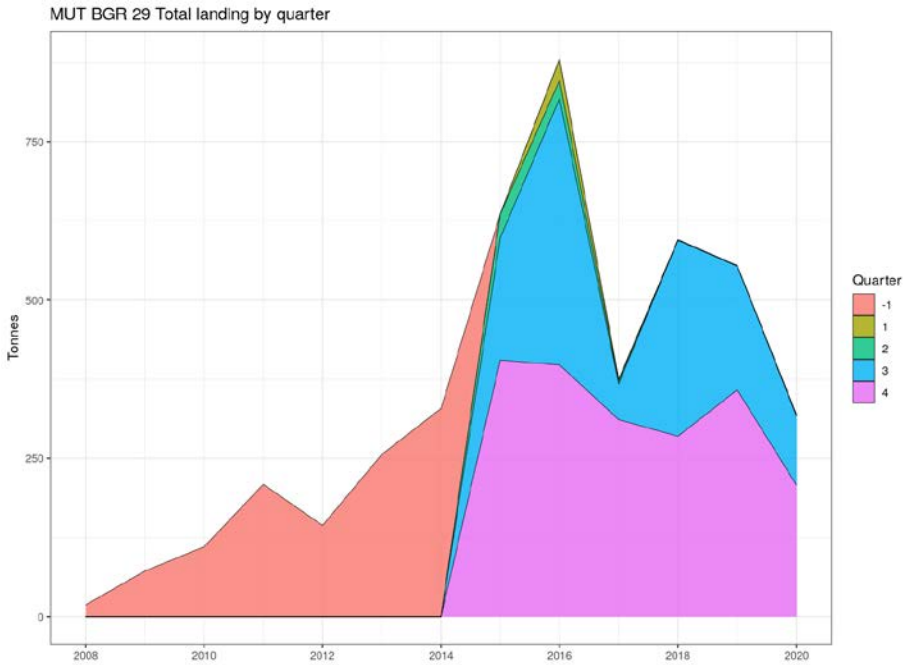


Figure 5.3.3.2: Total landings by quarter

- Mean weight is reported since 2017.
- Maturity is reported since 2016.
- Sex is determined since 2016.
- VBGF is reported since 2016, scale is in cm.
- LW is reported since 2016
- LFD are reported since 2017

Detected errors (severity of all errors is low, except where noted)

- Metiers need to be correctly defined e.g. catches are registered from pots and traps on small pelagics: FPO_SPF, that should be changed to pound nets on mixed pelagic and demersal: FPN_MPD

- All reported fish are reported as fully mature but this is not plausible as fish of age 0 and bellow 10cm should be juvenile. It seems that maturity is either not correctly assessed or not correctly reported. **(severity average)**

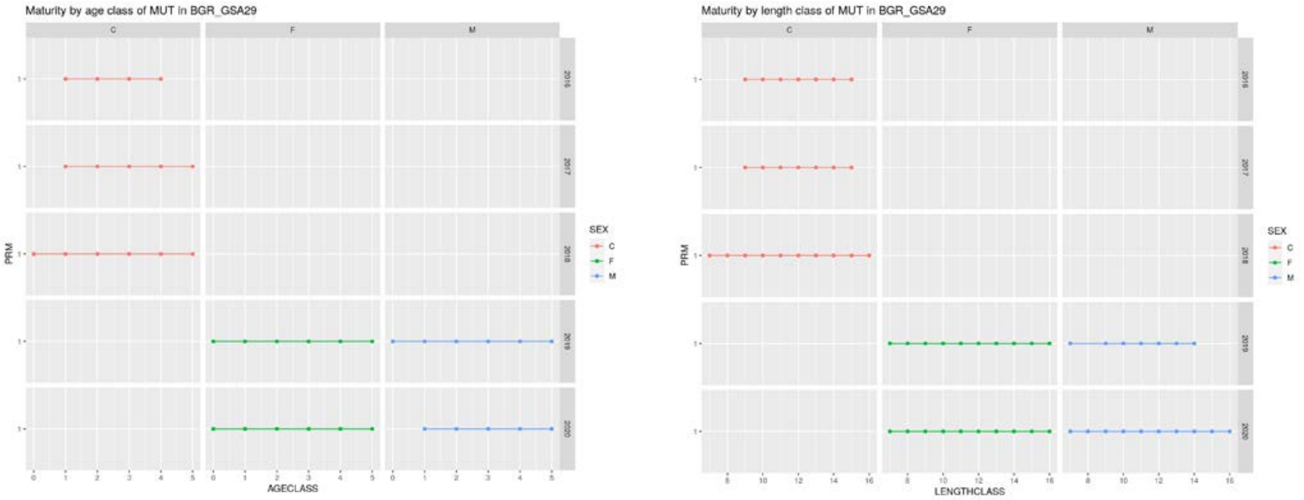


Figure 5.3.3.3: Maturity by age (left) and length (right)

- Sex ratio is reported uniformly as 50% that is not plausible. Sex ratio is not correctly reported.

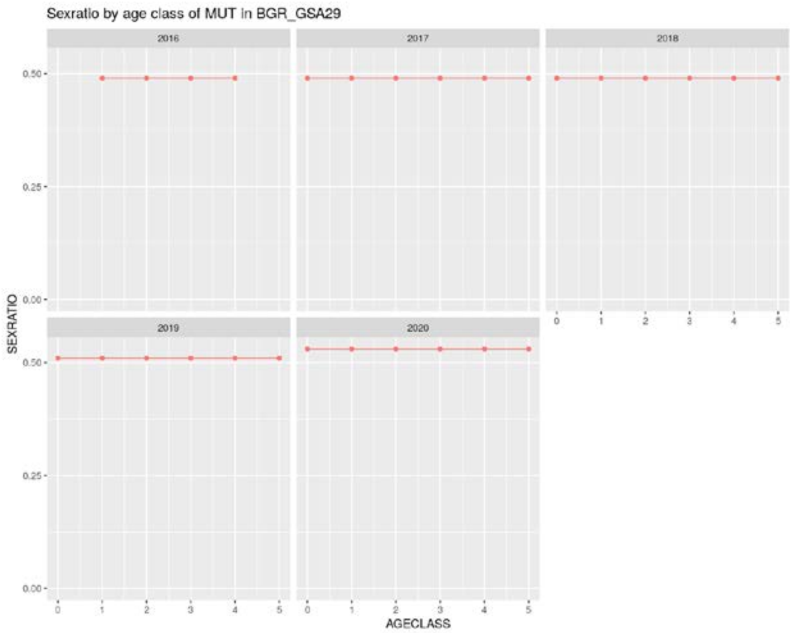


Figure 5.3.3.4: Sex ratio by age

- VBGF Loo in 2020 is wrong (1.83 cm) possibly because of typo: maybe Loo is meant to be 18.3cm.

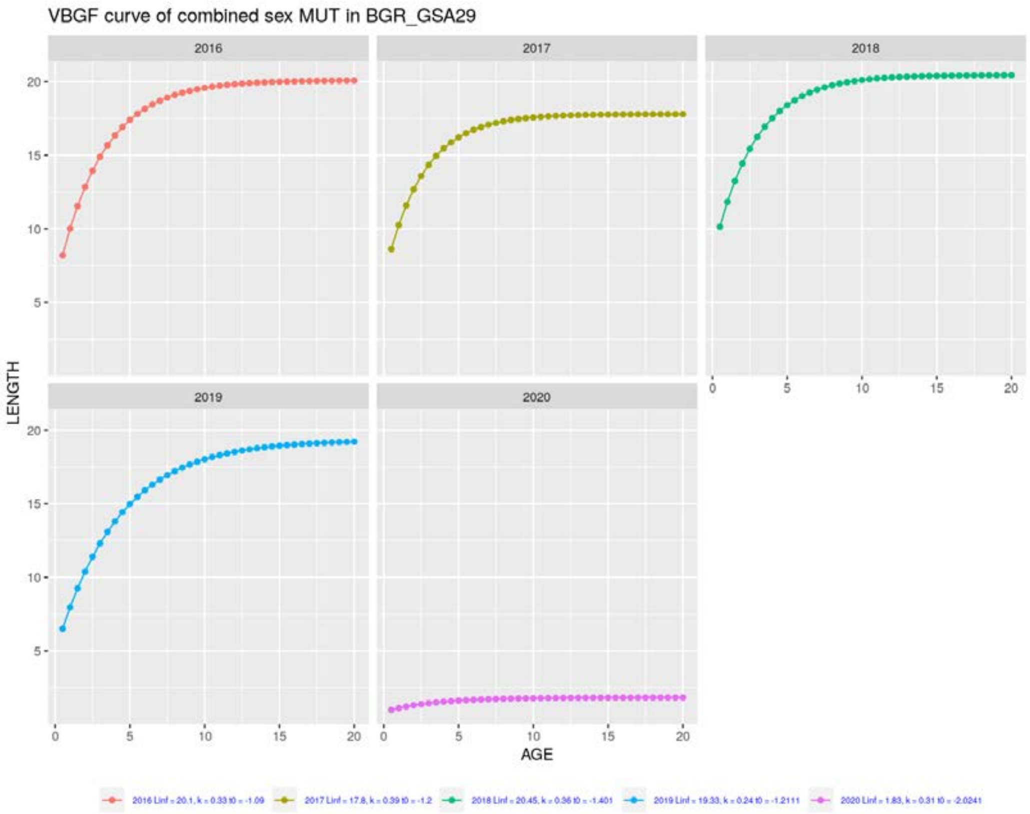


Figure 5.3.3.5: Size at age by year

- LW relationship in 2018 is erroneous

Checking Discards

No discards are reported in Bulgaria

Checking research survey

Red mullet is not reported in research surveys in Bulgaria.

Table 5.3.3.1: Items identified and noted in DTMT for Bulgaria

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_ANE. Length distributions are available only in the last 4 years even if only in 2017 are quite poor. What about all the previous years?	COVERAGE	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_ANE. Please check a and b parameters of the length weight relationships provided. They seems quite different across the years.	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_ANE. VB units is misreported in 2020 mm rather than cm	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at age	GSA_29_ANE. All ages including Age 0 have been always reported as fully mature. Is it correct?	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_29_ANE. Please check length classes reported in maturity at length file. Indeed, a 95 cm length has been reported in 2018	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_29_ANE. Sum of Product needed for 5 records for year 2019 gear OTM mesh size 00D14 fishery MPD in quarters 2,3 and 4	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_ANE. Landings in weight in years 2014 and 2020 differ quite a lot from all the others years. Are these two values correct? are the others correct?	QUALITY	LOW

2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_WHG. Please check length frequencies distribution of OTM_MPD in year 2020, it seems there is a weird abundance reported.	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_WHG. Landings abundances (number per length classes) are available only from 2018 onward. Are the previous years not available?	COVERAGE	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_WHG. The a parameter in the length weight relationships in years 2019 and 2020 must to be checked. They seem not plausible with the biology of the species.	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_WHG. VB units reported in 2020 (mm) is wrong. Shouldn't be cm?	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at age	GSA_29_WHG. For all ages maturty values is 1. IS it correct?	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_29_WHG. for all length maturity value is 1. Is it correct? Also for the very small specimens?	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_WHG. Please check landings in weight and number by length classes reported for year 2019 in OTM (MDD) because the relative mean weight is not plausible for this species (too high more than 15kg)	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_WHG. Landings in weight are not reported for years: 2013 and 2014	COVERAGE	LOW

2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_29_WHG. Sum of Product neede for 8 records for year 2019 gear OTM mesh size 00D14 fishery MPD in all the quarters	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_MUT. Length frequencies distributions are available only for the last 4 years. Are the LFD for the previous years not available?	COVERAGE	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_MUT. Could MS check a and b length weight parameters time series. Considering that always the same units of measures have been declared the values differ quite a lot in their order of magnitude.	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_MUT. Could MS fix VB units in 2020. Shouldn't be in cm?	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_29_MUT. Could MS check maturity ogive at length for this species. Indeed maturity is flat when at least for length less than 8 cm (in particular in female) some immature individuals are expected.	QUALITY	LOW
2021	Bulgaria	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_29_MUT. There are 14 cases in which a Sum of Product corrections should be applied in ANE. In particular check data provided for year 2019 in OTM MPD	QUALITY	LOW

5.4 Romania

*5.4.1 European Anchovy (ANE) in GSA 29**

Catch data of ANE from Romania are usually a small portion of the total catch in the Black Sea which is dominated by catches from Turkey. Data collection started in 2008, after Romania joined the EU in 2007.

Checking Landings

Data coverage

- Landings are provided by quarter since 2020

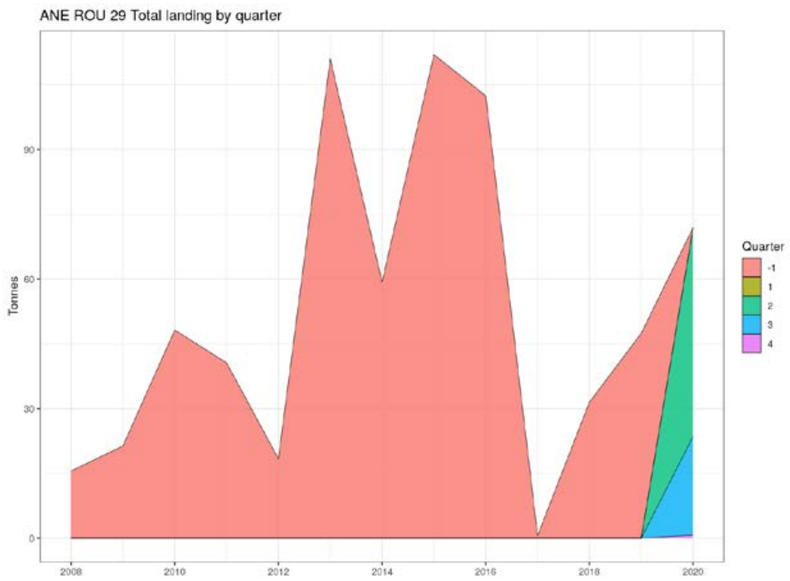


Figure 5.4.1.1: Landings by quarter

- Maturity by length collected in 2019-2020
- Maturity by age collected in 2017-2020
- Sex ratio (by length and age) is collected since 2010
- VBGF is provided since 2009.

Detected errors (severity of all errors is low, except where noted)

- 2017 mean weight for FPN_SPF is erroneous (0.094g - should be checked)

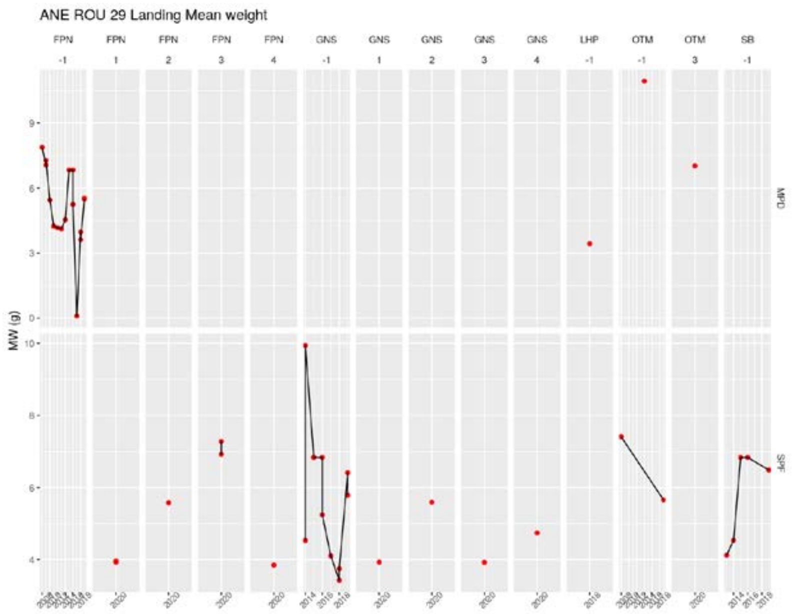


Figure 5.4.1.2: Landings by metier

- VBGF units are in mm in 2016-2017. It would be preferable to provide in same units, but OK provided units are correctly noted.

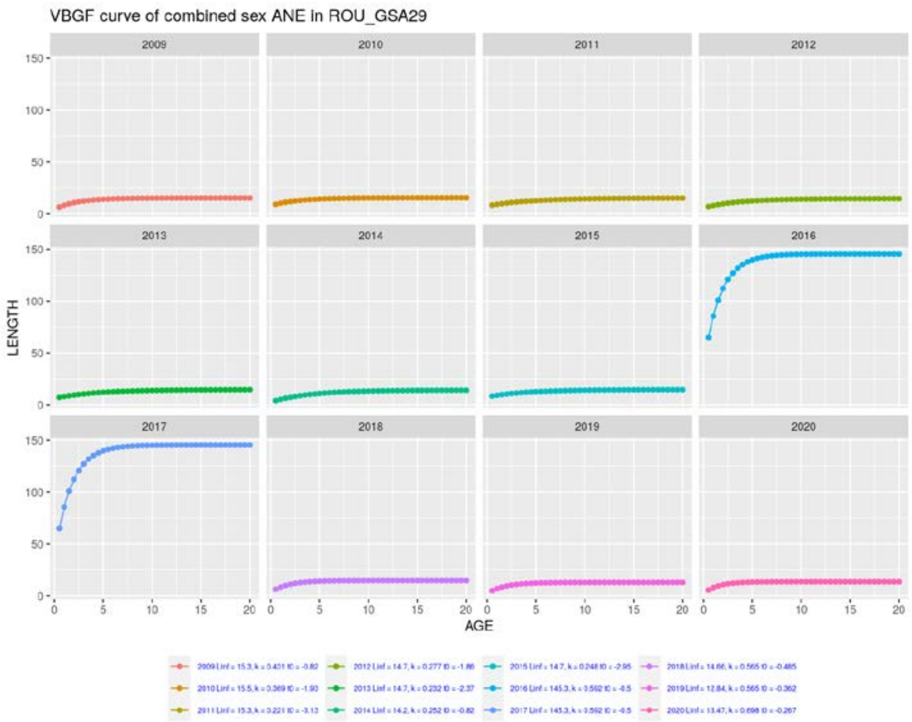


Figure 5.4.1.3: Size at age, note different units

Checking Discards

Discards are reported since 2008. No errors in data are detected

Checking research survey

Anchovy is not reported in research surveys in Romania.

*5.4.2 Whiting (WHG) in GSA 29**

The data checks were conducted in regards to the report ''Whiting (WHG) in GSA 29 (ROU) Quality checks, STECF EWG 22-03, 12 April, 2022" (available in Annex 1). Most of the issues presented in the report on Quality checks are due to not planned sampling for some metiers or missing landings of WHG during 2018.

Some minor issues were found in the data available for WHG in GSA 29 collected by Romania. The time frame and hauls position of the Surveys were checked. During the autumn survey in 2019, there are two points (46 and 47) of hauls positions that are with wrong coordinates (presented on land). The same issue appears with point 55 (presented in Razim Lake) from the 2020 autumn survey.

The issues found that need clarification by the MS are presented below.

- GSA_29_WHG_Landings length. For 2017 there are landings in weight >0 with missing length class distribution. The case is observed in the length class VL2440 for OTM_ SPF.
- GSA_29_WHG_Discards length. The values for mean weight in discards from FPM_MPD - VL0612 in 2014 are extremely low compared to the data for the rest of the years.
- GSA_29_WHG_Landings length. Three cases in Landings records in which SOP is needed are found. Two of them (FPN_MPD 00D14 in 2009 and FPN_MPD 14D16 in 2012) are < 1, and one is with a higher value - OTM_SPF in 2017 (10.0294985).
- GSA_29_WHG_Discards length. Two cases in Discards records in which SOP is needed are found. The cases are < 1 in 2012 for FPN_MPD 14D16 with VL0006 and VL0612.
- GSA_29_WHG_Growth parameters. Von Bertalanffy Growth functions in 2016 and 2017 diverse very much compared to the rest of the years. In addition Linf = 240.8, k = 0.571 and t0 = −0.24 for 2017 are the same as in 2016 (Linf = 240.8, k = 0.571, t0 = −0.24).
- GSA_29_WHG_Discards length. In regards to the plotting discards length frequencies distributions, the total numbers (51720) for the length class 12 for FPN_MPD in 2014 is very high compared to the rest.

MS is requested to revise and resubmit the data during the Med & BS Data Call 2022 or to provide reasonable clarification to the issues above.

In regards to the Data Transmission Monitoring Tool (DTMT) Guidance (version July 2021) all issues listed are related to Quality by type and the severity of the impact of the issue on the work of the EWG is Low. No recurrent issue was found.

5.4.3 Red mullet (MUT) in GSA 29

The data checks were conducted in regards to the report ''Red mullet (MUT) in GSA 29 (ROU) Quality checks, STECF EWG 22-03, 12 April, 2022" (available in Annex 1). Most of the issues presented in the report on Quality checks are due to not planned sampling for some years.

In the data available for MUT in GSA 29 collected by Romania few issues were found. Two of the issues could be considered minor and two are important in terms of coverage.

The issues found that need clarification by the MS are presented below.

- GSA_29_MUT_Discards length. For 2014 there are discards in weight >0 with missing length class distribution. The case is observed in the length class VL0612 for FPN_MPD.

- GSA_29_MUT_Landings length. Four cases in Landings records in which SOP is needed are found. Three of them (FPN_MPD 14D16 with VL0612 and VL1218 in 2012 as well as for OTM_MPD 14D16 with VL2440 in 2012) are < 1, and one is with higher value - FPN_MPD 14D16 with VL0006 in 2019 (17.6449529).

- GSA_29_MUT_Maturity ogive at length_Maturity ogive at age. Maturity at length and Maturity at age data is missing for 2018. In regards to the Romanian WP 2017-2019, the data collection of maturity data for MUT is planned for 2018 and 2019. Moreover, the FPN metier is planned for sampling and this metier landed more than 90% of the landings of MUT (7.5 tonnes) during 2018 for which there is data in the landings template.

- GSA_29_MUT_Growth parameters_Catch. Growth parameters are missing for 2017 and 2018. In regards to the Romanian WP 2017-2019 the data collection of length, weight, and age data for MUT are planned for the WP period. Even though the biological data from landings is provided in the catch template by age classes, the data regarding the number of length measurements from landings for 2017 and 2018 is missing. The possible mistake could be the provided numbers in column "T" (no_samples_catch) instead of providing the numbers in column "O" (no_length_measurements_landings). Anyway, the GP file should be filled in with data for 2017 and 2018.

  MS is requested to revise and resubmit the data during the Med & BS Data Call 2022 or to provide reasonable clarification to the issues above.

In regards to the Data Transmission Monitoring Tool (DTMT) Guidance (version July 2021) the first two issues listed are related to Quality by type and the severity of the impact of the issue on the work of the EWG is Low. The other two issues are related to Coverage by type and the severity of the impact of the issue on the work of the EWG is considered as Low. No recurrent issue was found.

Table 5.4.3.1: Items identified and noted in DTMT for Romania

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_29_MUT. No discards data available in years: 2016-2017-2018. Is it correct?	COVERAGE	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Sex ratio at length	GSA_29_MUT. Could MS check values provided for sex ratio at length. Indeed a dome shape curve seems unrealistic for this species.	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_29_MUT. Four cases in which SOP is needed are found. FPN_MPD 14D16 with VL0612 and VL1218 in 2012 as well as for OTM_MPD 14D16 with VL2440 in 2012, and FPN_MPD 14D16 with VL0006 in 2019.	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_MUT. Please check number and weight reported for year 2017 in gear FPN and fishery MPD becuase the corresponding mean weight seems very low comparing to the series.	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_MUT. Landings in weight in 2017 in quite low. In catch data a much higher values is reported.	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Sex ratio at length	GSA_29_ANE. Could MS check values reported for the sex ratio at length. Indeed, a dome shape curve is obtained when plotting them. Is it correct for this species in the area?	COVERAGE	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_29_ANE. VBGF Linf values in years 2016 and 2017 need to be checked because outliers.		
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_29_ANE. Two records likely need Sum of Product corrections (year 2012 gear FPN fishery MPD quarter -1). Moroever these two records refer to the same metier. Do need any aggregation?	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_29_ANE. No discards data provided in recent years. Is it correct?	QUALITY	LOW

2021	Romania	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_ANE.Please check weight and number provided for year 2017, gear FPN and fishery MPD as derived mean weight is very low comparing the ones in times series.	QUALITY	LOW
2021	Romania	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_29_ANE. Comparing the whole time series available low values of landings in weight reported in year 2017. Are these values ok?	QUALITY	LOW

5.5 France

*5.5.1 Gilthead seabream (SBG) in GSA07 (FRA)**

1. Data request = Fisheries catch, landings and discards by length.

a. GSA_07_SBG. Total landings per métier. Values of PS_DEF seem very high in 2016 in comparison with the other years.

b. GSA_07_SBG. Landings mean weight. GNS_DEMF values in 2009 seem excessively high in comparison with other years. Also check OTB_DEMF values in 2002, which also seem too high.

c. GSA_07_SBG. Total discards per métier. Values for 2011, 2015, and 2020 (OTB_DEF) and 2020 (OTT_DEF) seem very high in comparison with other years.

d. GSA_07_SBG. Landings Sum of Product. There are 313 cases in which SOP is needed.

2. Data request = Maturity at age

3. Data request = Biological parameters and ALK (Age length Key)

a. GSA_07_SBG. Length-weight relationships. “a” parameters are missing in years with growth parameters available.

4. Data request = Length frequency distributions

a. GSA_07_SBG. Discards mean length per métier. OTB_DEF and OTT_DEF values in 2014 seem very low.

5. Data request = MEDITS surveys

a. GSA_07_SBG. Hauls time series. Number of total hauls performed in years 1997; 1998; 2003; 2008; 2010 and 2019 differs from those performed the other years.

b. GSA_07_SBG. Comparing hauls in TA, TB and TC. Inconsistencies in number of hauls in TB and TC in several years: from 1994 to 1999, and from 2009 to 2013.

*5.5.2 Gilthead seabream (SBG) in GSA08 (FRA)**

1. Data request = Fisheries catch, landings and discards by length.

b. GSA_08_SBG. Total landings per métier. Landings of NA_DEF drastically increase in 2019 and 2020 in comparison with the other years, and seem very high.

2. Data request = Maturity data

No maturity data are available for this stock.

3. Data request = Biological parameters and ALK (Age length Key)

No biological parameters (growth, length-weight or age-length keys) are available for this stock.

4. Data request = Length frequency distributions

No length distributions are available for this stock.

5. Data request = MEDITS surveys

a. GSA_08_SBG. Hauls time series. Number of total hauls performed in years 1994, 1997, 2007 and 2008 differs from those performed the other years. No data are available for years 2002 and 2020. No A stratum hauls available for this stock. Increase of hauls in stratum D along the time series (from 2008-2009), coinciding with a reduction of E stratum hauls.

b. GSA_08_SBG. Comparing hauls in TA, TB and TC. Inconsistencies in number of hauls in TA, TB and TC in several years: 1994; 2004; 2009; 2010; 2014 and 2015.

5.5.3 Common octopus (OCC) in GSA07 (FRA)

1. Data request = Fisheries catch, landings and discards by length.

a. GSA_07_OCC. Landing by gear. Landings for FPO drastically increase in 2019 and 2020 in comparison with the other years, and seem very high.
b. GSA_07_OCC. Landings mean weight. Values for some métiers and years (OTB_CEP in 2010 and 2012; OTB_CRU in 2012, OTB_DES in 2010, 2012, 2017 and 2018) seem very high.
c. GSA_07_OCC. Discards at age. Data only reported for 2020.

2. Data request = Maturity data
No maturity data are available for this stock.

3. Data request = Biological parameters and ALK (Age length Key)
No biological parameters (growth, length-weight or age-length keys) are available for this stock.

4. Data request = Length frequency distributions
No major issues concerning length frequency distributions were found for this stock.

5. Data request = MEDITS surveys
a. GSA_07_OCC. Comparing hauls in TB and TC where the species was caught. Inconsistencies in number of hauls in TB and TC in several years: from 1994 to 1999.
b. GSA_07_OCC. Hauls in TB but not in TA. Inconsistencies in two cases: Haul nº 87 in 1997 and Haul nº 27 in 2011.
c. GSA_07_OCC. Hauls in TC but not in TA. Inconsistencies in two cases: Haul nº 87 in 1997 and haul nº 27 in 2011.
d. GSA_07_OCC. Checking if total weight and number reported in TB are consistent with the ones in TC. Inconsistencies in 20 cases: Haul nº 62 and 85 in 1998; haul nº 29 and 82 in 1999; haul nº 46 and 60 in 2000; haul nº 59 and 72 in 2001; haul nº 26, 34 and 51 in 2002; haul nº 29, 31, 32, 44 and 96 in 2003; haul nº 24 and 35 in 2004, haul nº 77 in 2005 and haul nº 66 in 2013.
e. GSA_07_OCC. Checking wrong step lengths. Inconsistencies in five cases: Lengths of 14, 16 and 18 in 1999; length of 6 in 2000 and length of 17 in 2005.
f. GSA_07_OCC. Length frequency distributions. Lengths distributions by sex only from 1994 to 2011. From 2011 to 2020 LDFs not sexed.

5.5.4 Common octopus (OCC) in GSA08 (FRA)

1. Data request = Fisheries catch, landings and discards by length.
No Issues

2. Data request = Maturity data
No maturity data are available for this stock.

3. Data request = Biological parameters and ALK (Age length Key)
No biological parameters (growth, length-weight or age-length keys) are available for this stock.

4. Data request = Length frequency distributions
No length distributions are available for this stock.

5. Data request = MEDITS surveys
a. GSA_08_OCC. Hauls in TB but not in TA. Inconsistencies in three cases: Haul nº 75 and 93 in 1994 and haul nº 12 in 1997.
b. GSA_08_OCC. Hauls in TC but not in TA. Inconsistencies in two cases: Haul nº 93 in 1994 and haul nº 12 in 1997.
c. GSA_08_OCC. Checking if total weight and number reported in TB are consistent with the ones in TC. Inconsistencies in 3 cases: Haul nº 80 and 88 in 1995, and haul nº 10 in 1999.

d. GSA_08_OCC. Mean length by year. There are no length data available in 1996, besides 2002 and 2020.

Table 5.5.4.1: Items identified and noted in DTMT for France

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2022	France	STECF EWG	Med and BS	EWG 22-03	Total Landings	GSA_07_SBG. Total landings per métier. Values of PS_DEF seem very high in 2016 in comparison with the other years.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Landings mean length	GSA_07_SBG. Landings mean weight. GNS_DEMF values in 2009 seem excessively high in comparison with other years. Also check OTB_DEMF values in 2002, which also seem too high.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Total discards	GSA_07_SBG. Total discards per métier. Values for 2011, 2015, and 2020 (OTB_DEF) and 2020 (OTT_DEF) seem very high in comparison with other years.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Landings	GSA_07_SBG. Landings Sum of Product. There are 313 cases in which SOP is needed.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Maturity at age	GSA_07_SBG. Maturity at age. In 2020, age classes seem too high (10-14), both for males and females.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Length-weight relationships	GSA_07_SBG. Length-weight relationships. “a” parameters are missing in years with growth parameters available.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Length frequency distributions	GSA_07_SBG. Discards mean length per métier. OTB_DEF and OTT_DEF values in 2014 seem very low.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Hauls time series	GSA_07_SBG. Hauls time series. Number of total hauls performed in years 1997; 1998; 2003; 2008; 2010 and 2019 differs from those performed the other years.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TA, TB and TC inconsistencies	GSA_07_SBG. Comparing hauls in TA, TB and TC. Inconsistencies in number of hauls in TB and TC in several years: from 1994 to 1999, and from 2009 to 2013.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG	Total	GSA_08_SBG. Missing years landings. Landings	Coverage	Low

				22-03	Landings	begin at 2010. From 2002 to 2009 are expected but not provided.		
2022	France	STECF EWG	Med and BS	EWG 22-03	Total Landings	GSA_08_SBG. Total landings per métier. Landings of NA_DEF drastically increase in 2019 and 2020 in comparison with the other years, and seem very high.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Hauls time series	GSA_08_SBG. Hauls time series. Number of total hauls performed in years 1994, 1997, 2007 and 2008 differs from those performed the other years. No data are available for years 2002 and 2020. No A stratum hauls available for this stock. Increase of hauls in stratum D along the time series (from 2008-2009), coinciding with a reduction of E stratum hauls.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TA, TB and TC inconsistencies	GSA_08_SBG. Comparing hauls in TA, TB and TC. Inconsistencies in number of hauls in TA, TB and TC in several years: 1994; 2004; 2009; 2010; 2014 and 2015.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Total Landings	GSA_07_OCC. Missing years landings. Landings begin at 2010. From 2002 to 2009 are expected but not provided.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Total Landings	GSA_07_OCC. Landing by gear. Landings for FPO drastically increase in 2019 and 2020 in comparison with the other years, and seem very high.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Landings mean length	GSA_07_OCC. Landings mean weight. Values for some métiers and years (OTB_CEP in 2010 and 2012; OTB_CRU in 2012, OTB_DES in 2010, 2012, 2017 and 2018) seem very high.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Discards at age	GSA_07_OCC. Discards at age. Data only reported for 2020.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TB and TC inconsistencies	GSA_07_OCC. Comparing hauls in TB and TC where the species was caught. Inconsistencies in number of hauls in TB and TC in several years: from 1994 to 1999.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TB and TA	GSA_07_OCC. Hauls in TB but not in TA. Inconsistencies in two cases: Haul nº 87 in 1997 and	Quality	Low

					inconsistencies	Haul nº 27 in 2011.		
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Biomass index	GSA_07_OCC. Total biomass trend. Biomass index sharply decrease in 2020 in comparison with the other years, while density index remains in similar values.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TC and TA inconsistencies	GSA_07_OCC. Hauls in TC but not in TA. Inconsistencies in two cases: Haul nº87 in 1997 and haul nº 27 in 2011.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TC and TB inconsistencies	GSA_07_OCC. Checking if total weight and number reported in TB are consistent with the ones in TC. Inconsistencies in 20 cases: Haul nº 62 and 85 in 1998; haul nº 29 and 82 in 1999; haul nº 46 and 60 in 2000; haul nº 59 and 72 in 2001; haul nº 26, 34 and 51 in 2002; haul nº 29, 31, 32, 44 and 96 in 2003; haul nº 24 and 35 in 2004, haul nº 77 in 2005 and haul nº 66 in 2013.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_07_OCC. Checking wrong step lengths. Inconsistencies in five cases: Lengths of 14, 16 and 18 in 1999; length of 6 in 2000 and length of 17 in 2005.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_07_OCC. Length frequency distributions. Lengths distributions by sex only from 1994 to 2011. From 2011 to 2020 LDFs not sexed.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_07_OCC. Checking maximum length range reported. Inconsistencies in maximum lengths reported in some years: 1994; 1995; 2005; 2014 and 2016.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_07_OCC. Checking minimum length range reported. Inconsistencies in minimum lengths reported in some years: 2000; 2005; 2007 and 2020.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	Landings missing years	GSA_08_OCC. Missing years landings. Landings data only available for 2011; 2013; 2016; 2019 and 2020.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TB and TC	GSA_08_OCC. Comparing hauls in TB and TC where the species was caught. Inconsistencies in number of	Quality	Low

					inconsistencies	hauls in TB and TC in two years: 1994 and 1996.		
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TB and TA inconsistencies	GSA_08_OCC. Hauls in TB but not in TA. Inconsistencies in three cases: Haul nº 75 and 93 in 1994 and haul nº 12 in 1997.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TC and TA inconsistencies	GSA_08_OCC. Hauls in TC but not in TA. Inconsistencies in two cases: Haul nº 93 in 1994 and haul nº 12 in 1997.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. TC and TB inconsistencies	GSA_08_OCC. Checking if total weight and number reported in TB are consistent with the ones in TC. Inconsistencies in 3 cases: Haul nº 80 and 88 in 1995, and haul nº 10 in 1999.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_08_OCC. Mean length by year. There are no length data available in 1996, besides 2002 and 2020.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_08_OCC. Length frequency distributions. Lengths distributions by sex only from 1994 to 2011. From 2011 to 2020 LDFs not sexed.	Coverage	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_08_OCC. Checking maximum length range reported. Inconsistencies in maximum lengths reported in some years: 1995; 2003; 2009 and 2010.	Quality	Low
2022	France	STECF EWG	Med and BS	EWG 22-03	MEDITS survey. Length distributions	GSA_08_OCC. Checking minimum length range reported. Inconsistencies in minimum lengths reported in some years: 1995; 1999; 2001; 2003; 2004; 2011; 2012; 2015 and 2019.	Quality	Low

5.6 Spain

*5.6.1 European Anchovy (ANE) in GSA 05**

Data checking for anchovy in GSA05 do not show major issues and the severity of the impact of these are low.

1. Data request = Fisheries catch, landings and discards by length.

GSA_05_ANE. Landings length frequencies data are missing for the period 2002 to 2015 and also in 2020.

*5.6.2 European Anchovy (ANE) in GSA 06**

Data checking for anchovy in GSA06 do not show major issues and the severity of the impact of these are low.

1. Data request = Fisheries catch, landings and discards by length.

a. GSA_06_ANE. For discards, data is missing for the years 2002, 2003, 2004, 2005, 2006, 2007 and 2012.

b. GSA_06_ANE. 62 cases in landings records in which SOP is needed are found.

c. GSA_06_ANE. 11 cases in discards records in which SOP is needed are found.

2. Data request = Maturity at age/ Maturity at length.

No specific issues

3. Data request = Growth parameters.

GSA_06_ANE. Von Bertalanffy Growth parameters in 2015 shows an outlier of t0=-4.38 and many years lower than t0=-2.0.

6. Data request = MEDITS surveys.

No specific issues identified

*5.6.3 Sardine (PIL) in GSA 01**

Data checking for sardine in GSA01 do not show major issues and the severity of the impact of these are low.

1. Data request = Fisheries catch, landings and discards by length.

a. GSA_01_PIL. For discards, in 2009 there's a very high value of 523 tonnes for purse seine.

b. GSA_01_PIL. 23 cases in landings records in which SOP is needed are found.

2. Data request = Landings length/Discards length.

b. GSA_01_PIL. Landings length frequencies in 2002 is missing.

c. GSA_01_PIL. Discards length frequencies in 2020 is missing.

5.6.4 Sardine (PIL) in GSA 06

Data checking for sardine in GSA06 do not show major issues and the severity of the impact of these are low.

1. Data request = Fisheries catch, landings and discards by length

a. GSA_06_PIL. For discards data in 2012 there's a high value for OTB that needs to be revised.

b. GSA_06_PIL. 58 cases in landings records in which SOP is needed are found.

c. GSA_06_PIL. 11 cases in discards records in which SOP is needed are found.

2. Data request = Maturity at age/ Maturity at length.

a. GSA_06_PIL. Several issues to be check for maturity at length. For year 2002 and 2005 strays from the trend of the other years. For year 2017 in length class 10 is too high and can't be higher than length class 11. For year 2018 from length class 13 to 18 are too low. For year 2019 in length class 15 and 14 can't be lower than length class 13.

3. Data request = Growth parameters.

a. GSA_06_PIL. Von Bertalanffy Growth parameters have some outliers (like to values higher than -3.0) and a high variation in to values.

b. GSA_06_PIL. Length weight relationships for year 2019, b=4.0279 is too high for the species. Also 2019 has a weight values equal to 500 and 1250g for the last length classes.

5. Data request = Landings length/Discards length.

a. GSA_06_PIL. For landing length frequency distribution missing data for OTB_DEMSP in 2016, 2017, 2019 and 2020.

b. GSA_6_PIL. For discards length frequency distribution missing data for OTB_DEMSP in 2018.

5.6.5 European Anchovy (ANE) in GSA 01

Data checking for anchovy in GSA01 do not show major issues and the severity of the impact of these are low.

1. Data request = Fisheries catch, landings and discards by length

a. GSA_01_ANE. Check if tonnes for landings in year 2002 (around 3000t) are correct.

b. GSA_01_ANE. Data missing for years 2007 and 2020 for discards.

c. GSA_01_ANE. Check if discards in 2015 are for purse seine gear.

d. GSA_01_ANE. 23 cases in landings records in which SOP is needed are found.

Table 5.6.5.1: Items identified and noted in DTMT for Spain

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_6_PIL. For discards length frequency distribution missing data for OTB_DEMSP in 2018.	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_06_PIL. Length weight relationships for year 2019, b=4.0279 is too high for the species. Also 2019 has a weight values equal to 500 and 1250g for the last length classes.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_06_PIL. Several issues to be check for maturity at length. For year 2002 and 2005 strays from the trend of the other years. For year 2017 in lengthclass 10 is too high and can't be higher than lengthclass 11. For year 2018 from lengthclass 13 to 18 are too low. For year 2019 in lengthclass 15 and 14 can't be lower than lenghtclass 13	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_01_ANE. 23 cases in landings records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_ANE. Check if discards in 2015 are for purse seine gear.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_ANE. Data missing for years 2007 and 2020 for discards.	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_ANE. There are 14 cases in which length class number are zero and discards >0 for discards. Is it correct?	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_01_ANE. Check if tonnes for landings in year 2002 (around 3000t) are correct.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_6_PIL. For discards length frequency distribution missing data for OTB_DEMSP in 2018.	COVERAGE	LOW

2021	Spain	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_06_PIL. For landing length frequency distribution missing data for OTB_DEMSP in 2016, 2017, 2019 and 2020.	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_06_PIL. 11 cases in discards records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_06_PIL. 58 cases in landings records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_06_PIL. For discards data in 2012 there's a high value for OTB that needs to be revised.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_06_PIL. There are 40 cases in which length class number are zero and discards >0 for discards.Is it correct?	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_PIL. Discards length frequencies are available only for some years. Is it correct?	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_01_PIL. 23 cases in landings records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_PIL. For discards, in 2009 there's a very high value of 523 tonnes for purse seine. Could be a raising issue?	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_01_PIL. There are 44 cases in which length class number are zero and discards >0 for discards.Is it correct?	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	MEDITS_TA_TB	GSA_06_ANE. In 1995 haul number 103 in reported in TB but not in TA.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_06_ANE. 11 cases in discards records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_06_ANE. 62 cases in landings records in which SOP is needed are found.	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_06_ANE. For discards, data is missing for the years 2002, 2003, 2004, 2005, 2006, 2007 and 2012.	COVERAGE	LOW

2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_05_ANE. There are 2 cases in which length class number are zero and discards >0 for discards. Is it correct?	QUALITY	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Discards length	GSA_05_ANE. Discards data with values > 0 are only available in 2017. Is it correct? No any other LFDs are available?	COVERAGE	LOW
2021	Spain	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_05_ANE. Landings length frequencies data are missing for the period 2002 to 2015 and also in 2020.	COVERAGE	LOW

5.7 Cyprus

General comments:

- Cyprus acceded in the EU in mid-2004 and started implementing the Data Collection Regulation in 2005. Therefore, data for the period 2002-2004 cannot be provided.
- The value of field «fisheries» does not in line with the coding in Appendix 1.5 – ANNEX 1 of the datacall. GTR, GNS, OTB are reported as DEF, DEFMF, DEMSP while LLS is reported as DEF, DEFMF. It is suggested to be revised as DEF. PS is reported as MPD, SPF and is suggested to be revised as SPF
- MEDITS survey: Swept area and wing opening by depth strata - the lowest value of swept area should be checked for stratum 50-100, 100-200, 200-500, 500-800

*5.7.1 Bogue (BOG) in GSA 25**

Landings at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 2 in the Appendix)
- The gears GNS, GTR, LLS, OTB, PS are reported, total landings are available for the period 2005-2020 (Figure 1 in the CYPRUS_GSA25_BOG.pdf). GNS is the main gear fishing this species. Small quantities are reported from OTB, GTR and LLS
- The starting class of the LFD corresponds to a real 0 (field “specon”)
- There are 28 cases in which landings is zero (see CYPRUS_GSA25_BOG.pdf p. 9)
- No significant issues observed in mean weight by métier and quarter. A high value of landings is reported in 2013 for GTR and should be checked (Figure 4: Landings Mean Weight in CYPRUS_GSA25_BOG.pdf p. 11).
- Consistent LFDs are reported among years for GNS, GTR, OTB

Discards at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 6 in CYPRUS_GSA25_BOG.pdf)
- The gear OTB, is reported, total discards are available for the period 2005-2020 (Figure 5 in CYPRUS_GSA25_BOG.pdf). OTB is the main gear fishing this species.
- The starting class of the LFD corresponds to a real 0 (field “specon”)
- No discards are reported for GNS, GTR, LLS and PS
- Consistent LFDs are reported among years for OTB

Catch at age

- Landings in catch: Good consistency was observed for GNS, GTR, OTB
- Discards in catch: Good consistency was observed for OTB

Landings Sum of Product (SoP)

- 36 cases in which SoP is needed (CYPRUS_GSA25_BOG.pdf, p. 24)

Discards Sum of Product (SoP)

- 0 cases in which SoP is needed

Maturity at length and age

- Maturity at length vectors available for combined sex (Figure 11, 12 in CYPRUS_GSA25_BOG.pdf)
- Maturity at age vectors available for combined sex (Figure 13 in CYPRUS_GSA25_BOG.pdf)

No issues identified

Sex ratio at length and age

- Sex ratio at length vectors available (Figure 15 in CYPRUS_GSA25_BOG.pdf)
- Sex ratio at age vectors available (Figure 16 in CYPRUS_GSA25_BOG.pdf)

No issues identified

Von Bertalanffy Growth functions

- VBGF parameters for combined sex available (Figure 16-21 in CYPRUS_GSA25_BOG.pdf)

Length weight relationships

- Zero values for L-W parameter a in 2006, 2008, 2009, 2010 (Figure 22-26 in CYPRUS_GSA25_BOG.pdf) It is noted that although this is a problem it is thought ti be the result of insufficient numerical precision. This problem is already fixed in the next data call.

Age length keys (ALKs)

- Age length key matrix available (Figure 27, 28 in CYPRUS_GSA25_BOG.pdf)

No issue identified

Exploring data for future stock assessment

Figures 29-45 in CYPRUS_GSA25_BOG.pdf

Figure 29. Mean Landings at length

Figure 30. Median Landings at length

Figure 31. Cumulative landings length frequency distributions of GNS_DEMF

Figure 32. Cumulative landings length frequency distributions of GTR_DEMF

Figure 33. Cumulative landings length frequency distributions of OTB_DEMF

Figure 34. Cumulative landings length frequency distributions of GNS_DEMSP

Figure 35. Cumulative landings length frequency distributions of GTR_DEMSP

Figure 36. Cumulative landings length frequency distributions of OTB_DEMSP

Figure 37. Mean Discards at length

Figure 38. Median Discards at length

Figure 39. Cumulative discards length frequency distributions of OTB_DEMF

Figure 40. Cumulative discards length frequency distributions of OTB_DEMSP

Figure 41. Landings Length Frequency Distributions

Figure 42. Landings Length Frequency Distributions

Figure 43. Missing length data to be filled in landings

Figure 44. Discards Length Frequency Distributions

Figure 45. Missing length data to be filled in discards

MEDITS

Hauls position

- No issue identified (Figure 1-15 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Haul time series and positions

- No issue identified

Comparing hauls in TA, TB and TC

- No issue identified

Survey period

- No issue identified

Biomass index by macrostrata

- No issue identified (Figure 18 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Density index by macrostrata

- No issue identified (Figure 19 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Hauls in TB but not in TA

- No issue identified

Hauls in TC but not in TA

- No issue identified

Total biomass with variance

- No issue identified

Total density with variance

- No issue identified

Mean weight by year as ratio between biomass and density indexes

- No issue identified

Checking sampling ratio applied (threshold values define by the user)

- No issue identified

Checking if total weight and number reported in TB are consistent with the ones in TC

- Hauls 10, 11 and 27 from 2015 should be checked (p. 33 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Total length frequencies distributions sex combined

- No issue identified

Checking if some wrong step length have been used

- No issue identified

Mean length by year

- No issue identified (Figure 24 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Female length frequencies distributions

- No issue identified (Figure 25 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Male length frequencies distributions

- No issue identified (Figure 26 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Sex ratio vectors

- No issue identified (Figure 27 in CYPRUS_GSA25_BOG_MEDITS.pdf)

Maximum length reported

- No issue identified (Page 41 in CYPRUS_GSA25_BOG_MEDITS.pdf)

*5.7.2 Picarel (SPC) in GSA 25**

Landings at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 2 in CYPRUS_GSA25_PIC.pdf)
- The gears GNS, GTR, OTB, PS are reported, total landings are available for the period 2005-2020 (Figure 1 in the Appendix). GNS and OTB are the main gears fishing this species. Small quantities are reported from GTR and PS
- The starting class of the LFD corresponds to a real 0 (field "specon")
- There are 36 cases in which landings is zero (see CYPRUS_GSA25_PIC.pdf p. 10
- No issues observed in mean weight by métier and quarter (Figure 4 in CYPRUS_GSA25_PIC.pdf)
- Consistent LFDs are reported among years for GNS, GTR, OTB (Figure 50 in CYPRUS_GSA25_PIC.pdf)

Discards at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 6 in CYPRUS_GSA25_PIC.pdf)
- The gear OTB is reported, total discards are available for the period 2005-2020 (Figure 5 in CYPRUS_GSA25_PIC.pdf).
- The starting class of the LFD corresponds to a real 0 (field "specon")
- No discards are reported for GNS, GTR, LLS and PS
- No issues observed in discards mean weight by métier and quarter (Figure 8 in CYPRUS_GSA25_PIC.pdf)
- Consistent LFDs are reported among years for OTB (Figure 53 in CYPRUS_GSA25_PIC.pdf)

Catch at age

- Landings in catch: Good consistency was observed for GNS, GTR, OTB
- Discards in catch: Good consistency was observed for OTB

Landings Sum of Product (SoP)

- 38 cases in which SoP is needed (CYPRUS_GSA25_PIC.pdf p. 24)

Discards Sum of Product (SoP)

- 3 cases in which SoP is needed (CYPRUS_GSA25_PIC.pdf p. 25)

Maturity at length and age

- Maturity at length vectors available for female, male and combined sex (Figure 11-14 in CYPRUS_GSA25_PIC.pdf)
- Maturity at age vectors available for combined sex (Figure 15 in CYPRUS_GSA25_PIC.pdf)

No issues identified

Sex ratio at length and age

- Sex ratio at length vectors available (Figure 17 in CYPRUS_GSA25_PIC.pdf)
- Sex ratio at age vectors available (Figure 18 in CYPRUS_GSA25_PIC.pdf)

No issues identified

Von Bertalanffy Growth functions

- VBGF parameters for male, female and combined sex available (Figure 19-27 in CYPRUS_GSA25_PIC.pdf)

Length weight relationships

Zero values for L-W parameter a in 2007, 2009, 2010 (Figure 28-36 CYPRUS_GSA25_PIC.pdf) It is noted that although this is a problem it is thought to be the result of insufficient numerical precision. This problem is already fixed in the next data call.

Age length keys (ALKs)

- Age length key matrix for combined sex available (Figure 37, 38 in CYPRUS_GSA25_PIC.pdf)

No issue identified

Exploring data for future stock assessment

Figures 39-52 in CYPRUS_GSA25_PIC.pdf

Figure 39. Mean Landings at length

Figure 40. Median Landings at length

Figure 41. Cumulative landings length frequency distributions of GNS_DEMF

Figure 42. Cumulative landings length frequency distributions of GTR_DEMF

Figure 43. Cumulative landings length frequency distributions of OTB_DEMF

Figure 44. Cumulative landings length frequency distributions of GNS_DEMSP

Figure 45. Cumulative landings length frequency distributions of OTB_DEMSP

Figure 46. Mean Discards at length

Figure 47. Median Discards at length

Figure 48. Cumulative discards length frequency distributions of OTB_DEMF

Figure 49. Cumulative discards length frequency distributions of OTB_DEMSP

Figure 50. Landings Length Frequency Distributions

Figure 51. Landings Length Frequency Distributions

Figure 52. Missing length data to be filled in landings

MEDITS

Hauls position

- No issue identified (Figure 1-15 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Haul time series and positions

- No issue identified

Comparing hauls in TA, TB and TC

- No issue identified

Survey period

- No issue identified

Biomass index by macrostrata

- No issue identified (Figure 18 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Density index by macrostrata

- No issue identified (Figure 19 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Hauls in TB but not in TA

- No issue identified

Hauls in TC but not in TA

- No issue identified

Total biomass with variance

- No issue identified (Figure 20 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Total density with variance

- No issue identified (Figure 21 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Mean weight by year as ratio between biomass and density indexes

- No issue identified (Figure 22 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Checking sampling ratio applied (threshold values define by the user)

- No issue identified

Checking if total weight and number reported in TB are consistent with the ones in TC

- Hauls presented in Table 6 should be checked (CYPRUS_GSA25_SPC_MEDITS.pdf p. 33)

Total length frequencies distributions sex combined

- No issue identified (Figure 23 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Checking if some wrong step length have been used

- No issue identified

Mean length by year

- No issue identified (Figure 24 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Female length frequencies distributions

- No issue identified (Figure 25 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Male length frequencies distributions

- No issue identified (Figure 26 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Sex ratio vectors

No issue identified (Figure 27 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Indetermine length frequencies distributions

- Years 2013 and 2015 should be checked for Lengths>100mm (Figure 28 in CYPRUS_GSA25_SPC_MEDITS.pdf)

Maximum length reported

No issue identified (CYPRUS_GSA25_SPC_MEDITS.pdf p. 41)

Minimum length reported

- Length values of years 2005, 2009, 2010, 2011, 2015, 2018 and 2020 need to be checked It is noted that although this is a problem it is thought to be the result of insufficient numerical precision. This problem is already fixed in the next data call.

5.7.3 Red mullet (MUT) in GSA 25

Landings at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 2 in CYPRUS_GSA25_MUT.pdf)
- The gears GNS, GTR, OTB, are reported, total landings are available for the period 2005-2020 (Figure 1 in the Appendix). GTR and OTB are the main gears fishing this species. Small quantities are reported in GNS
- The starting class of the LFD corresponds to a real 0 (field “specon”)
- There are 23 cases in which landings is zero (CYPRUS_GSA25_MUT.pdf p. 9)
- No issues observed in mean weight by métier and quarter (Figure 4 in CYPRUS_GSA25_MUT.pdf)
- Consistent LFDs are reported among years for GNS, GTR, OTB (Figure 40 in CYPRUS_GSA25_MUT.pdf)

Discards at length by métier

- No duplicate records have been detected in the dataset
- The data reported by quarter (Figure 6 in CYPRUS_GSA25_MUT.pdf)
- The gear OTB is reported, total discards are available for the period 2005-2020 (Figure 5 in CYPRUS_GSA25_MUT.pdf).
- The starting class of the LFD corresponds to a real 0 (field “specon”)
- No discards are reported for GNS, GTR
- No issues observed in discards mean weight by métier and quarter (Figure 8 in CYPRUS_GSA25_MUT.pdf)
- Consistent LFDs are reported among years for OTB (Figure 42 in CYPRUS_GSA25_MUT.pdf)

Catch at age

- Landings in catch: Good consistency was observed for GNS, GTR, OTB (Figure 9 in CYPRUS_GSA25_MUT.pdf)
- Discards in catch: Good consistency was observed for OTB (Figure 10 in CYPRUS_GSA25_MUT.pdf)

Landings Sum of Product (SoP)

- 38 cases in which SoP is needed (CYPRUS_GSA25_MUT.pdf, p. 24)

Discards Sum of Product (SoP)

- 1 case in which SoP is needed (CYPRUS_GSA25_MUT.pdf, p. 25)

Maturity at length and age

- Maturity at length vectors available for combined sex (Figure 11-13 in CYPRUS_GSA25_MUT.pdf)

No issues identified

Sex ratio at length and age

- Sex ratio at length vectors available (Figure 15 in CYPRUS_GSA25_MUT.pdf)
- Sex ratio at age vectors available (Figure 16 in CYPRUS_GSA25_MUT.pdf)

No issues identified

Von Bertalanffy Growth functions

- VBGF parameters for male, female and combined sex available (Figure 17-21 in CYPRUS_GSA25_MUT.pdf)
- Zero values for L-W parameter a in 2010 It is noted that although this is a problem it is thought to be the result of insufficient numerical precision. This problem is already fixed in the next data call.

Length weight relationships

- Length weight relationships (Figure 22-26 in CYPRUS_GSA25_MUT.pdf)

Zero values for L-W parameter a in 2010

Age length keys (ALKs)

- Age length key matrix for combined sex available (Figure 27, 28 in CYPRUS_GSA25_MUT.pdf)

No issue identified

Exploring data for future stock assessment

Figures 29-43 in CYPRUS_GSA25_MUT.pdf

Figure 29. Mean Landings at length

Figure 30. Median Landings at length

Figure 31. Cumulative landings length frequency distributions of GNS_DEMF

Figure 32. Cumulative landings length frequency distributions of GTR_DEMF

Figure 33. Cumulative landings length frequency distributions of OTB_DEMF

MEDITS

Hauls position

- No issue identified (Figure 1-15 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Haul time series and positions

- No issue identified

Comparing hauls in TA, TB and TC

- No issue identified

Survey period

- No issue identified

Biomass index by macrostrata

- No issue identified (Figure 18 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Density index by macrostrata

- No issue identified (Figure 19 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Hauls in TB but not in TA

- No issue identified

Hauls in TC but not in TA

- No issue identified

Total biomass with variance

- No issue identified (Figure 20 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Total density with variance

- No issue identified (Figure 21 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Mean weight by year as ratio between biomass and density indexes

- No issue identified (Figure 22 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Checking sampling ratio applied (threshold values define by the user)

- No issue identified

Checking if total weight and number reported in TB are consistent with the ones in TC

- Haul 13 for year 2015 should be checked (Table 6 in CYPRUS_GSA25_MUT_MEDITS.pdf p. 33)

Total length frequencies distributions sex combined

- No issue identified (Figure 23 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Checking if some wrong step length have been used

- Two lengths (102mm and 62mm) have wrong step length in years 2008 and 2013 respectively (Table 7 in CYPRUS_GSA25_MUT_MEDITS.pdf p. 35)

Mean length by year

- No issue identified (Figure 24 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Female length frequencies distributions

- No issue identified (Figure 25 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Male length frequencies distributions

- No issue identified (Figure 26 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Sex ratio vectors

- No issue identified (Figure 27 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Indetermine length frequencies distributions

- No issue identified (Figure 28 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Maximum length reported

- No issue identified (p. 41 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Minimum length reported

- No issue identified (p. 41 in CYPRUS_GSA25_MUT_MEDITS.pdf)

Table 5.7.3.1: Items identified and noted in DTMT for Cyprus

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	MEDITS_TC	GSA_25_MUT. Checking if some wrong step length have been used - Two lengths (102mm and 62mm) in years 2008 and 2013 respectively should be checked	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	MEDITS_TB_TC	GSA_25_MUT. Checking if total weight and number reported in TB are consistent with the ones in TC - Haul 13 for year 2015 should be checked	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_25_MUT. Discards Sum of Product (SoP) - 1 case in which SoP is needed	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_25_MUT. Landings Sum of Product (SoP) - 38 cases in which SoP is needed	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	MEDITS_TB_TC	GSA_25_SPC. Checking if total weight and number reported in TB are consistent with the ones in TC. Please check 2015 year	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_25_SPC. Discards Sum of Product (SoP) - 3 cases in which SoP is needed	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_25_SPC. Landings Sum of Product (SoP) - 38 cases in which SoP is needed	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	MEDITS_TB_TC	GSA_25_BOG. Checking if total weight and number reported in TB are consistent with the ones in TC - Hauls 10, 11 and 27 from 2015 should be checked	QUALITY	LOW
2021	Cyprus	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_25_BOG 36 cases in which SoP is needed	QUALITY	LOW

5.8 Malta

*5.8.1 Chub Mackerel (MAS, MAZ and/or VMA) in GSA 15**

Due to recent change of chub mackerel scientific name, from *Scomber japonicus* to *Scomber colias*, there is also difference in species scientific name between EWG 22-03 ToR 1 (*S. colias*) and previous Data calls - ANNEX 1 (*S. japonicus)*. This species has been coded in JRC database with different codes also (MAS and the code MAZ related to mackerel species in general (*Scomber spp*.). The code for *Scomber colias* as indicated in Data call - ANNEX 1 (e.g. VMA) has not been used by Malta for this species.

Data coverage

Data related to chub mackerel are not included in Tables with MEDIAS outputs (e.g. abundance, abund_biom, biomass) nor in 4 tables from commercial fisheries such as: alk, effort, ma and sra. In general, no age-related data are available for this stock.

In catch data table for chub mackerel (MAS), MLT provided landing information only (Figure 5.8.1.1), with discard data reported as 0 and -1, in period 2014-2020 (148 records). Landing information are covering 5 different vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440), reported with 10 different fishery codes (DEF, DEMF, DEMSP, FIF, FIN, LPF, MDD, MPD, SLP and SPF), using 10 known gears (GND, GNS, GTN, GTR, LHM, LHP, LLS, LTL, OTB and PS) and unreported or unknown gears (-1 and NA). Landings are reported in all 4 quarters.

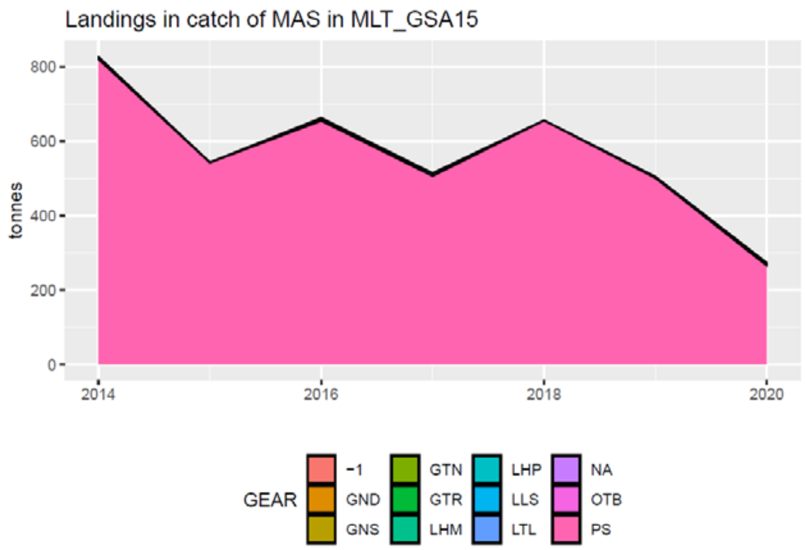


Figure 5.8.1.1: Landings of chub mackerel (MAS), reported by MLT in catch data table by gears.

In addition to 148 records for MAS code in catch data table, there are 194 records (2005-2017) related to MAZ code (*Scomber spp*.) with unknown fraction of *Scomber colias* in these mixed landing data (i.e. *S. colias* and *S. scombrus* combined). In accordance with catch data table, no chub mackerel is reported in discard data table.

In landing data table for chub mackerel (MAS), MLT provided landing data in period 2014-2020 (145 records). Landing data are covering the same vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440) as catch table, reporting the same 10 different fishery codes (DEF, DEMF, DEMSP, FIF, FIN, LPF, MDD, MPD, SLP and SPF), and 10 gear types (GND, GNS, GTN, GTR, LHM, LHP, LLS, LTL, OTB and PS) and unknown gears (-1 and NA). Among them, the largest amount is landed by PS (Figure 5.8.1.2) Landings are reported in all 4 quarters, but indicating that the bulk of MAS landings occurs in 3rd quarter (Figure 5.8.1.3).

Years for which landing data for MAS are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2011 2012 and 2013.

Within the period 2014-2020 in many métiers weight data are available only, without fish numbers at lengths (Figure 5.8.1.2).

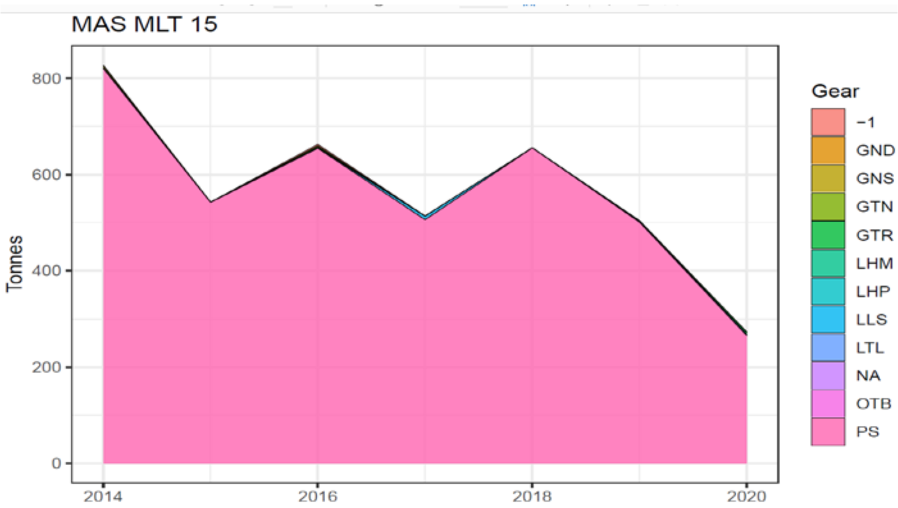


Figure 5.8.1.2: Figure 5.8.1.3: Landings of chub mackerel (MAS) in MLT by gears.

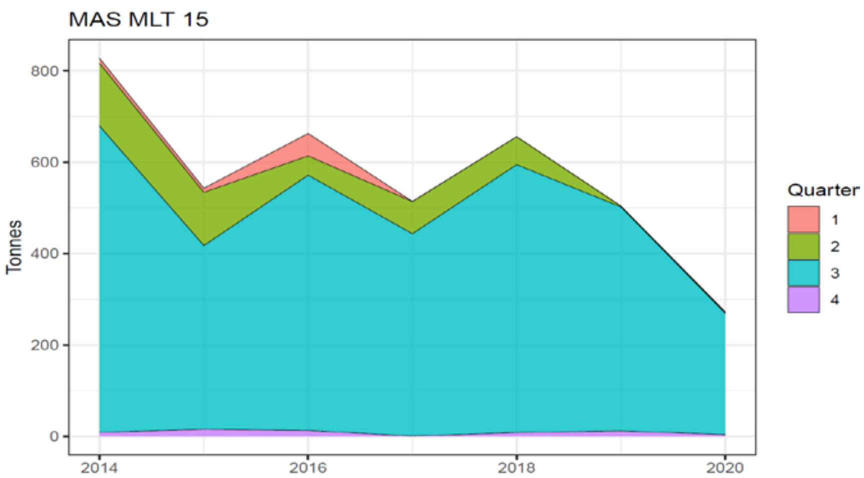


Figure 5.8.1.3: Landings of chub mackerel (MAS) in MLT by quarters.

Available length frequencies of chub mackerel (MAS) landings are shown in Figure 5.8.1.4. At the first sight this might be misleading, suggesting that there are LFD information before 2017 only. In fact, it seems that numbers reported before 2017 were not reported in thousands, and therefore are probably over reported by 10^3. In addition, LFD data are missing in many métiers as shown in Figure 5.8.1.5.

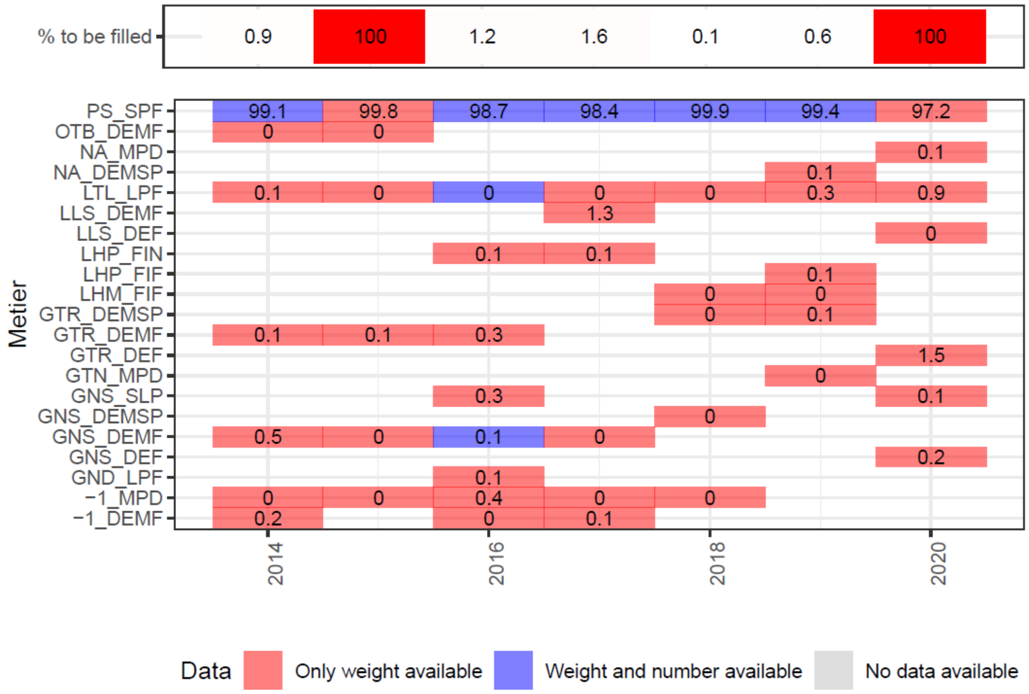


Figure 5.8.1.4: Missing length data to be filled in landings.

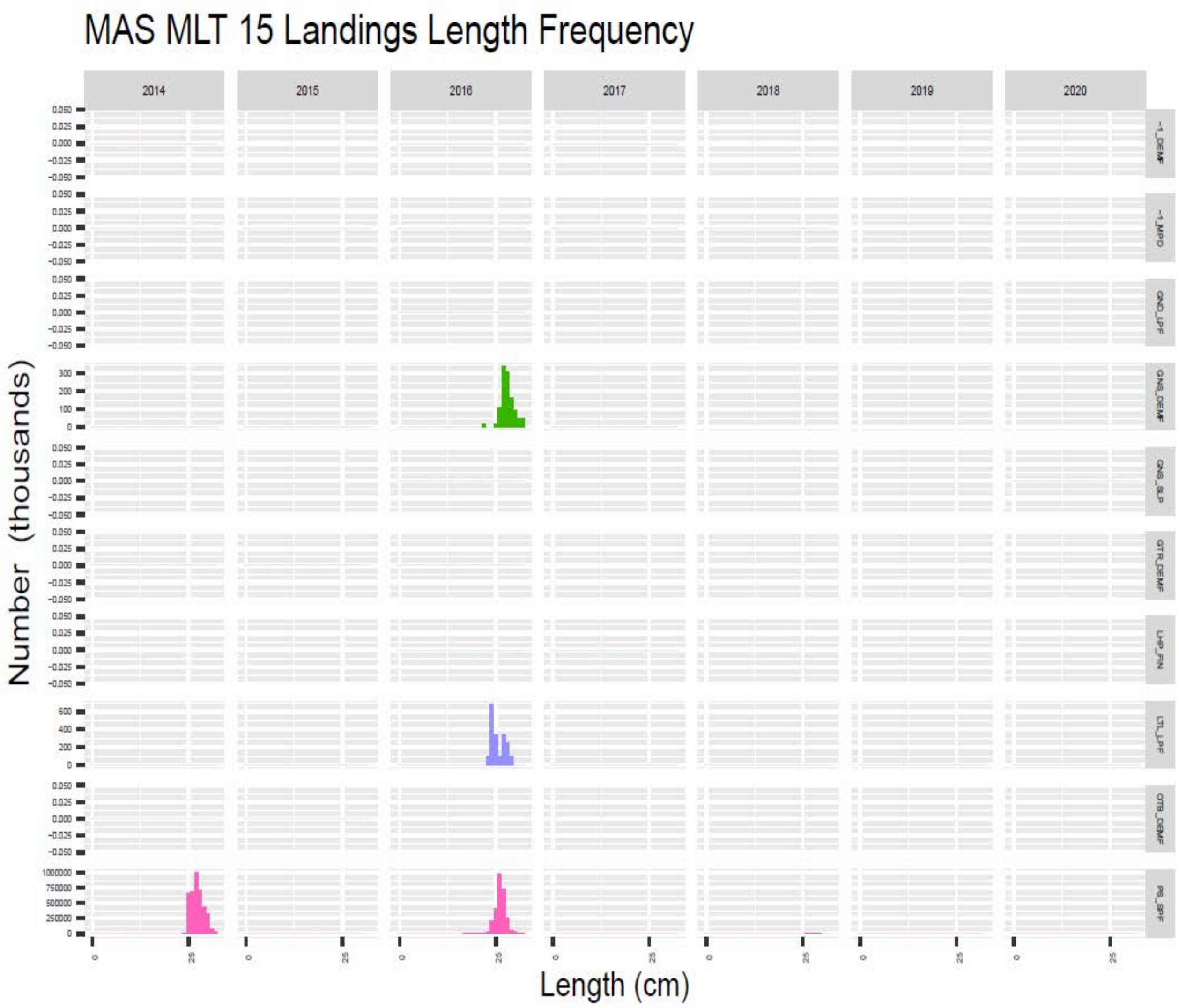


Figure 5.8.1.5: Length frequencies of chub mackerel (MAS) landings reported by MLT

Table .5.8.1.1: Landings length frequencies data missing for chub mackerel (MAS) in MLT.

year	gear	fishery	total_number_landed
2014	-1	DEMF	0
2014	-1	MPD	0
2014	GNS	DEMF	0
2014	GTR	DEMF	0
2014	LTL	LPF	0
2014	OTB	DEMF	0
2015	-1	MPD	0
2015	GNS	DEMF	0
2015	GTR	DEMF	0
2015	LTL	LPF	0
2015	OTB	DEMF	0
2015	PS	SPF	0
2016	-1	DEMF	0
2016	-1	MPD	0
2016	GND	LPF	0
2016	GNS	SLP	0
2016	GTR	DEMF	0
2016	LHP	FIN	0
2017	-1	DEMF	0
2017	-1	MPD	0
2017	GNS	DEMF	0
2017	LHP	FIN	0
2017	LLS	DEMF	0
2017	LTL	LPF	0
2018	-1	MPD	0
2018	GNS	DEMSP	0
2018	GTR	DEMSP	0
2018	LHM	FIF	0
2018	LTL	LPF	0
2019	GTN	MPD	0
2019	GTR	DEMSP	0
2019	LHM	FIF	0
2019	LHP	FIF	0
2019	LTL	LPF	0
2019	NA	DEMSP	0
2020	GNS	DEF	0
2020	GNS	SLP	0
2020	GTR	DEF	0
2020	LLS	DEF	0
2020	LTL	LPF	0
2020	NA	MPD	0
2020	PS	SPF	0

In addition to 145 records for MAS code in catch data table, there are 21 records (2012-2017) related to MAZ code (*Scomber spp*.) also, with unknown fraction of *Scomber colias* in these mixed landing data (i.e. *S. colias* and *S. scombrus* combined). These records are related mainly to SPF and PS as a fishing gear.

Years for which landing at length data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010 2011, 2012 and 2013.

In growth parameters table for chub mackerel (MAS), MLT provided 12 records for years 2012, 2013, 2014, 2015, 2017 and 2020, including information on L-W relation only, and not covering both sexes in some years. No VBGF parameters are available for this stock.

Years for which growth parameters data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2016, 2018 and 2019.

In maturity-at-length table, for chub mackerel (MAS) 70 records with maturity at length data are provided, covering both sexes in 2011 and in period 2014-2018 (Figure 5.8.1.7). In addition, MLT provided 19 data records on maturity at length, covering both sexes, in the 2020 using MAZ as species code.

Maturity at length data for 2015 and 2016, regarding small sizes of MAS, need to be checked for accuracy.

Years for which data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2012, 2013 and 2019. EWG 22-03 noted that MLT provided records on sex ratio at length in the 2020, using MAZ as species code.

In sex ratio-at-length data table, for chub mackerel (MAS) 46 records with sex ratio at length data are provided, covering both sexes in 2011 and in period 2014-2018 (Figure 5.8.1.8). In addition, MLT provided 14 data records on sex ratio at length in the 2019-2020, using MAZ as species code.

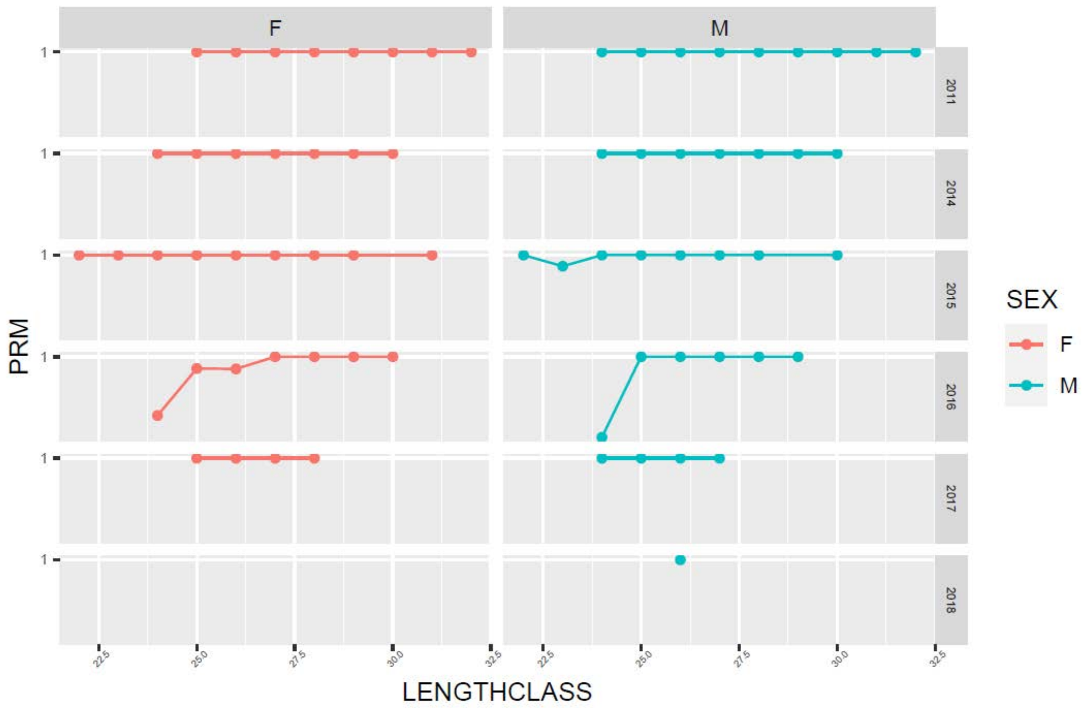


Figure 5.8.1.6: Maturity at length of MAS in MLT (GSA 15).

Years for which data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2012 and 2013.

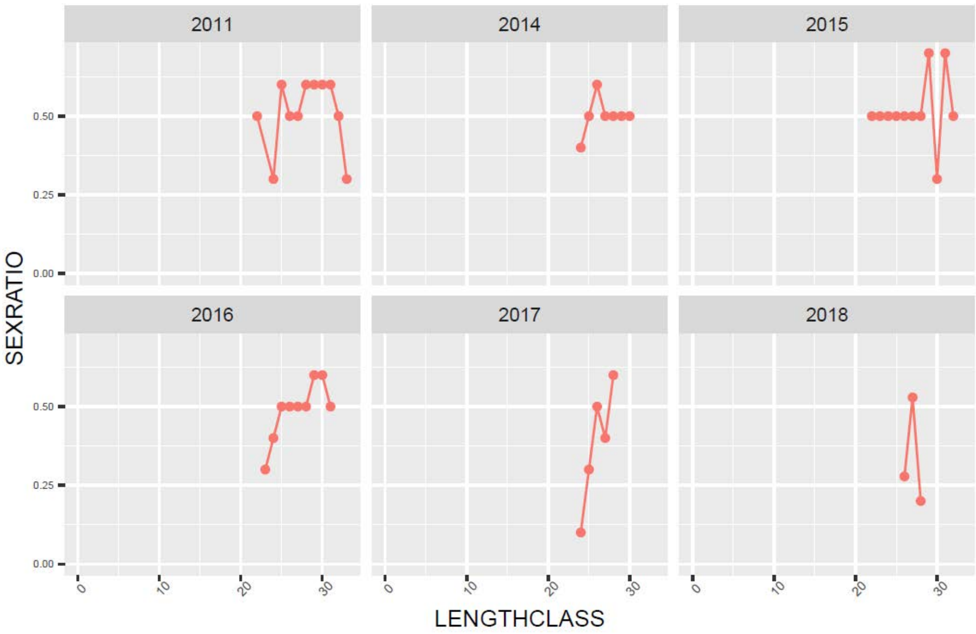


Figure 5.8.1.7: Sex ratio by length of MAS in MLT (GSA 15).

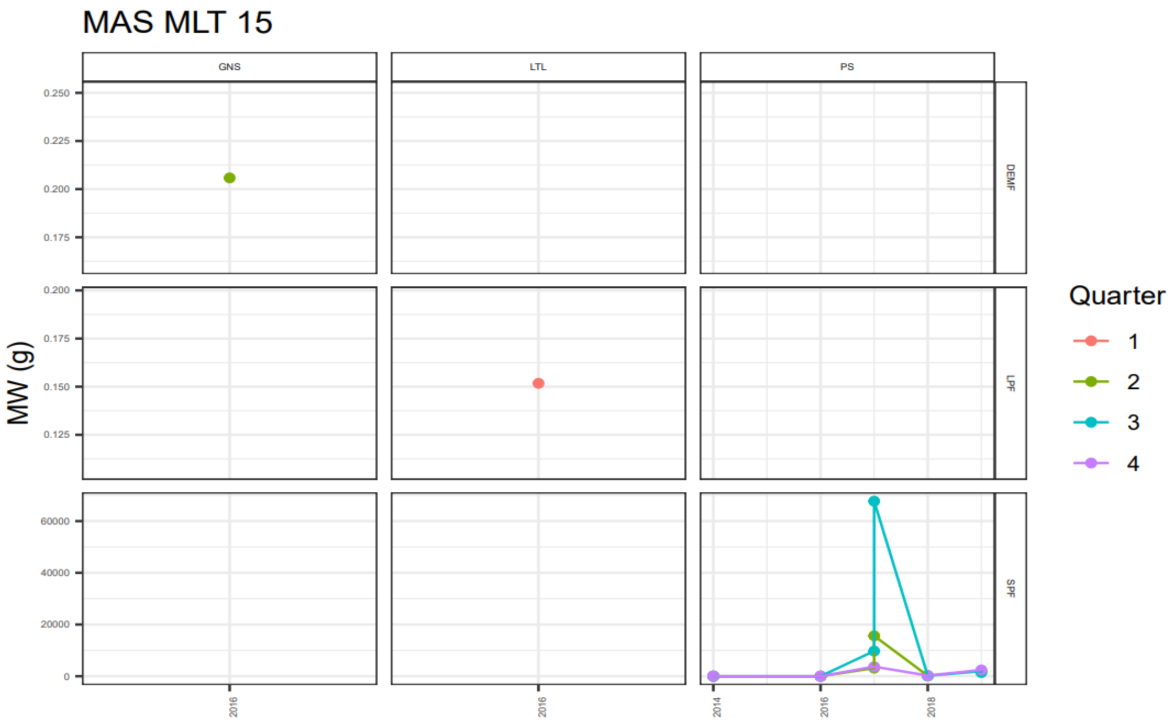


Figure 5.8.1.8: Mean weights of chub mackerel (MAS) as reported by MLT in GSA15.

Data quality

A part of landing data from MLT are related to fisheries hardly related to this species (e.g. LPF and MDD). Also, it seems that before 2014, landings of chub mackerel (*Scomber colias*) were reported as mackerel (*Scomber spp.)* using MAZ code only. More recently, MAZ code (for *Scomber spp.*) seems to be used by MLT for reporting mixed mackerel catches obtained by PS gear. No data on *Scomber colias* are reported using VMA as species code till now.

A strange record from MLT in 2017, reporting small quantity of mackerels (MAZ) landed from drifting longline (LLD) in LPF (*Note: Mackerels are used as a bait on LLD in LPF*).

EWG 22-03 noticed that MAS landing mean weight after 2016 is much higher than in years before and need to be checked for accuracy (Table 5.8.1.2). Following more detailed look on data provided by MLT, it seems that numbers (totN) reported by MLT before 2017 (Table 5.8.1.2) were not reported in thousands, and therefore are probably over-reported by 10^{3}., thus making significant differences between totN reported before and from 2017. It is suggested to check accuracy of all data on totN provided by MLT.

Table 5.8.1.2: Landings mean weights of MAS as reported by MLT in GSA15.

year	quarter	vessel_length	gear	mesh_size_range	fishery	totW	totN	MW
2014	1	VL1218	PS	14D16	SPF	700000	3429000	2.041411e-01
2014	2	VL1218	PS	14D16	SPF	19236000	100575000	1.912603e-01
2014	2	VL2440	PS	14D16	SPF	110000000	493013000	2.231178e-01
2014	3	VL1218	PS	14D16	SPF	84136000	605007000	1.390662e-01
2014	3	VL2440	PS	14D16	SPF	503800000	2734651000	1.842283e-01
2014	4	VL1218	PS	14D16	SPF	2400000	12247000	1.959664e-01
2016	1	VL0612	LTL	-1	LPF	290000	1911000	1.517530e-01
2016	1	VL1824	PS	14D16	SPF	13060000	75208000	1.736517e-01
2016	2	VL0612	GNS	16D20	DEMF	240000	1166000	2.058319e-01
2016	2	VL1824	PS	14D16	SPF	24470000	133234000	1.836618e-01
2016	3	VL1218	PS	14D16	SPF	75550000	447528000	1.688163e-01
2016	3	VL2440	PS	14D16	SPF	326500000	2039518000	1.600868e-01
2016	4	VL0612	PS	14D16	SPF	4500000	21958000	2.049367e-01
2016	4	VL1824	PS	14D16	SPF	3890000	45045000	8.635810e-02
2017	2	VL1824	PS	14D16	SPF	53824000	17217	3.126212e+03
2017	2	VL2440	PS	14D16	SPF	4000000	256	1.562500e+04
2017	3	VL1218	PS	14D16	SPF	128840000	13232	9.737001e+03
2017	3	VL2440	PS	14D16	SPF	239500000	3538	6.769361e+04
2017	4	VL1218	PS	14D16	SPF	835000	226	3.694690e+03
2018	2	VL1824	PS	14D16	SPF	53730000	306963	1.750374e+02
2018	3	VL1218	PS	14D16	SPF	69834000	407906	1.712012e+02
2018	3	VL2440	PS	14D16	SPF	419400000	2260378	1.855442e+02
2018	4	VL1218	PS	14D16	SPF	8126000	30702	2.646733e+02
2019	3	VL1218	PS	14D16	SPF	111624000	57644	1.936437e+03
2019	3	VL2440	PS	14D16	SPF	302850000	214667	1.410790e+03
2019	4	VL1218	PS	14D16	SPF	5043900	2074	2.431967e+03

There aren't duplicated records. No shifting in the length assignment has been declared. There aren't zero landings having length class filled in, nor -1 landings having length class filled in. However, there are landings reported with values >0 having length class not filled in.

<u>Landing of MAS reported by MLT in GSAs other than GSA15</u>

EWG 22-03 noted that MLT occasionally reported landings of chub mackerel (MAS) (2018 and-2020) in very small quantities (in total approx. 1.4 ton) in fishing areas outside GSA15 also (Table 5.8.1.3).

Table 5.8.1.3: Landing of MAS reported by MLT (2018 and 2020) in GSAs other than GSA15.

id	country	year	quarter	vessel_	gear	mesh_s	fishery	area	specon	species	landing
20204VL06	MLT	2020	4	VL0612	GTR	16D20	DEF	GSA 19	-1	MAS	0,012
20204VL24	MLT	2020	4	VL2440	OTB	40SXX	MDD	GSA 14	-1	MAS	0,008
	MLT	2018	3	VL1218	PS	14D16	SPF	GSA 16	-1	MAS	1,27
	MLT	2018	4	VL1218	PS	14D16	SPF	GSA 14	-1	MAS	0,085

Odd record (e.g. small vessel from MLT (VL0612) of fishing with coastal gear, trammel nets, far from Malta island in 2020) indicate possible GSA, gear or vessel size misreporting. It is suggested to MLT to check this record for accuracy.

In general, the quality of chub mackerel data provided by MLT is affected by the facts that there are no age-related data available for this species and the fact that in number of cases chub mackerel (MAS) catches were reported together with other mackerel species using MAZ species code for *Scombrus spp.* (e.g. *S. scombrus* and *S. colias* in mixed catches). From administrative point of view, use of MAZ for reporting mackerel species combined is not an issue for MLT nor any other MS, but end-data users need to consider this fact in eventual assessments of chub mackerel stocks.

<u>MEDITS issues</u>

TB data files are missing from MEDITS data provided for GSA15 by MLT in 2017.

Haul positions in 2007 south of Malta island are different/missing. EWG 22-03 noted unusual changes in sampling intensities (Table 5.8.1.4) related to stratum B and D in 2007 (e.g. decrease no. hauls in stratum D and increased in stratum B).

In 2018 survey was performed in the 4th quarter and not in usual survey period.

As demersal trawl survey MEDITS do not provide data on chub mackerel (MAS) in GSA 15. It is not an issue for MLT.

Table 5.8.1.4: Yearly total number of hauls by strata in

Year	A	B	C	D	E	Total
2005	1	5	14	9	16	45
2006	1	5	13	10	16	45
2007	0	12	12	4	17	45
2008	0	6	13	9	17	45
2009	0	6	14	10	15	45
2010	0	6	14	10	15	45
2011	0	6	12	12	14	44
2012	0	6	14	11	13	44
2013	0	6	14	10	15	45
2014	0	6	14	10	15	45
2015	0	6	14	10	15	45
2016	0	6	14	9	16	45
2017	0	6	14	9	16	45
2018	0	6	14	9	16	45
2019	0	6	14	10	15	45
2020	0	7	13	9	16	45

*5.8.2 Bogue (BOG) in GSA 15**

<u>Data coverage</u>

Data related to bogue, *Boops boops* (BOG) are not included in Tables with MEDIAS outputs (e.g. abundance, abund_biom, biomass) nor in 4 tables from commercial fisheries such as: <u>alk</u>, <u>effort</u>, <u>ma</u> and <u>sra</u>. In general, <u>no age-related data are available for this stock</u>.

<u>In catch data table</u> for bogue (BOG), MLT provided landing data with only few discard data (Figure 5.8.2.1) in period 2005-2020 (553 records). Catch data are covering 5 different vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440), reported with 12 different fishery codes (CEP, DEF, DEMF, DEMSP, DWS, FIF, FIN, LPF, MDD, MPD, SLP and SPF), using 14 known

gears (FPO, GND, GNS, GTN, GTR, LA, LHM, LHP, LLD, LLS, LTL, OTB, PS and SV) and unreported (-1). Catches are reported in all 4 quarters.

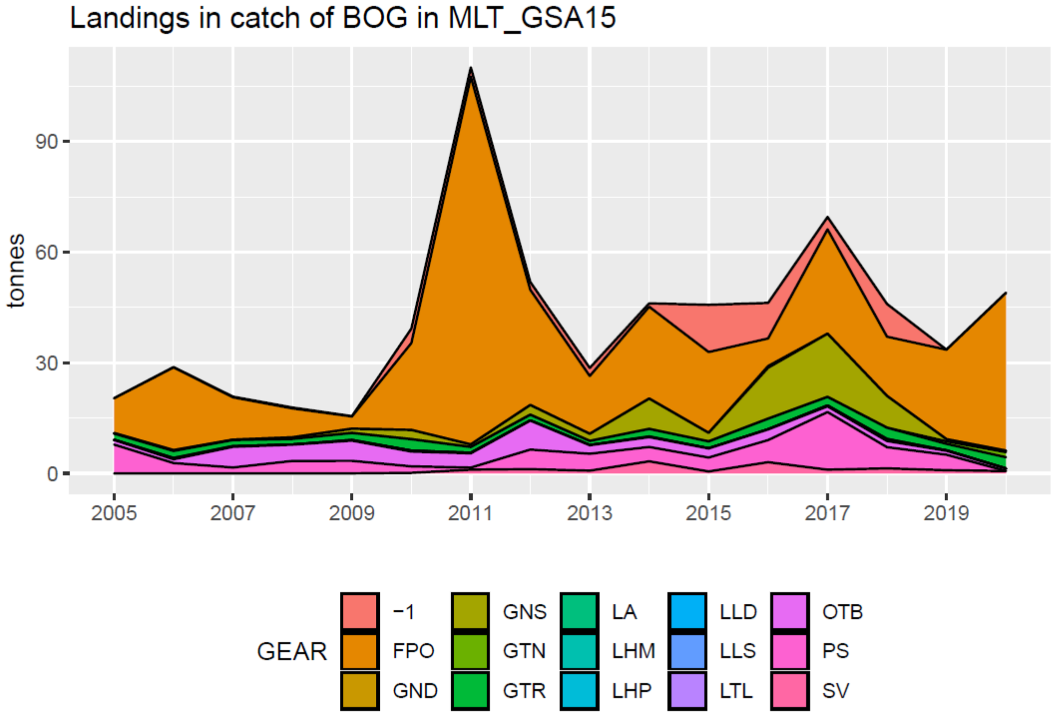


Figure 5.8.2.1: Landings of bogue reported by MLT in catch data table by gears

In discard data table for bogue (BOG), MLT provided very little information, consisting of 8 records only as shown in Figure 5.8.2.3 and Table 5.8.1.2.

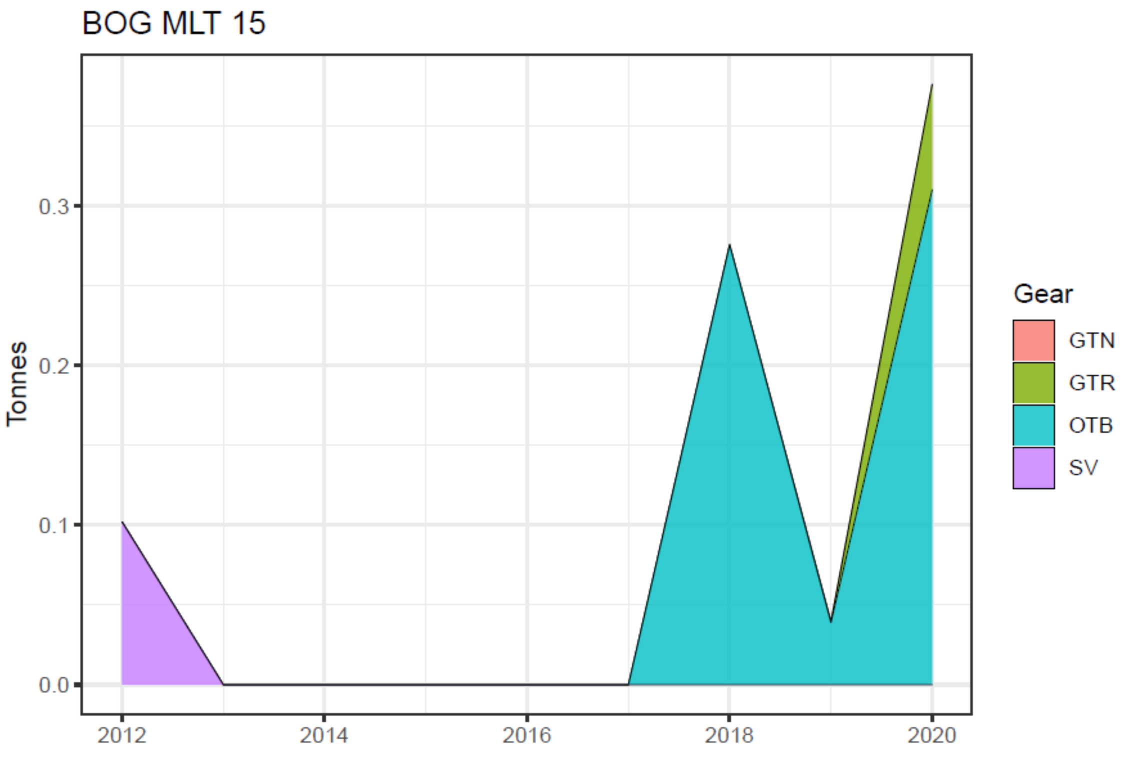


Figure 5.8.2.2: Available discard data of BOG in MLT by gear.

Table 5.8.2.1: All discard data on BOG as available from MLT.

id	country	year	quarter	vessel_l	gear	mesh_s	fishery	area	specon	species	discards
479542	MLT	2019	1	VL0612	GTN	NA	MPD	GSA 15	-1	BOG	0,001
479559	MLT	2019	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	BOG	0,013
479590	MLT	2019	4	VL1824	OTB	40SXX	MDD	GSA 15	-1	BOG	0,026
521143	MLT	2020	2	VL0006	GTR	16D20	DEF	GSA 15	-1	BOG	0,066
521155	MLT	2020	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	BOG	0,306
521185	MLT	2020	3	VL1824	OTB	40SXX	MDD	GSA 15	-1	BOG	0,004
440025	MLT	2012	3	VL0006	SV	-1	DEMF	GSA 15	-1	BOG	0,102
450109	MLT	2018	2	VL1824	OTB	40SXX	DEMSP	GSA 15	-1	BOG	0,2756

From the information available it remained unclear if BOG is rarely discarded, or most of discard data are missing for large number of gears/métiers. The highest numbers of BOG discarded are reported by boat seine (SV) gear in which small specimens of BOG probably occur as by-catch.

Years for which discard data for BOG are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2011 2013, 2014, 2015, 2016 and 2017.

In addition, in discard data table there are 8 records in which landings are >0 but not nb or weight data are provided (Table 5.8.2.2).

Table 5.8.2.2: Discard data records in which landings are >0 but not nb or weight data are provided

COUNTRY	YEAR	QUARTER	GEAR	MESH_SIZE_RANGE	FISHERY	AREA	SPECIES	DISCARDS
MLT	2019	1	GTN	NA	MPD	15	BOG	0.0010
MLT	2019	2	OTB	40SXX	MDD	15	BOG	0.0130
MLT	2019	4	OTB	40SXX	MDD	15	BOG	0.0260
MLT	2012	3	SV	-1	DEMF	15	BOG	0.1020
MLT	2020	2	GTR	16D20	DEF	15	BOG	0.0660
MLT	2020	2	OTB	40SXX	MDD	15	BOG	0.3060
MLT	2020	3	OTB	40SXX	MDD	15	BOG	0.0040
MLT	2018	2	OTB	40SXX	DEMSP	15	BOG	0.2756

Discard length frequency data for BOG in GSA 15 are available for some métiers in some years (Figure 5.8.2.3).

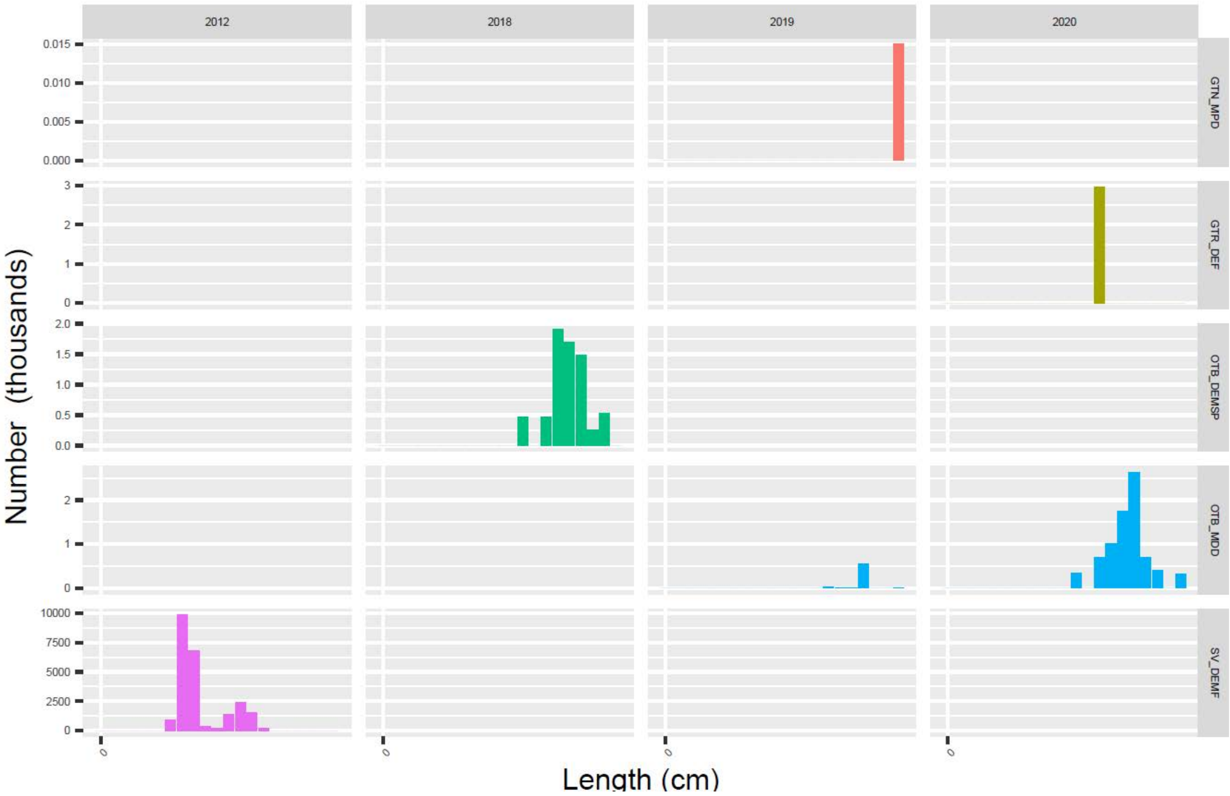


Figure 5.8.2.3 Discard length frequency data for BOG in GSA 15 (MLT).

In landing data table for bogue (BOG), MLT provided landing data in period 2012-2020 (323 records). Landing data are covering the same vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440) as catch table, but reporting the 11 fishery codes (CEP, DEF, DEMF, DEMSP, DWS, FIF, LPF, MDD, MPD, SLP and SPF), and 11 gear types (FPO, GND, GNS, GTN, GTR, LHM, LHP, LLS, OTB, PS and SV) and unknown gears (-1 and NA), as shown in Figure 5.8.2.4. Landings are reported in all 4 quarters (Figure 5.8.2.5).

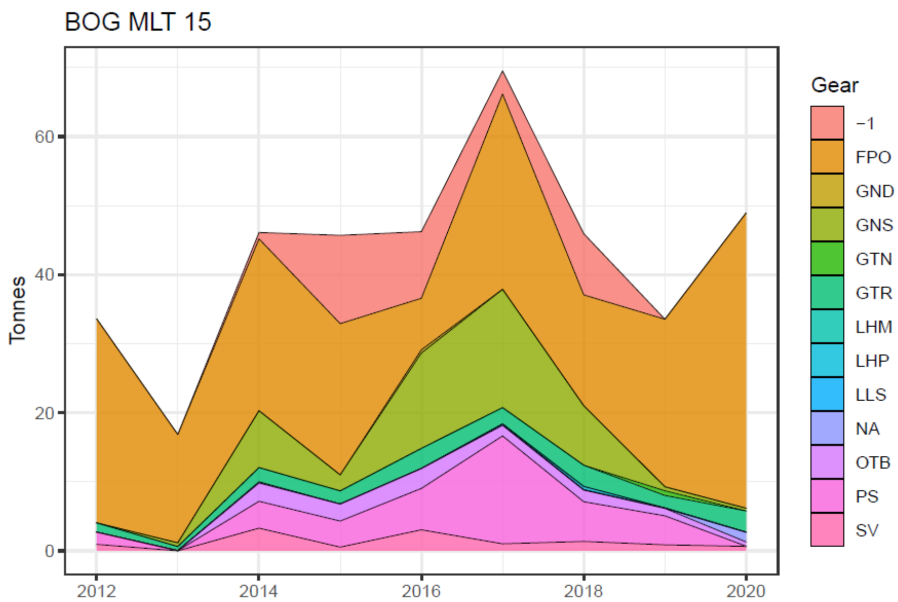


Figure 5.8.2.4: Landings of bogue (BOG) in MLT by gears.

Obviously, there is a discrepancy between catch and landing data tables in the period covered. It seems that before 2012, MLT reported BOG landing data just in catch data table and not in landing data table.

EWG 22-03 noted that significant amounts of BOG catches are reported for FPO gear, that usually is not used to catch this species. Is it quite odd and need to be checked and/or explained by MLT.

Years for which data for BOG in landing table are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

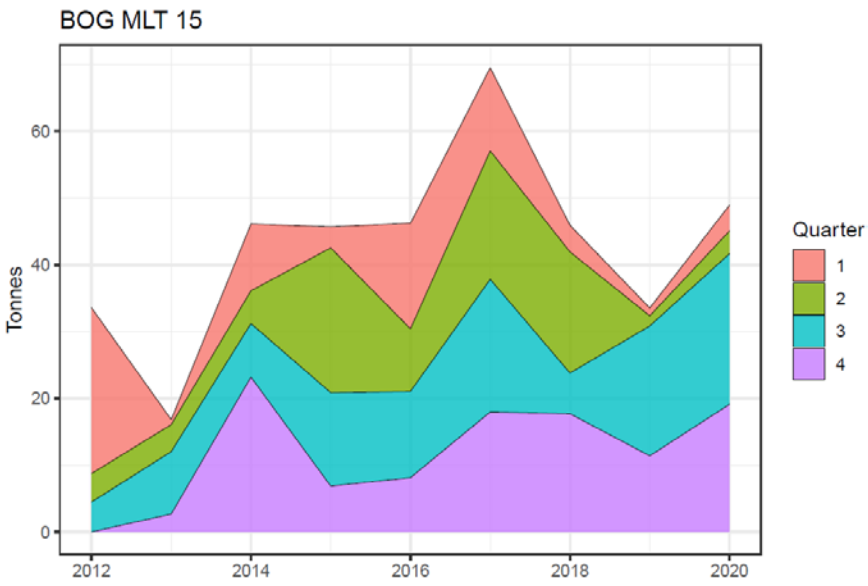


Figure 5.8.2.5: Landings of bogue (BOG) in MLT by quarters.

Landing length frequency data for BOG in GSA 15 are available for some métiers in some years, as shown in example bellow, but most of this information is missing (Figure 5.8.2.5).

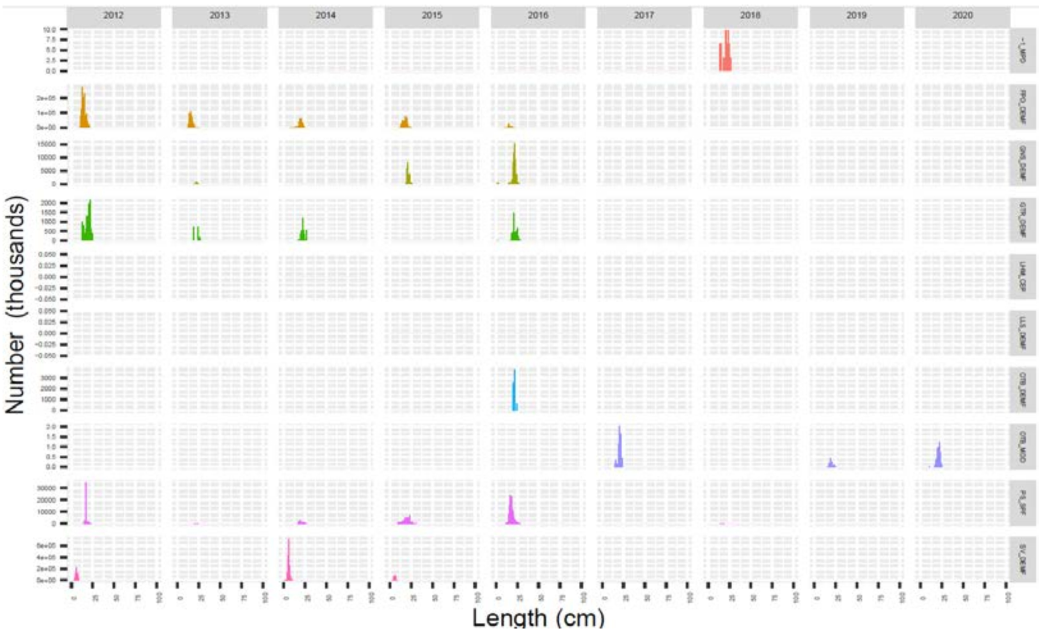


Figure 5.8.2.6: Example of landing length frequency data available for BOG in GSA 15 (MLT)

At the first sight this figure 6 might be misleading, suggesting that for some métiers there are LFD information before 2017 only, and for other métiers since 2017 only. In fact, it seems that numbers reported before 2017 were not reported in thousands, and therefore are probably over reported by 10^3. In addition, in landing data table there are many métiers in which landings are >0 but not nb or weight data are provided (Table 5.8.2.3).

Missing length data to be filled in are shown in Figure 5.8.2.7 .

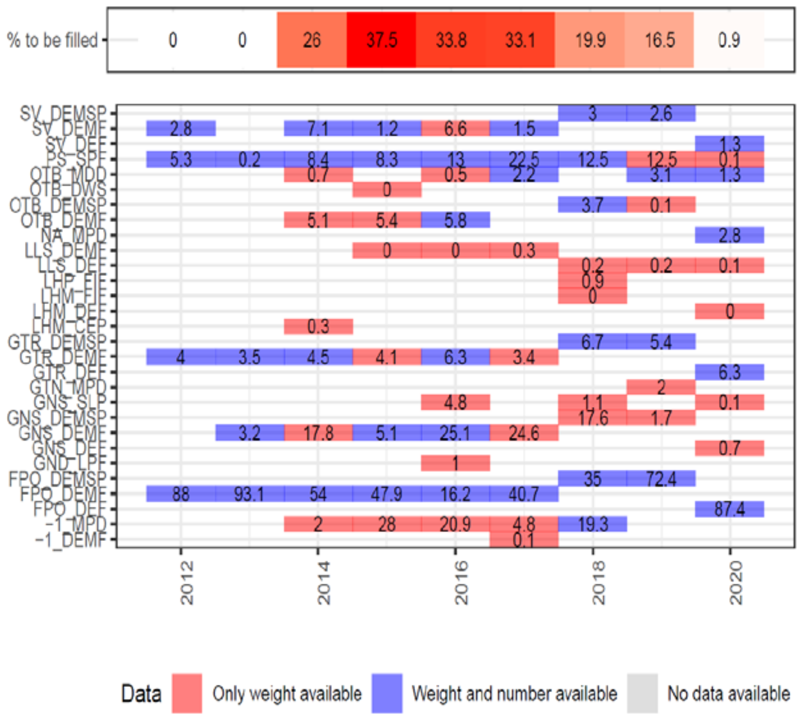


Figure 5.8.2.7: Overview of missing length data for BOG in GSA 15 (MLT).

Table 5.8.2.3: Métiers in which landings are >0 but not nb of fish data are provided.

year	gear	fishery	total_number_landed
2014	-1	MPD	0
2014	GNS	DEMF	0
2014	LHM	CEP	0
2014	OTB	DEMF	0
2014	OTB	MDD	0
2015	-1	MPD	0
2015	GTR	DEMF	0
2015	LLS	DEMF	0
2015	OTB	DEMF	0
2015	OTB	DWS	0
2016	-1	MPD	0
2016	GND	LPF	0
2016	GNS	SLP	0
2016	LLS	DEMF	0
2016	OTB	MDD	0
2016	SV	DEMF	0
2017	-1	DEMF	0
2017	-1	MPD	0
2017	GNS	DEMF	0
2017	GTR	DEMF	0
2017	LLS	DEMF	0
2018	GNS	DEMSP	0
2018	GNS	SLP	0
2018	LHM	FIF	0
2018	LHP	FIF	0
2018	LLS	DEF	0
2019	GNS	DEMSP	0
2019	GTN	MPD	0
2019	LLS	DEF	0
2019	OTB	DEMSP	0
2019	PS	SPF	0
2020	GNS	DEF	0
2020	GNS	SLP	0
2020	LHM	DEF	0
2020	LLS	DEF	0
2020	PS	SPF	0

In growth parameters table for bogue (BOG), MLT provided 17 records for years 2013, 2014, 2015, 2016, 2017, 2018, 2019 and 2020, including information on L-W relation only, and covering both sexes. No VBGF parameters are available for this stock.

Years for which data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2011 and 2012.

In maturity-at-length table, for bogue (BOG) 174 records with maturity at length data are provided, covering both sexes in 2011 and in period 2014-2020 (Figure 5.8.2.3).

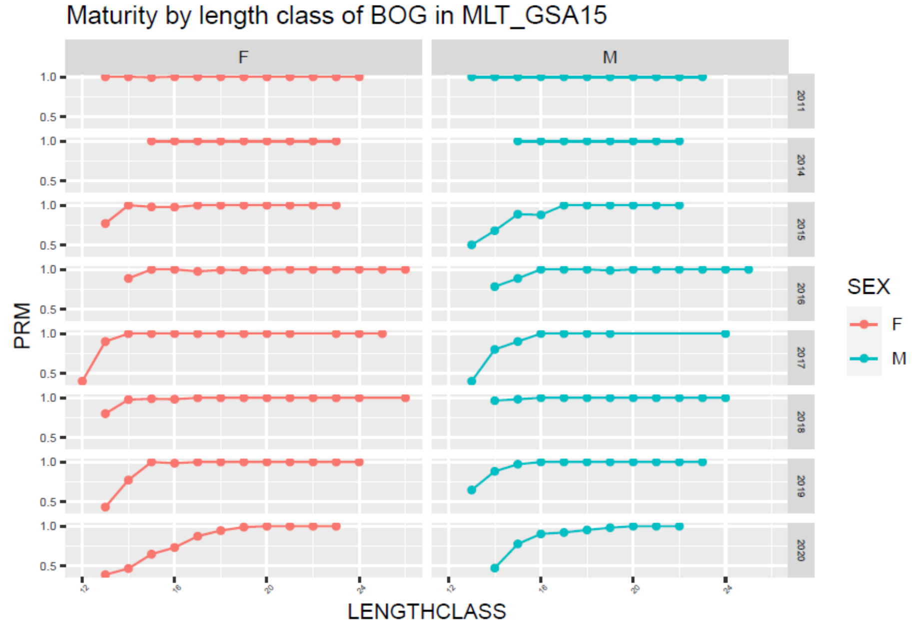


Figure 5.8.2.8: Maturity at length of BOG in MLT (GSA 15).

Maturity at length data for 2011, regarding small sizes of BOG, need to be checked for accuracy.

Years for which data are expected but are not provided are: 2005, 2006, 2007, 2008, 2009, 2010, 2012 and 2013.

In sexratio-at-length table, for bogue (BOG) in GSA 15, 101 records with sex ratio at length data are provided by MLT, covering year 2011 and the period 2014-2020 (Figure 5.8.2.9).

Years for which data are expected but are not provided are: 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012 and 2013.

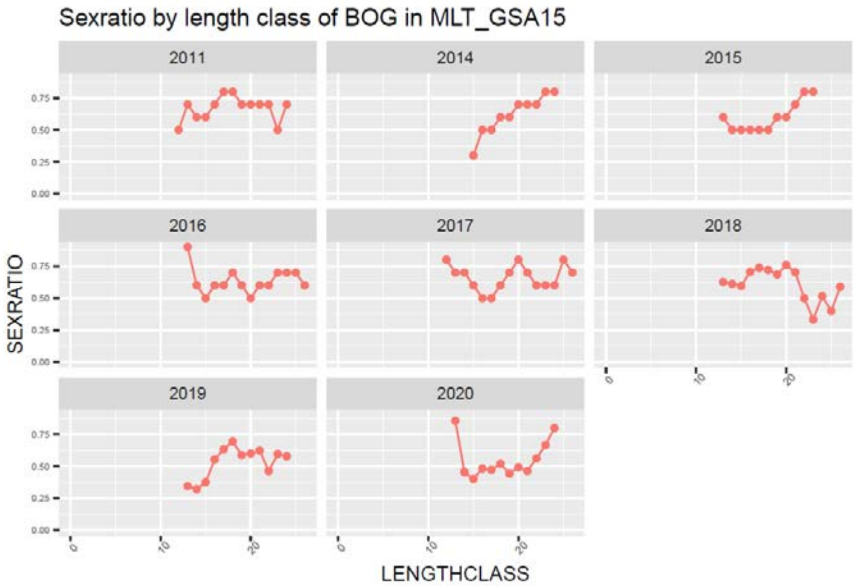


Figure 5.8.2.9: Sex ratio by length of BOG in MLT

Data quality

Catches of bogue reported in catch data table in some fisheries such as CFP, DWS, LPF, and for some gears such as FPO, LLD, LLS and LTL looks a bit odd and probably should be checked by MS.

Data reported by MLT in growth parameters table are related to L-W relation only. It seems that in 2016 and 2017 data covered wide range of fish sizes, but it is a bit odd to have bogue of <2 cm (e.g. 15 and 16 mm) in size with sex determined!?

Data on maturity at length for the small fish provided by MLT in 2011 are indicating fully mature specimens that is not in line with maturity estimates in other years. It is suggested to check these data for accuracy.

Checking landings mean weight highlighted issues with data accuracy in several métiers with unrealistically high mean weights in some years, such as FPO/DEMF in 2017, FPO/DEMSP in 2019, GTR/DEMSP in 2019, OTB/MPD in 2019 and PS/SPF in 2017, etc. (Figure 5.8.2.10). Checking more in details data on landings (Table 5.8.2.5), it seems that numbers reported by MLT before 2017 were not reported in thousands, and therefore are probably over reported by 10^{3}., thus making significant differences between totN reported before and from 2017. It is suggested to check accuracy of all data on totN provided by MLT.

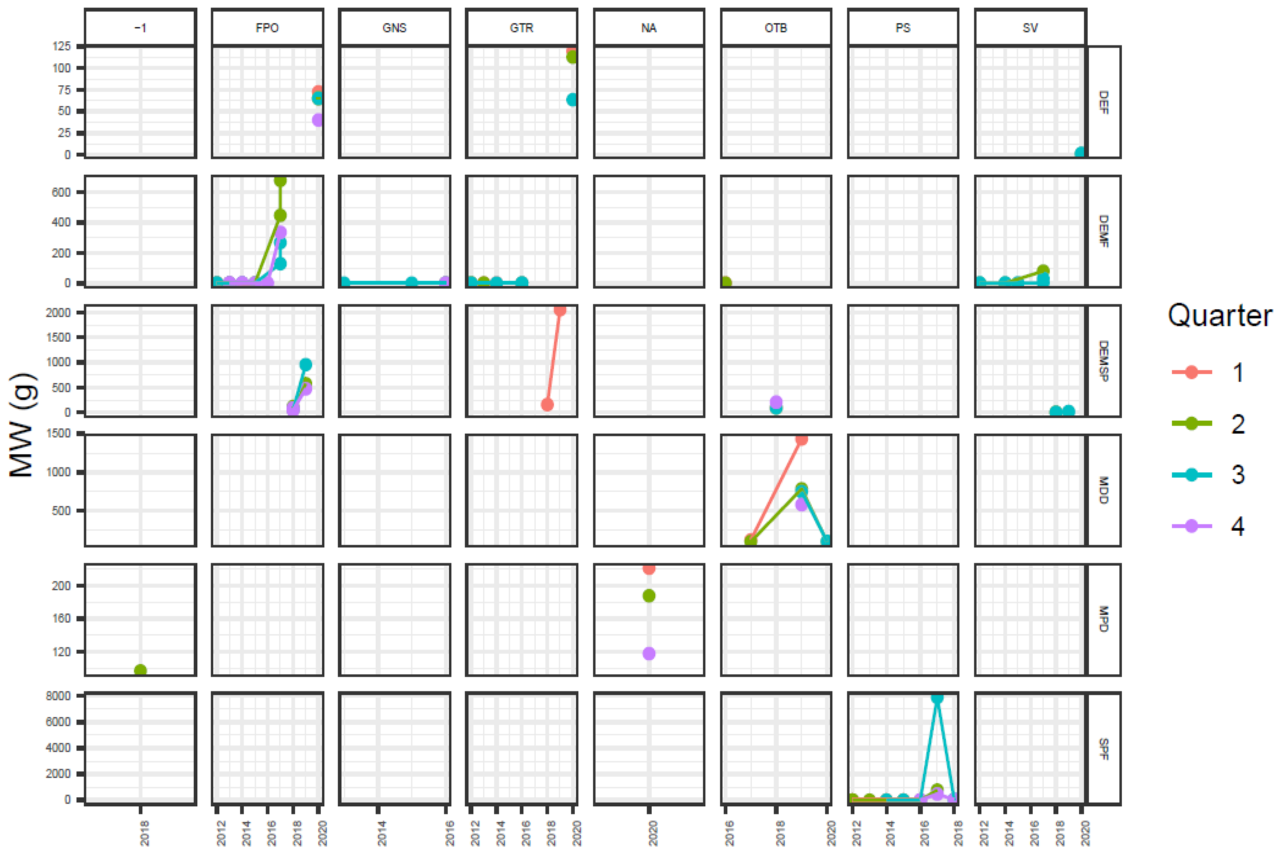


Figure 5.8.2.10: Mean weights for BOG in GSA 15 by métiers/quarter as reported by MLT.

Checking if there are any duplicated records, no duplicated records are noted. Also, no shifting in the length assignment has been noted.

There are no landings in weight with -1 nor landings equal to zero having length class filled in, but there are landing records in weight >0 having length class not filled in (181 records).

Table 5.8.2.5: Changes in BOG discards mean weights in GSA 15 (MLT).

year	quarter	vessel_length	gear	mesh_size_range	fishery	totW	totN	MW
2012	3	VL0006	SV	-1	DEMF	102000	23777752	0.0042897
2018	2	VL1824	OTB	40SXX	DEMSP	275600	6819	40.4164834
2019	1	VL0612	GTN	NA	MPD	1000	15	66.6666667
2019	2	VL1824	OTB	40SXX	MDD	13000	77	168.8311688
2019	4	VL1824	OTB	40SXX	MDD	26000	547	47.5319927
2020	2	VL0006	GTR	16D20	DEF	66000	2971	22.2147425
2020	2	VL1824	OTB	40SXX	MDD	306000	7814	39.1604812
2020	3	VL1824	OTB	40SXX	MDD	4000	58	68.9655172

Landing of BOG reported by MLT (2015-2020) in GSAs other than GSA15

Table 5.8.2.4: Landing of BOG reported by MLT (2015-2020) in GSAs other than GSA15

id	country	year	quarter	vessel_	gear	mesh_s	fishery	area	specon	species	landing
2VL1824O	MLT	2019	2	VL1824	OTB	40SXX	MDD	GSA 14	-1	BOG	0,053
2VL2440O	MLT	2019	2	VL2440	OTB	40SXX	MDD	GSA 13	-1	BOG	0,024
2VL2440O	MLT	2019	2	VL2440	OTB	40SXX	MDD	GSA 14	-1	BOG	0,242
3VL2440O	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 13	-1	BOG	0,005
3VL2440O	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 14	-1	BOG	0,005
3VL2440O	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 21	-1	BOG	0,006
4VL2440O	MLT	2019	4	VL2440	OTB	40SXX	MDD	GSA 14	-1	BOG	0,309
	MLT	2015	4	VL2440	OTB	40SXX	DEMF	GSA 17	-1	BOG	0,03
20201VL24	MLT	2020	1	VL2440	OTB	40SXX	MDD	GSA 14	-1	BOG	0,018
20202VL24	MLT	2020	2	VL2440	OTB	40SXX	MDD	GSA 14	-1	BOG	0,012
20204VL06	MLT	2020	4	VL0612	GTR	16D20	DEF	GSA 13	-1	BOG	0,0109
	MLT	2016	2	VL0612	SV	-1	DEMF	GSA 18	-1	BOG	0,01
	MLT	2018	1	VL1824	OTB	40SXX	DEMSP	GSA 14	-1	BOG	0,049
	MLT	2018	1	VL2440	OTB	40SXX	DEMSP	GSA 14	-1	BOG	0,03
	MLT	2018	2	VL1824	OTB	40SXX	DEMSP	GSA 14	-1	BOG	0,007
	MLT	2018	2	VL1824	OTB	40SXX	MDD	GSA 16	-1	BOG	0,006
	MLT	2018	2	VL2440	LLS	-1	DEF	GSA 14	-1	BOG	0,01
	MLT	2018	2	VL2440	OTB	40SXX	DEMSP	GSA 14	-1	BOG	0,07
	MLT	2018	4	VL1218	PS	14D16	SPF	GSA 14	-1	BOG	0,032

EWG 22-03 noted that MLT occasionally reported landings of BOG (2015-2020) in very small quantities (in total approx. 1 ton) in fishing areas outside GSA15 also (Table 5.8.2.4).

Odd records (e.g. small vessels from MLT (VL0612) fishing far from Malta island in 2016 and 2020) indicated possible GSA or vessel size misreporting. It is suggested to MLT to check these records for accuracy.

MEDITS issues

TB data files are missing from MEDITS data provided for GSA15 by MLT in 2017.

In 2018 survey was performed in the 4th quarter and not in usual survey period.

Haul positions in 2007 south of Malta island are different/missing. EWG 22-03 noted unusual changes in sampling intensities 5.8.2.6) related to stratum B and D in 2007 (e.g. decrease no. hauls in stratum D and increased in stratum B).

Table 5.8.2.6: Yearly total number of hauls by strata in

Year	A	B	C	D	E	Total
2005	1	5	14	9	16	45
2006	1	5	13	10	16	45
2007	0	12	12	4	17	45
2008	0	6	13	9	17	45
2009	0	6	14	10	15	45
2010	0	6	14	10	15	45
2011	0	6	12	12	14	44
2012	0	6	14	11	13	44
2013	0	6	14	10	15	45
2014	0	6	14	10	15	45
2015	0	6	14	10	15	45
2016	0	6	14	9	16	45
2017	0	6	14	9	16	45
2018	0	6	14	9	16	45
2019	0	6	14	10	15	45
2020	0	7	13	9	16	45

EWG 22-03 also noted that MEDITS in 2018 in GSA15 (MLT) was performed in the 4th quarter and therefore not in line with survey protocol.

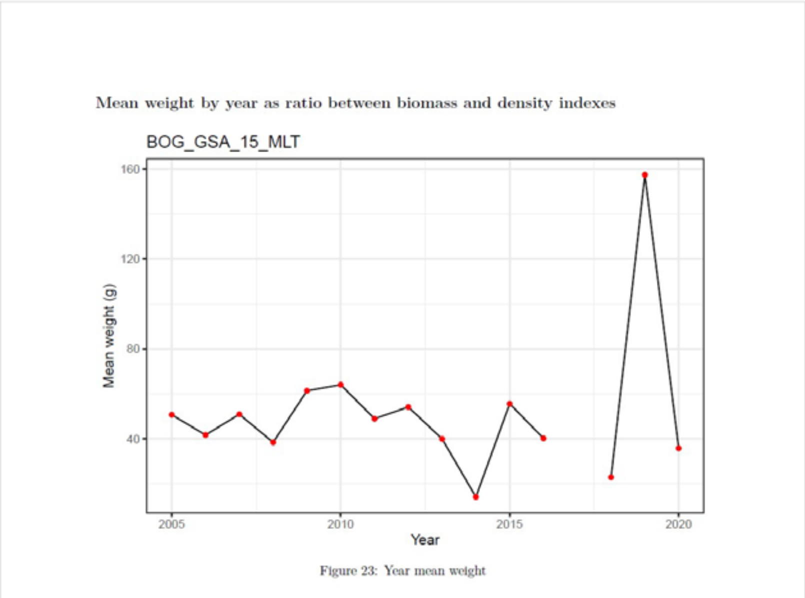


Figure 5.8.2.11: Mean weight of BOG in MEDITS data as ratio of biomass and density index in GSA15 (MLT).

Data on bogue (BOG) are provided by the MEDITS in GSA 15 as occurrence and biomass & density index in the period 2005-2020, except for 2017. Therefore, it is odd that length frequency data are available for BOG in 2017. Also, unusually high mean weight for BOG in 2019 (Figure 5.8.2.11 is noted in MEDITS data from GSA15 (MLT). No data on BOG by sex are available after 2011.

In line with occurrence =0 for 2017, no biomass & density index, nor mean weight data are available for BOG in 2017. However, mean length is available for BOG in 2017.

Table 5.8.2.7: Ranges of minimum and maximum lengths of BOG recorded in GSA 15 by MLT in MEDITS.

Year	Total_min	Male_min	Female_min	Indeterminate_min	Total_max	Male_max	Female_max	Indeterminate_max
2005	110	NA	NA	110	110	NA	NA	110
2006	105	130	140	105	215	215	215	205
2007	115	120	115	120	230	230	225	210
2008	110	135	130	110	225	210	225	215
2009	115	135	135	115	250	250	235	220
2010	120	150	165	120	225	225	225	215
2011	120	120	135	125	250	220	250	215
2012	135	NA	NA	135	220	NA	NA	220
2013	100	NA	NA	100	240	NA	NA	240
2014	80	NA	NA	80	185	NA	NA	185
2015	120	NA	NA	120	200	NA	NA	200
2016	125	NA	NA	125	215	NA	NA	215
2017	50	NA	NA	50	180	NA	NA	180
2018	100	NA	NA	100	190	NA	NA	190
2019	125	NA	NA	125	220	NA	NA	220
2020	105	NA	NA	105	1160	NA	NA	1160

In relation to maximum length of BOG recorded in MEDITS 2020 (e.g. 116 cm), EWG 22-03 noted that it is not in line with biology of this species and need to be checked by MLT ().

It is suggested to MLT to check all these MEDITS data issues, as described above, in GSA15.

5.8.3 Striped red mullet (MUR) in GSA 15

Data coverage

Data related to striped red mullet, *Mullus surmuletus* (MUR), are not included in Tables with MEDIAS outputs (e.g. abundance, abund_biom and biomass).

In catch data table for striped red mullet, *Mullus surmuletus* (MUR), MLT provided landing data from GSA15 in period 2005-2020 (297 records). Catch data are covering 5 different vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440), reported with 8 different fishery codes (DEF, DEMF, DEMSP, DWS, MDD, MPD, SLP and SPF), using 5 known gears (GNS, GTR, LLS, OTB and PS) and unknown or unreported gears (-1 and NA) as shown in Figure 1. Catches are reported in all 4 quarters.

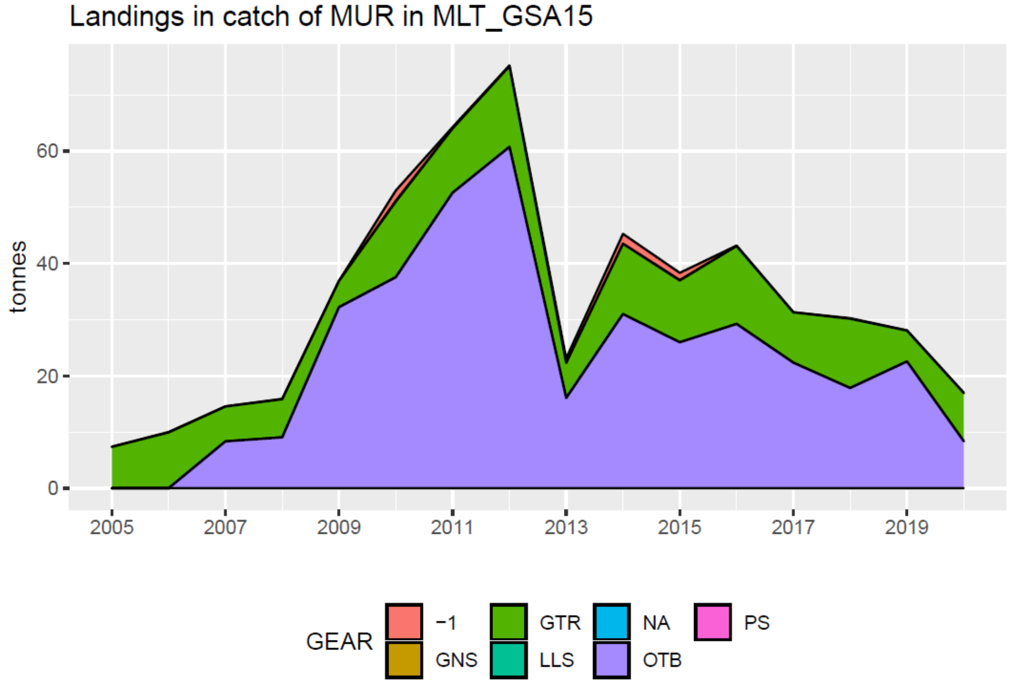


Figure 5.8.3.1: Landings of striped red mullet reported by MLT in catch data table by gears.

Years for which data are expected but are all provided in catch data table.

In discard data table for striped red mullet (MUR), MLT provided very little information, consisting of 17 records, mainly in the most recent years as shown in Figure 2 and Table 13. It seems that MLT not reported discard data in the past.

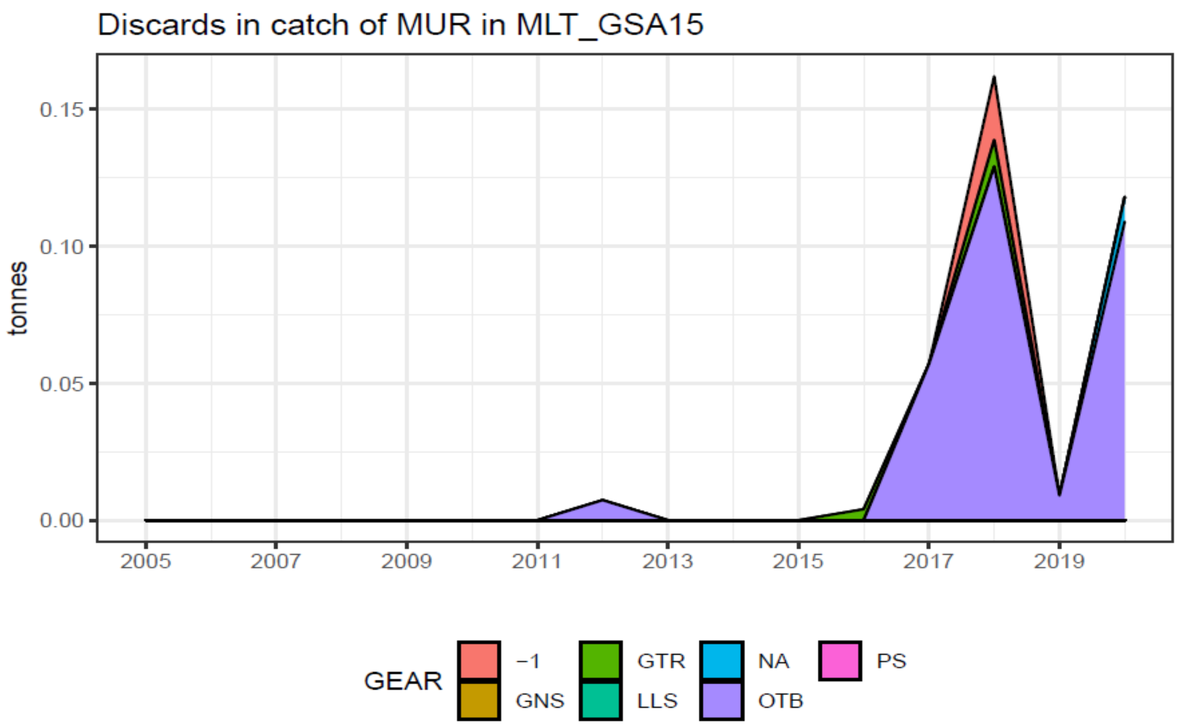


Figure 5.8.3.2: Available discard data of MUR in MLT by gear.

In addition, in discard data table there are 17 records in which landings are >0 but not nb or weight data are provided (Table 14).

Table 5.8.3.1: All discard data on MUR as available from MLT.

id	country	year	quarter	vessel_	gear	mesh_s	fishery	area	specon	species	discard
445866	MLT	2017	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,057
479551	MLT	2019	1	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,002
479567	MLT	2019	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,007
521149	MLT	2020	2	VL0612	GTN	NA	MPD	GSA 15	-1	MUR	0,001
521166	MLT	2020	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,019
521196	MLT	2020	3	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,09
521208	MLT	2020	4	VL0612	GTN	NA	MPD	GSA 15	-1	MUR	0,008
440005	MLT	2015	1	VL1824	OTB	40SXX	DEMF	GSA 15	-1	MUR	0,000002
440051	MLT	2012	1	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,00139
440052	MLT	2012	2	VL1824	OTB	40SXX	DWS	GSA 15	-1	MUR	0,00593
441051	MLT	2016	4	VL0612	GTR	16D20	DEMF	GSA 15	-1	MUR	0,004
450155	MLT	2018	1	VL1824	OTB	40SXX	DEMSP	GSA 15	-1	MUR	0,0405
450156	MLT	2018	2	VL0612	-1	-1	MPD	GSA 15	-1	MUR	0,0233
450157	MLT	2018	2	VL0612	GTR	16D20	DEMSP	GSA 15	-1	MUR	0,0097
450158	MLT	2018	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,0037
450159	MLT	2018	2	VL1824	OTB	40SXX	DEMSP	GSA 15	-1	MUR	0,0772
450160	MLT	2018	3	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,0077

Table 5.8.3.2: Discard data records in which number of

year	gear	fishery	total_number_landed
2014	-1	MPD	0
2014	OTB	MDD	0
2015	-1	MPD	0
2015	GNS	DEMF	0
2015	GNS	SLP	0
2015	LLS	DEMF	0
2015	OTB	MDD	0
2016	-1	MPD	0
2016	OTB	MDD	0
2017	-1	MPD	0
2017	GNS	DEMF	0
2017	LLS	DEMF	0
2018	-1	MPD	0
2019	GNS	DEMSP	0
2019	GTR	DEMSP	0
2019	LLS	DEF	0
2019	OTB	DEMSP	0
2019	PS	SPF	0

In landing data table for striped red mullet (MUR), MLT provided landing data in period 2009-2020 (188 records). Landing data reported are covering the same vessel length classes (VL0006, VL0612, VL1218, VL1824 and VL2440) as catch table, but reporting the 8 fishery codes (DEF, DEMF, DEMSP, DWS, MDD, MPD, SLP and SPF), and 5 gear types (GNS, GTR, LLS, OTB and PS) and unreported gear (-1). However, EWG 22-03 noted discrepancies in periods covered between landing data reported by MLT in catch vs. landing data tables (e.g. in period 2005-2008 is missing in landing table), as shown in Figure 4. Landings are reported in all 4 quarters (Figure 5).

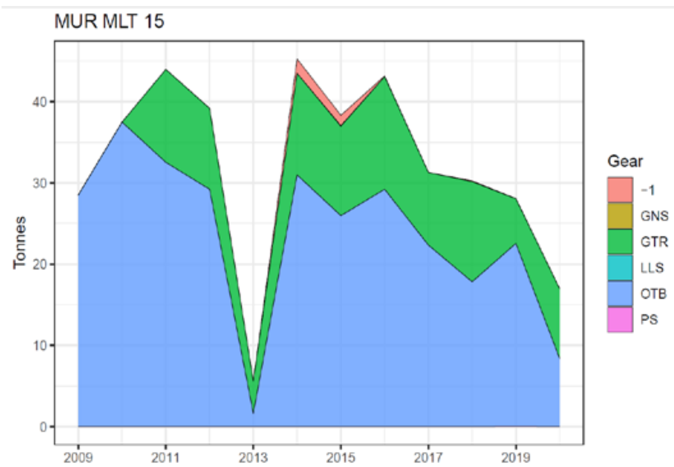


Figure 5.8.3.3: Landings of striped red mullet (MUR) in GSA15 (MLT) by gears as reported in landing data table.

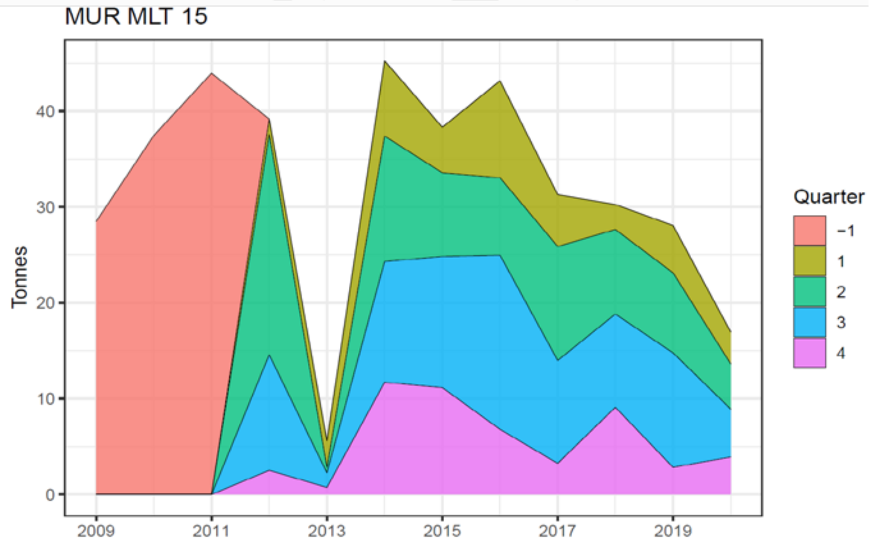


Figure 5.8.3.4: Landings of striped red mullet (MUR) in GSA15 (MLT) by gears as reported in landing data table.

Obviously, there is a strange drop in striped red mullet (MUR) reported landings in GSA15 for 2013. EWG 22-03 compared data entries in catch and landing tables, and find out that in catch data table there are 21 data rows with total landing amount of >23 tons, while in landing data table there are 7 data rows only with total landings amount of <6 tons. Different no. records

Table 5.8.3.3: Data entries for MUR in GSA15 by MLT in catch data table for 2013.

id	country	year	quarter	vessel_	gear	mesh_s	fishery	area	specon	species	landing
	MLT	2013	1	VL0006	GTR	16D20	DEMF	GSA 15	-1	MUR	0,754975
	MLT	2013	1	VL0612	GTR	16D20	DEMF	GSA 15	-1	MUR	0,387134
	MLT	2013	1	VL1824	OTB	40SXX	DEMF	GSA 15	-1	MUR	1,609
	MLT	2013	1	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,151
	MLT	2013	2	VL0006	-1	-1	MPD	GSA 15	-1	MUR	0,469241
	MLT	2013	2	VL0006	GTR	16D20	DEMF	GSA 15	-1	MUR	1,599766
	MLT	2013	2	VL0612	GTR	16D20	DEMF	GSA 15	-1	MUR	0,592082
	MLT	2013	2	VL1824	OTB	40SXX	DEMF	GSA 15	-1	MUR	5,081
	MLT	2013	2	VL1824	OTB	40SXX	MDD	GSA 15	-1	MUR	0,04
	MLT	2013	2	VL2440	OTB	40SXX	DEMF	GSA 15	-1	MUR	2,317
	MLT	2013	2	VL2440	OTB	40SXX	MDD	GSA 15	-1	MUR	0,022
	MLT	2013	3	VL0006	-1	-1	MPD	GSA 15	-1	MUR	0,328469
	MLT	2013	3	VL0006	GTR	16D20	DEMF	GSA 15	-1	MUR	0,409054
	MLT	2013	3	VL0612	-1	-1	MPD	GSA 15	-1	MUR	0,024316
	MLT	2013	3	VL0612	GTR	16D20	DEMF	GSA 15	-1	MUR	1,120212
	MLT	2013	3	VL1824	OTB	40SXX	DEMF	GSA 15	-1	MUR	5,116
	MLT	2013	3	VL2440	OTB	40SXX	DEMF	GSA 15	-1	MUR	0,089
	MLT	2013	4	VL0006	GNS	16D20	SLP	GSA 15	-1	MUR	0,023462
	MLT	2013	4	VL0006	GTR	16D20	DEMF	GSA 15	-1	MUR	0,64085
	MLT	2013	4	VL0612	GTR	16D20	DEMF	GSA 15	-1	MUR	0,735103
	MLT	2013	4	VL1824	OTB	40SXX	DEMF	GSA 15	-1	MUR	1,615
										TOTAL:	**23,12466**

between catch data (Table 5.8.15) and landing data (Table 5.8.16) were noted by EWG 22-03. Therefore, it is suggested that MLT check the completeness of MUR landing data records in landing data table for GSA15 in entire period (2009-2020).

Table 5.8.3.4: Data entries for MUR in GSA15 by MLT in landing data table for 2013.

Years for which data in landing table are expected but are not provided are: 2005, 2006, 2007 and 2008.

In landing data table, length frequency data for striped red mullet (MUR) in GSA 15 are available for some métiers as shown in Figure 6. In principle, length frequency data are available from GTR and OTB gears. Landing length frequency data for some years (e.g. 2017, 2019 and 2020) are provided but are not visible in the figure bellow (Figure 6). Also, it has been noted that in 2017 only positive numbers were provided in the database, without -1 and 0 values. It might be related to more general problem of DCF data reporting by MLT as noted in other species also. It is likely that numbers provided by MLT up to 2017 are over reported by factor x1000, suppressing other length frequency data reported eventually. As it can be seen from Figure 6, length frequency data after 2016 are visible only if there were no previously reported length frequency data.

In addition, in landing data table there are many métiers in which landings are >0 but not nb or weight data are provided (Table 5.8.17).

Table 5.8.3.5: Métiers in which MUR landings in GSA15 (MLT) are >0 but not

year	gear	fishery	total_number_landed
2014	-1	MPD	0
2014	OTB	MDD	0
2015	-1	MPD	0
2015	GNS	DEMF	0
2015	GNS	SLP	0
2015	LLS	DEMF	0
2015	OTB	MDD	0
2016	-1	MPD	0
2016	OTB	MDD	0
2017	-1	MPD	0
2017	GNS	DEMF	0
2017	LLS	DEMF	0
2018	-1	MPD	0
2019	GNS	DEMSP	0
2019	GTR	DEMSP	0
2019	LLS	DEF	0
2019	OTB	DEMSP	0
2019	PS	SPF	0

Missing length data to be filled in are shown in Figure 7.

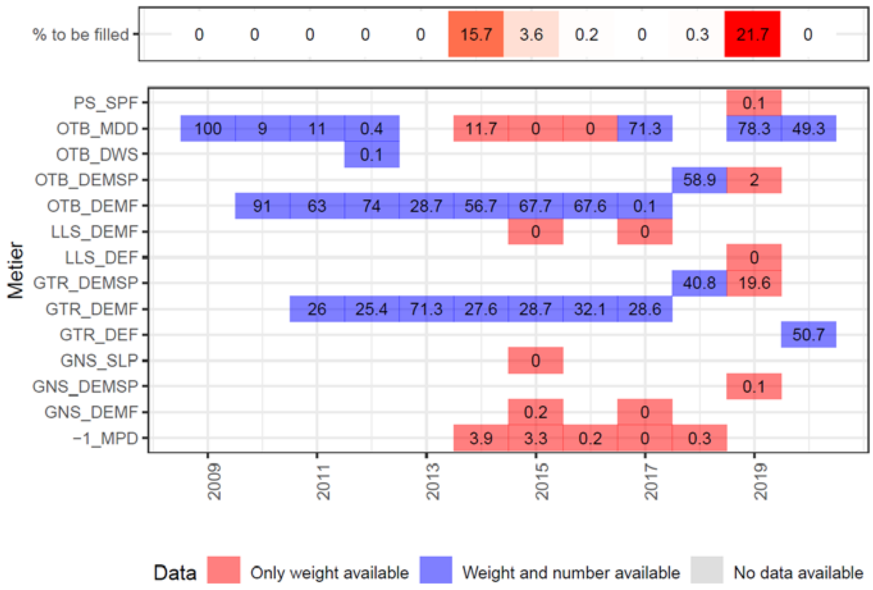


Figure 5.8.3.5: . Overview of missing length data for MUR in GSA 15 (MLT).

While checking if there are any duplicated records, no duplicated records were noted. Also, no shifting in the length assignment has been noted.

There aren't zero landings having length class filled in, nor -1 landings having length class filled in. However, there are 90 cases in which length class number are zero but landing is >0.

In alk table, there are 76 records provided by sex for MUR for the period 2013-2020 in GSA15 (MLT). Data available by sex are shown in Figure 8. Age data in 2020 are available for sex combined only.

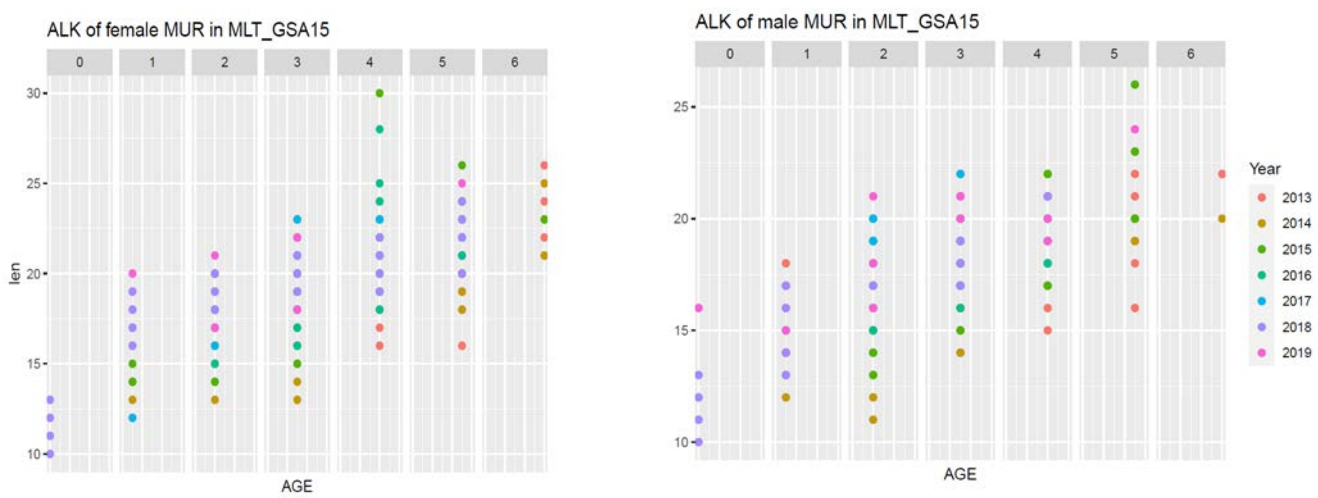


Figure 5.8.3.6: Age-at-length data by sex for MUR in GSA15 provided by MLT.

Age-at-length data by sex for MUR are expected but are not provided in 2020. Also, it seems that were no age analyses of MUR in MLT before 2013.

In growth parameters table for striped red mullet (MUR), MLT provided 22 records for years 2009, 2010, 2011, 2012, 2013, 2014, 2016, 2018 and 2020, including information on L-W relation only, and covering both sexes. Despite the fact that age data are available, no VBGF parameters are provided for this stock by MLT.

Years for which growth parameters data are expected but are not provided are 2013, 2014, 2015, 2016, 2017, 2018, 2019 and 2020.

In maturity tables (ma and ml), for striped red mullet (MUR), MLT provided data with maturity at length for the period 2009-2020 and data with maturity at age for the period 2013-2020 by sex, as shown in figures 9 and 10.

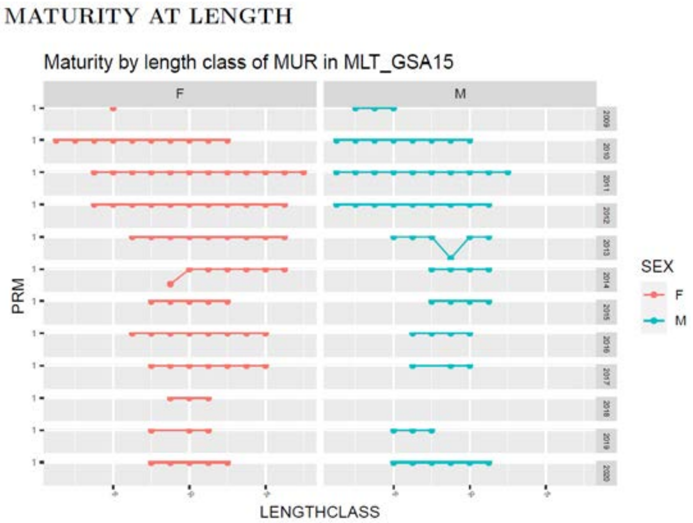


Figure 5.8.3.7:: Maturity at length of MUR in MLT (GSA 15).

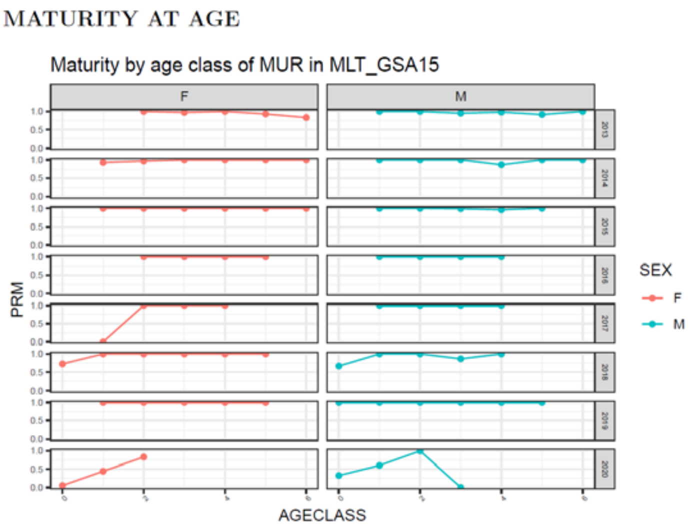


Figure 5.8.3.8: Maturity at age of MUR in MLT (GSA 15).

EWG 22-03 noted odd data reported for MUR by MLT for age 1 in females 2017, and in age 3 in males 2020.

In sex ratio at length table, for striped red mullet (MUR) in GSA 15, 104 records with sex ratio at length data are provided by MLT, covering the period 2009-2020, while sex ratio at age data table contains 43 records covering the period 2013-2020 (Figure 11). EWG 22-03 noted no particular issues in sex ratio data provided by MLT, but just that records are related to different numbers of age classes by years.

SEX RATIO AT AGE

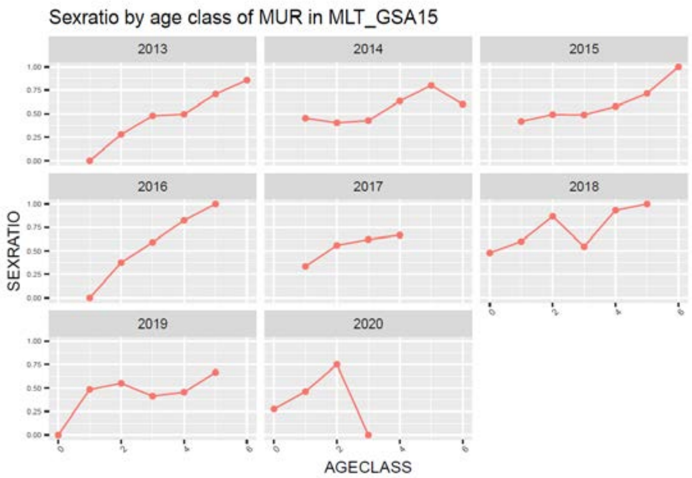


Figure 5.8.3.9: Sex ratio by age of MUR in MLT (GSA 15).

Landing of MUR reported by MLT (2015-2020) in GSAs other than GSA15

EWG 22-03 noted that MLT reported landings of MUR not in GSA15 only, but in 5 other GSAs also (e.g. GSAs 13, 14, 16, and 19) in period 2018-2020. In 21 records MLT reported landing quantities of MUR (in total approx. 10 tons) in fishing areas outside GSA15, related mainly to OTB fishing gear (Table 5.8.18).

Table 5.8.3.6:. Landings of MUR reported by MLT in fishing areas outside of GSA15.

id	country	year	quarter	vessel_le	gear	mesh_si	fishery	area	specon	species	landings
1VL1824C	MLT	2019	1	VL1824	OTB	40SXX	MDD	GSA 14	-1	MUR	0,208
1VL2440C	MLT	2019	1	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,366
2VL1824C	MLT	2019	2	VL1824	OTB	40SXX	MDD	GSA 14	-1	MUR	1,025
2VL1824C	MLT	2019	2	VL1824	OTB	40SXX	MDD	GSA 16	-1	MUR	0,006
2VL2440C	MLT	2019	2	VL2440	OTB	40SXX	MDD	GSA 13	-1	MUR	0,484
2VL2440C	MLT	2019	2	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,548
3VL2440C	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 13	-1	MUR	0,05
3VL2440C	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,018
3VL2440C	MLT	2019	3	VL2440	OTB	40SXX	MDD	GSA 21	-1	MUR	2,08
4VL2440C	MLT	2019	4	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	2,33
20201VL1	MLT	2020	1	VL1824	OTB	40SXX	MDD	GSA 14	-1	MUR	0,073
20201VL2	MLT	2020	1	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,306
20202VL2	MLT	2020	2	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,024
20203VL2	MLT	2020	3	VL2440	OTB	40SXX	MDD	GSA 13	-1	MUR	0,036
20204VL0	MLT	2020	4	VL0612	GTR	16D20	DEF	GSA 13	-1	MUR	0,0063
20204VL0	MLT	2020	4	VL0612	GTR	16D20	DEF	GSA 19	-1	MUR	0,0161
20204VL2	MLT	2020	4	VL2440	OTB	40SXX	MDD	GSA 14	-1	MUR	0,144
	MLT	2018	1	VL1824	OTB	40SXX	DEMSP	GSA 14	-1	MUR	0,598
	MLT	2018	1	VL2440	OTB	40SXX	DEMSP	GSA 14	-1	MUR	0,888
	MLT	2018	2	VL1824	OTB	40SXX	DEMSP	GSA 14	-1	MUR	0,49
	MLT	2018	2	VL2440	OTB	40SXX	DEMSP	GSA 14	-1	MUR	0,63
										Total:	**10,3264**

5.8.1.2 Data quality

In relation to quality of MUR data provided by MLT, EWG 22-03 noted discrepancies between landing data reported by MLT in catch vs. landing data tables (e.g. in period 2009-2013), as shown in Figure 5.8.3.10.

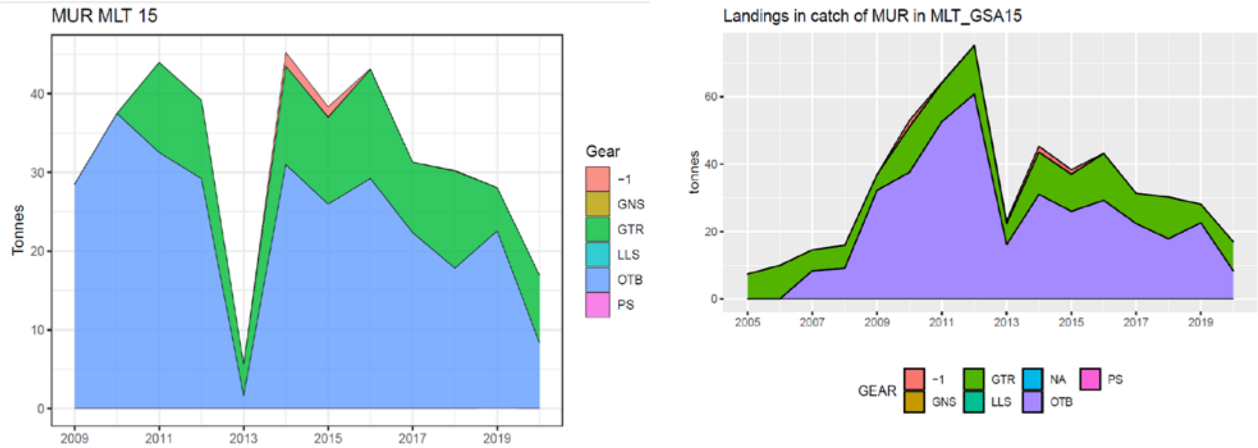


Figure 5.8.3.10: Landings of striped red mullet (MUR) in GSA15 (MLT) by gears as reported in landing data table (left) vs. catch data table (right).

Therefore, it would be important that MLT check the accuracy of MUR landing data provided in catch and landing data table for GSA15 in entire period (2005-2020).

While checking MUR length frequency data provided by MLT, EWG 22-03 noticed discrepancies in order of magnitude of numbers reported before and from 2017, and concluded that there might be more general problem of DCF data reporting by MLT, as noted in other species also. It is likely that numbers provided by MLT up to 2017 are over reported by factor x1000. It is likely that this issue is reflecting in MUR mean lengths and other parameters derived from numbers of MUR specimens provided by MLT before 2017. Therefore, it would be important that MLT check the accuracy of total number of fish data provided for all species in period 2005-2016.

Among other issues related to data quality, EWG noted odd data on maturity-at-length in females 2014, and in males 2013, as well as odd data on maturity-at-age1 in females 2017, and in age 3 in males 2020, and suggest that MLT check accuracy of these data provided.

Table 5.8.3.7: Items identified and noted in DTMT for Malta

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Landings length - Catch	GSA_15_MUR: differences between landing data provided in catch vs. landing data tables in period 2009-2020	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at age	GSA_15_MUR: odd maturity at age data reported for age 1 in females 2017, and in age 3 in males 2020.	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_15_MUR: growth parameters data are not provided in years 2005-2008, 2015, 2017 and 2019	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_15_MUR: landing data are not available in landing data table in period 2005-2008	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	MEDITS_TC	GSA_15_BOG: maximum length of bogue recorded in 2020 (e.g. 116 cm) is not in line with biology of this species	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_15_BOG: maturity at length data in 2011, regarding small sizes of fish, are odd; please check	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Sex ratio at length	GSA_15_BOG: data in srl table are not available in years 2005-2010 and 2012-2013	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_15_BOG: data in gp table are not provided in period 2005-2012	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_15_BOG: data in landing table are missing in period 2005-2011	COVERAGE	LOW
2021	Malta	STECF	Med and	EWG	Discards	GSA_15_BOG_MUR: discard data are not	COVERAGE	LOW

		EWG	BS	22-03	data	available in years 2005-2011 and 2013-2015		
2021	Malta	STECF EWG	Med and BS	EWG 22-03	MEDITS_TA	GSA_15_MAS: In 2007 haul positions in area south of Malta island are different/missing; unusual change in sampling intensities related to stratum B and D	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	MEDITS_TB	GSA_15_MAS: TB data files are missing in 2017	COVERAGE	MEDIUM
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_15_MAS_BOG_MUR: it seems that numbers (totN and LFD) for all species reported before 2017 were not reported in thousands, and therefore are probably over-reported by 103., thus making significant differences between totN and LFD reported before and from 2017; please check for period 2005-2020	QUALITY	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_15_MAS: maturity at length data for small sizes need to be checked for accuracy	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Sex ratio at length	GSA_15_MAS: Sex ratio by length is missing for years before 2013	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Maturity ogive ata length	GSA_15_MAS. Maturity at length data are not available in years 2005-2010, 2012-2013 and 2019	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_15_MAS: growth parameters data are not provided in years 2005-2011, 2016, 2018 and 2019	COVERAGE	LOW
2021	Malta	STECF EWG	Med and BS	EWG 22-03	Landings length and Catch	GSA_15_MAS: landing data are not available in catch and landing tables before 2013	COVERAGE	LOW

5.9 Greece

Data quality checks on commercial data – provided by the Members States through the Med&BS datacall – have been conducted on Greek data, for Common Cuttlefish (*Sepia officinalis*) and Bogue (*Boops boops*) in GSAs 20 (Ionian Sea), 22 (Aegean Sea) and 23 (Cretan Sea), by using the JRC data quality routines. In the following sections the outcomes of these checks are presented. It has to be noted that the datasets didn't contain any information for years 2002, 2007, 2009-2012. However, this is a known issue for the Greek data, since the DCF program didn't run for these years in this Member State, due to administrative reasons. Other well-known issues for the Greek DCF data are the fact that DCR run only for the last semester in years 2013, 2015 and 2017, and the fact that all Small-Scale Fisheries data for the period 2003-2008 are reported together (and thus the NA gear for the relevant data) as a result of the sampling scheme applied from the Member State during this period. Finally, GSA23 (Cretan Sea) has been established in 2013 (prior to that year, this area was a part of the GSA22) and as a result, data reporting for this GSA started in 2013.

*5.9.1 Common Cuttlefish (CTC) in GSA 20**

- ***Commercial data***

The quality check revealed a high value of discards for GNS gear in the 4th quarter in year 2015 compared to other years, that should be checked (Figure 5.9.1.1). Apart from that, no Length-Weight parameters have ever been reported for this stock by the Member State.

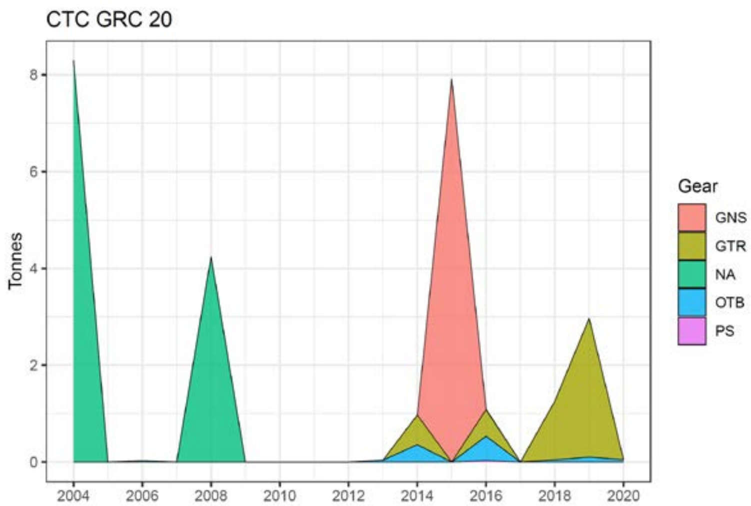


Figure 5.9.1.1: Discards per Gear for the Common Cuttlefish, GSA20 Greece.

- ***MEDITS data***

The comparison between the TA, TB and TC MEDITS files revealed some inconsistencies between the number of hauls reported in TA files, as well as those included in the TB and TC files. More specifically, hauls 109 and 110 in 1994 don't have information in TB and TC, although they have information in TA. Apart from that, in haul 52 in 2008 either the length of a *Sepia officinalis* individual (350 mm) or the sample and total weight of the sample are misreported and should be checked and revised.

*5.9.2 Common Cuttlefish (CTC) in GSA 22**

- ***Commercial data***

Apart from already known issues, the quality check revealed that, no Length-Weight parameters have ever been reported for this stock by the Member State.

- ***MEDITS data***

Quality check revealed several issues in the TA, TB and TC MEDITS files for this stock. More specifically, three hauls (hauls 28, 29, 30) for the year 2016 are reported in GSA22 although located in Ionian Sea (hauls located within Gulf of Corinth, see Figure 5.9.1.2).

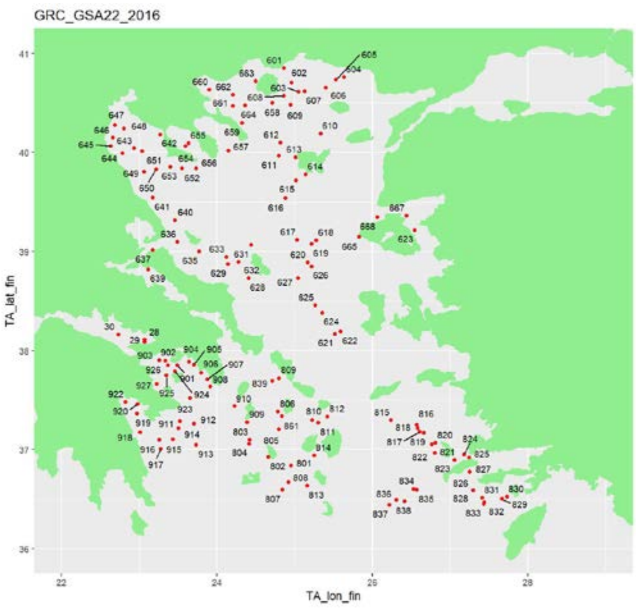


Figure 5.9.2.1The position of the MEDITS hauls for GSA22 in 2016, Greece.

Apart from that, several inconsistencies between the number of hauls reported in TA, TB and TC have been discovered. These include the hauls 25 in 1994, 728 and 730 in 1996, 410 in 2000, 216 and 430 in 2003, 205 and 428 in 2004, 238 and 430 in 2005, 214 in 2006, 219 in 2008, 639 in 2014 and 639 in 2016 which don't have information in TB and TC files, although they have been reported in TA file. More importantly, an inconsistency between the haul numbering for all the hauls for the vessel NAU in TA, TB and TC files for 2020 have been found; TA hauls follow a sequential numbering form ranging from 1 to 39, while the haul number for these hauls in TB and TC range between 801-839. As a result, the information between the different MEDITS files for these hauls could not be combined, since the key ID for them is different in the different files. Finally, one haul (Haul 61) in 2020 was reported to GSA 22 in TA file, while it is assigned to GSA 23 (as haul 861) in TB and TC.

Apart from the above, in haul 824 in 2001 the length of a *Sepia officinalis* individual (255 mm) is probably misreported and should be checked.

*5.9.3 Common Cuttlefish (CTC) in GSA 23**

- ***Commercial data***

The quality check revealed a high value of discards for GTR gear in the 2nd quarter of the year 2014, compared to other years, that should be checked (Figure 5.9.1.3). Apart from that, no Length-Weight parameters have ever been reported for this stock by the Member State.

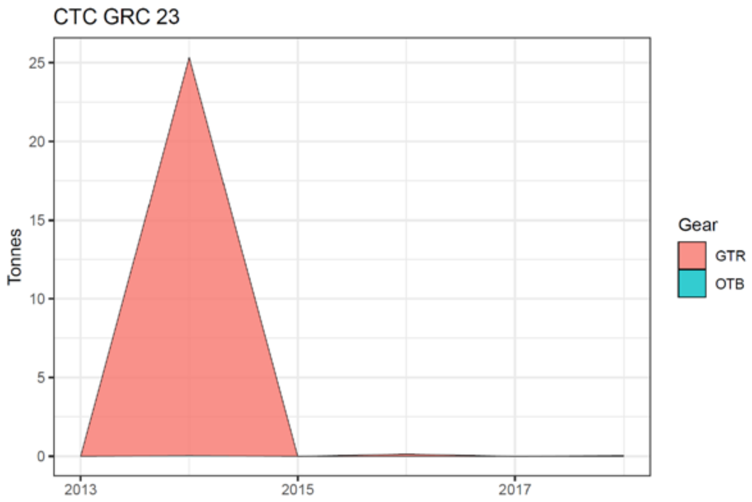


Figure 5.9.3.1: Discards per Gear for the Common Cuttlefish, GSA23 Greece.

- ***MEDITS data***

One inconsistency between TA, TB and TC files have been found in data, which was the haul 52 in 1994 which doesn't have information in TB and TC (although it has in TA). Apart from that, the same inconsistency in haul numbering for the vessel NAU in 2020 found in GSA 22 is also noticed in GSA23; haul numbering in TA, TB and TC files should be harmonized in order to make it possible to cross-combine the information from the three files. Additionally, in haul 53 in 2000 the number of individuals in TB and the sample weight in TC for *Sepia officinalis* should be checked and revised: in TC the sample weight of 10 individuals measured is unrealistically low (23 g) resulting in high total number of individuals in TB, due to raising to the measured total weight of the sample in the haul (420 gr). Finally, in haul 52 in 2003 the total number of individuals reported in TB file (12 individuals with total weight of 330 g) is incompatible with the numbers reported in TC file (11 individuals with total weight of 330 g).

5.9.4 Bogue (BOG) in GSA 20

- ***Commercial data***

For this stock, no growth parameters have ever been reported from the Member State. Probably because of that, there are no discards at age for Bogue in catch file, although discards are reported in the discards at length file.

- ***MEDITS data***

In haul 103, year 1994 and in haul 49, year 2020 the number of individuals and the weights between TB and TC for Bogue are incompatible (see Table 5.9.1).

Table 5.9.4.1: TB and TC consistency as total weight and number reported, for Greece, GSA20, Bogue.

country	area	year	haul_number	totwgB	totnbB	totwgC	totnbC	wgratio	nbratio
GRC	20	1994	103	11100	292	11100	50.00000	1	5.840000
GRC	20	2020	49	4980	106	4980	47.78252	1	2.218385

Finally, the length of a Bogue individual in haul 41 in 2016 (50 mm) and one in haul 42 in 2019 (10 mm) are probably misreported and should be checked.

5.9.5 Bogue (BOG) in GSA 22

- ***Commercial data***

The quality check on these data didn't reveal any additional issues.

- ***MEDITS data***

In hauls 823, 825 and 861 in 2014, and in hauls 813, 823 and 825 in 2016 the number of individuals of Bogue and the weights between TB and TC are incompatible and should be checked (Table 5.9.5.1).

Table 5.9.5.1: TB and TC consistency as total weight and number reported, for Greece, GSA22, Bogue.

country	area	year	haul_number	totwgB	totnbB	totwgC	totnbC	wgratio	nbratio
GRC	22	2014	823	2035	34	2035	47.18841	1	0.720516
GRC	22	2014	825	9090	778	9090	497.37736	1	1.564205
GRC	22	2014	861	5430	118	5430	111.89091	1	1.054599
GRC	22	2016	813	9400	570	9400	440.62500	1	1.293617
GRC	22	2016	823	1280	20	1280	16.00000	1	1.250000
GRC	22	2016	825	4440	305	4440	242.81250	1	1.256113

Additionally, in haul 823, year 2018, the total weight of Bogue in TB and TC should be checked since it is probably misreported.

5.9.6 Bogue (BOG) in GSA 23

Commercial data

The quality check on these data didn't reveal any additional issues.

MEDITS data

In hauls 46 and 47 in 1994, and in hauls 40 and 51 in 2014 and in hauls 47 and 59 in year 2016 the number of individuals of Bogue and the weights between TB and TC are incompatible and should be checked (Table 5.9.2).

Table 5.9.6.1: TB and TC consistency as total weight and number reported, for Greece, GSA23, Bogue.

country	area	year	haul_number	totwgB	totnbB	totwgC	totnbC	wgratio	nbratio
GRC	23	1994	46	2050	105	2050	50.00000	1	2.100000
GRC	23	1994	47	3400	90	3400	50.00000	1	1.800000
GRC	23	2014	40	295	28	295	24.13636	1	1.160075
GRC	23	2014	51	510	28	510	24.48000	1	1.143791
GRC	23	2016	47	4940	211	4940	200.27027	1	1.053576
GRC	23	2016	59	12220	898	12220	745.89610	1	1.203921

Finally, in haul 40, year 2016 the length of an individual of Bogue with value 5mm should be checked.

*5.9.7 Giant red shrimp (ARS) in GSA 20**

No data available for ARS in GSA 20, except for 2017 that only total landings have been reported. Although, there are reported landings from 2014 to 2020 through the FDI data call.

MEDITS

No particular issues where identified in MEDITS data, although there are several missing years due to non implementation of DCF

Issues to be reported in DTMT

Country	Data requested	Issue	Issue type	Severity
GRC	landings	Landings only reported for 2017 although in FDI there are landings from 2014 - 2020	coverage	high
GRC	Landings	No landings at length	Coverage	high

Table 5.9.7.1: Items identified and noted in DTMT for Greece

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS_TA_TB_TC	GSA_20: Hauls 109 and 110 in 1994 don't have information in TB and TC (although they have in TA)	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_20_ARS. No landings at length	COVERAGE	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_20_ARS. Landings only reported for 2017 although in FDI there are landings from 2014 - 2020	COVERAGE	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23_BOG: In haul 40, year 2016 the length of an individual of Boops boops with value 5mm should be checked	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23_BOG: In hauls 46, 47 in year 1994, in hauls 40, 51 in year 2014 and in hauls 47, 59 in year 2016 the number of individuals and the weights between TB and TC for Boops boops are incompatible.	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_22_BOG: In hauls 823, 825 and 861 in 2014, and in hauls 813, 823 and 825 in 2016 the number of individuals and the weights between TB and TC are incompatible.	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_22_BOG: In haul 823, year 2018, the total weight of Boops boops in TB and TC should be checked.	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_20_BOG: In haul 42, year 2019 the length of an individual of Boops boops with value 10mm should be checked	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_20_BOG: In haul 41, year 2016 the length of an individual of Boops boops with value 50mm should be checked	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_20_BOG: In haul 103, year 1994 and in haul 49, year 2020 the number of individuals and the weights between TB and TC for Boops	QUALITY	LOW

						boops are incompatible.		
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_20_BOG: No growth parameters are provided for Boops boops	QUALITY	MEDIUM
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Catch at age	GSA_20_BOG: There are no discards at age for Boops boops in catch file, although they are reported in the discards file.	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23_CTC: In haul 52 in 2003 the total number of individuals in TB and TC for Sepia officinalis are incompatible	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23_CTC: In haul 53 in 2000 the number of individuals in TB and the sample weight in TC for Sepia officinalis should be checked and revised	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23: Haul numbers for the vessel NAU in 2020 are incompatible between TA and TB, TC.	QUALITY	MEDIUM
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_23_CTC: Haul 52 in 1994 does't have information in TB and TC (although it has in TA)	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Discards at length	GSA_23_CTC: In year 2014 total discards volume in GTR, second quarter is very high compared to other years	QUALITY	LOW
2021	Greece	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_23_CTC: No length-weight parameters have ever been provided	QUALITY	MEDIUM
2021	Greece	STECF EWG	Med and BS	EWG 22-03	MEDITS survey TA_TB_TC	GSA_22_CTC: In haul 824 in 2001 the length of a Sepia officinalis individual (255 mm) should be checked	QUALITY	LOW

5.10 Italy

Data quality checks on commercial data and survey have been conducted on Italian data as provided by the Member State through the Med&BS datacall), using the JRC data quality routines that were made available in this working group. The quality check includes European anchovy (ANE, Engraulis encrasicolus) in GSA 16 (section 5.10.1) and GSA 19 (section 5.10.2) as well as Blue and Red shrimp (ARA, Aristeus antennatus) in GSA 16 (section 5.10.3) and GSA 19 (section 5.10.4).

Based on the above the data quality issues that need to be checked and possibly revised by the Member State, are the summarized in the DTMT Table below.

The results of the data quality checks are presented in the following sections.

5.10.1 Anchovy Engraulis encrasicolus *(ANE) in GSA 16**

The issues that need clarification by the MS are given below.

GSA_16_ANE_Landings at length. Landings are missing for years 2002, 2003 and 2011.

GSA_16_ANE_Landings at length. A very high value of mean weight (1276.18) in 2006 metier PTM, quarter -1 should be checked. Year 2006, metier PS, quarter -1 should also be checked for a high value (87.86) and perhaps year 2020, metier PS quarter 4 (37.14).

GSA_16_ANE_Catch at age. 2011 is missing in landings at age.

GSA_16_ANE_Maturity at length. In some recent years (2016, 2017, 2020) the PRM appears elevated in the first length class.

GSA_16_ANE_Length weight relationships. 2017 should be checked as combined in higher than males and females.

GSA_16_ANE_ Landings length distributions. Very high numbers appear for PS_SPF and PTM_SPF in 2004 and 2005. A correction should be applied.

GSA_16_ANE_Hauls time series and positions. In 1996 a haul is missing from TC.

Regarding the Data Transmission Monitoring Tool (DTMT), all issues listed are related to Quality and the severity of the impact on the work of the EWG is Low for all of them. No recurrent issues are reported.

*5.10.2 Anchovy Engraulis encrasicolus (ANE) in GSA 19**

No issues that need clarifications by the MS are observed.

5.10.3 Blue and red shrimp Aristeus antennatus (ARA) in GSA 16

GSA_16_ARA_Landings at length. Mean weight in Year 2014, metier OTB, quarter 4 should be checked for a low value as well as 2016, metier MDD, quarter 4.

GSA_16_ARA_Growth parameters. The scale of 2019 plot should be checked. Linf should read 61.9 instead of 619.

GSA_16_ARA_Growth parameters. 2019 is problematic in combined sexes, separate plots are ok. The same growth function was used for both sexes which do not grow the same in this species.

GSA_16_ARA_ Landings length distributions. 2002 ,2003, 2005, 2006, 2007, 2008, 2017 and 2018 are completely missing, also 2012 (OTB_MDD). 2004 (OTB_DEMF) should be checked

Regarding the Data Transmission Monitoring Tool (DTMT), all issues listed are related to Quality and the severity of the impact on the work of the EWG is Low for most of them. No recurrent issues are reported.

5.10.4 Blue and red shrimp Aristeus antennatus (ARA) in GSA 19

Data Quality Checking

GSA_19_ARA_Landings at length. Landings are missing for years 2002.

GSA_19_ARA_Growth parameters. The same growth function was used for both sexes which do not grow the same in this species.

Regarding the Data Transmission Monitoring Tool (DTMT), all issues listed are related to Quality and the severity of the impact on the work of the EWG is Low for the majority of them. No recurrent issues are reported.

Table 5.10.4.1: Items identified and noted in DTMT for Italy.

Year	Country	End User	Data Call	Meeting	Data Requested	Issue	Issue Type	Severity
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_16_ARA. 2002, 2003, 2005, 2006, 2007, 2008, 2017 and 2018 are completely missing, also 2012 (OTB_MDD). 2004 (OTB_DEMF) should be checked	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_16_ANE_Length weight relationships. 2017 should be checked as combined in higher than males and females.	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at length	GSA_16_ANE_Maturity at length. In some recent years (2016, 2017, 2020) the PRM appears elevated in the first length class.	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_17_SVE. Although landings in weight are available in years 2019 and 2020 no associated length distributions have been provided.	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_17_SVE. No landings data available in years: 2002-2006, 2008, 2017-2018	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_18_SVE. Length frequencies distributions are available from 2009 to 2013; the others years are missing.	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_18_SVE. No landings data provided for years 2002, 2003 and 2019	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_18_ARS. Landings reported under gear GTR in 2003	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_18_ARS.Landings data are missing from year 2019	COVERAGE	LOW

2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_19_ARA. No landings data reported for 2002	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_18_ARA Same VBGF parameters reported for male and female. Based on the biology of the species is quite unrealistic that male growth as female. Please check	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_18_ARA. No landings data reported from 2002, 2003 and in 2019. Please check	COVERAGE	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_19_ARA. The same growth function have been provided for both sexes which do not growth the same in this species.	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_16_ARA_2019. The same growth function was used for both sexes which do not grow the same in this species	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Growth parameters	GSA_16_ARA. Linf values (year 2019 and combined sex) is not realistic having set VB units in cm	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_16_ARA_Mean weight in Year 2014, metier OTB, quarter 4 should be checked for a low value as well as 2016, metier MDD, quarter 4	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_16_ANE_Very high numbers appear for PS_SPF and PTM_SPF in 2004 and 2005. A correction should be applied.	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Catch	GSA_16_ANE_2011 is missing in landings at age	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Maturity ogive at	GSA_16_ANE. Age classes is wrong (600 years) in year 2019	QUALITY	LOW

					age			
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_16_ANE_A very high value of mean weight (1276.18) in 2006 metier PTM, quarter -1 should be checked. Year 2006, metier PS, quarter -1 should also be checked for a high value (87.86) and perhaps year 2020, metier PS quarter 4 (37.14).	QUALITY	LOW
2021	Italy	STECF EWG	Med and BS	EWG 22-03	Landings length	GSA_16_ANE_Landings are missing for years 2002, 2003 and 2011	QUALITY	LOW

5.11 Venus clam (SVE) in GSA 17 and 18 data preparation for assessment

5.11.1 Data checks

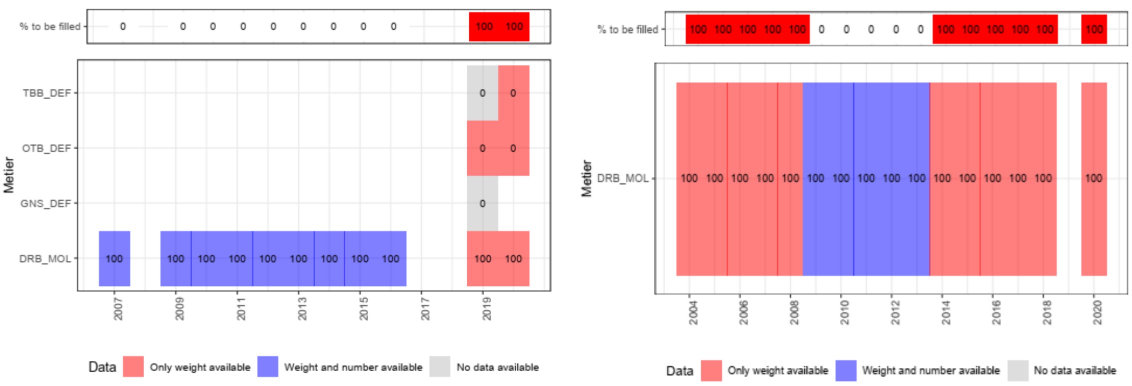
Data quality checks were performed on the available data sources from Italy, Slovenia and Croatia and have been provided in the corresponding subsections above.

5.11.2 Exploring for future assessments

Mean and median length showing same trend. No issues noted.

Cumulative landings length frequency distributions and Kolmogorov Smirnoff test without issues.

Stock parameterization was significantly compromised by short time series of available data, gaps between years, and missing or scarcity of biological and discard data, making this stock in this form not a suitable candidate for future stock assessment.



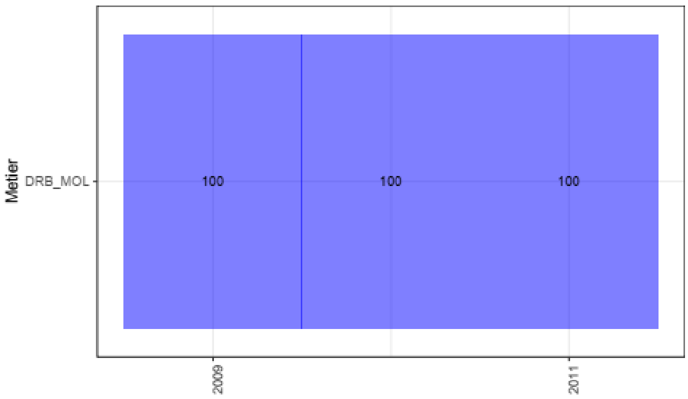


Figure 5.11.2.1: Missing length data to be filled in discards ITA GSA 18

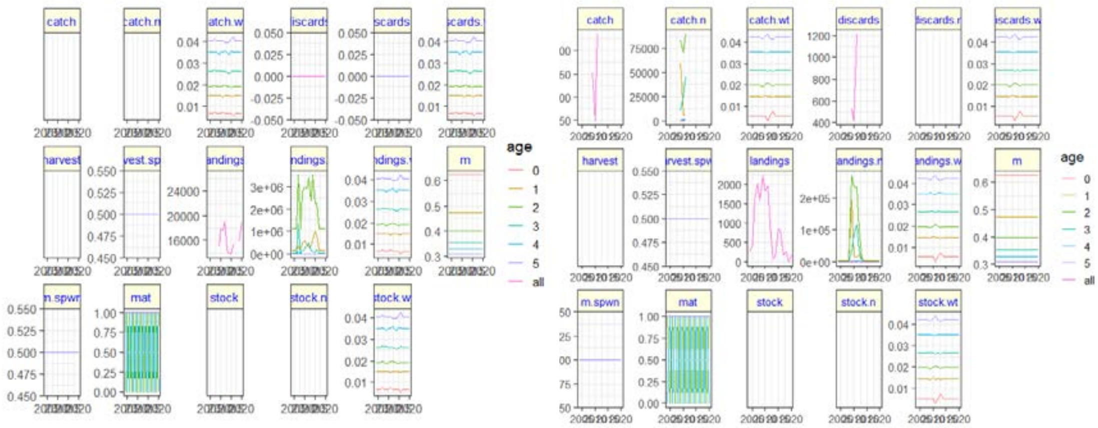


Figure 5.11.2.2: Stock data for SVE; A) ITA GSA 17; B) ITA GSA 18

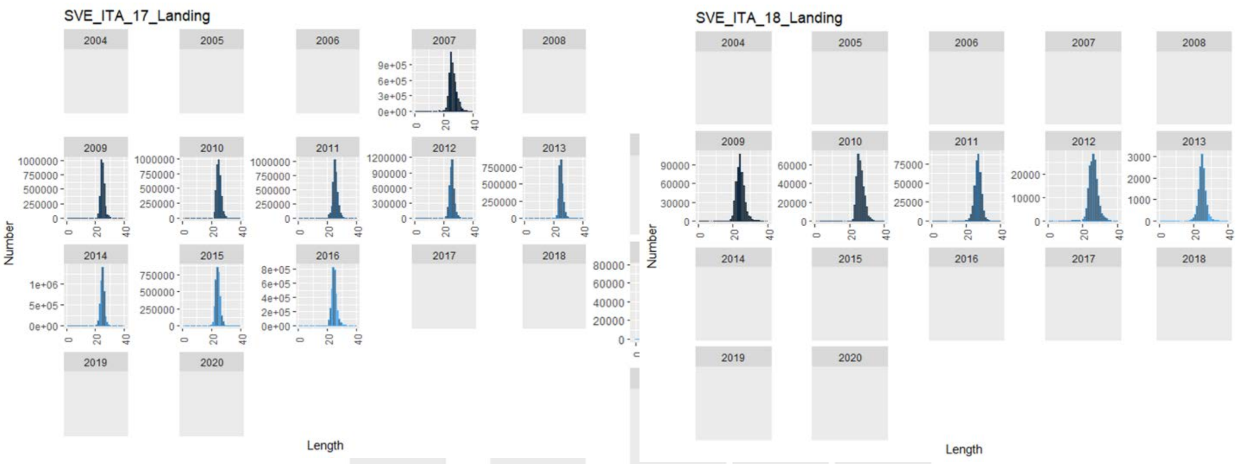


Figure 5.11.2.3: Length frequency distribution of SVE in landings: A) ITA GSA 17 and B) ITA GSA 18

Figure 5.11.2.4: Length frequency distribution of SVE in discards in ITA GSA 18

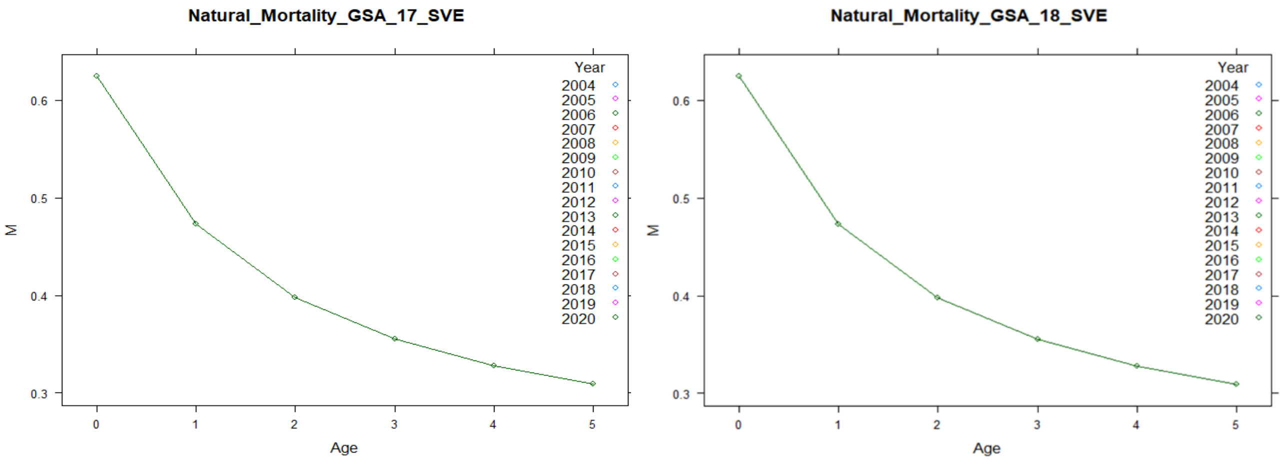


Figure 5.11.2.5: Natural mortality of SVE: A) ITA GSA 17 and B) ITA GSA 18

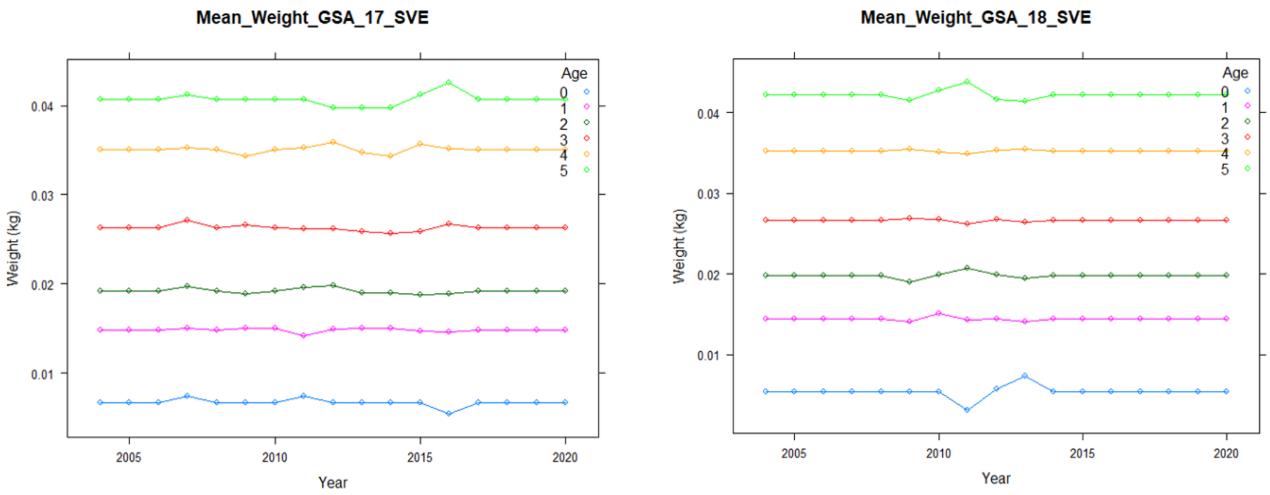


Figure 5.11.2.6: Mean weight of SVE: A) ITA GSA 17 and B) ITA GSA 18

HISTORICAL DATA

Table 5.11.2.1: FAO-GFCM. 2021. Fishery and Aquaculture Statistics

Country (Name)	Italy	Slovenia	Totals
[1970]	13622	0	13622
[1971]	9997	0	9997
[1972]	14598	0	14598
[1973]	9027	0	9027
[1974]	26695	0	26695
[1975]	48973	0	48973
[1976]	37167	0	37167
[1977]	11424	0	11424
[1978]	8976	0	8976
[1979]	20381	0	20381
[1980]	26041	0	26041
[1981]	18910	0	18910
[1982]	27231	0	27231
[1983]	34300	0	34300
[1984]	38126	0	38126
[1985]	24415	0	24415
[1986]	25034	0	25034
[1987]	34445	0	34445
[1988]	31751	0	31751
[1989]	28295	0	28295
[1990]	20060	0	20060
[1991]	25416	0	25416
[1992]	31434	0	31434
[1993]	24239	0	24239
[1994]	16528	0	16528
[1995]	29841	0	29841
[1996]	31769	0	31769
[1997]	25363	0	25363
[1998]	25343	0	25343
[1999]	33350	0	33350
[2000]	31583	0	31583
[2001]	32314	1	32315
[2002]	23651	1	23652
[2003]	38918	1	38919
[2004]	34848	1	34849
[2005]	14262	3	14265
[2006]	17401.3	0	17401.3
[2007]	26728.1	0	26728.1
[2008]	23277.9	0	23277.9
[2009]	14956.5	0	14956.5
[2010]	17831.5	0	17831.5
[2011]	17574.9	0	17574.9
[2012]	19019.6	0	19019.6
[2013]	14493	0	14493
[2014]	13984	0	13984
[2015]	13799.9	0	13799.9
[2016]	16222.8	0	16222.8
[2017]	11635.5	0	11635.5
[2018]	13707.8	0	13707.8
[2019]	15734.6	0	15734.6

5.12 Giant red shrimp (ARS) in GSAs 18, 19, 20

The three following sections summarize the main data issues by MS and GSA. The fourth section describes data preparation for stock assessment while the last section is a preliminary stock assessment run using a4a.

5.12.1 Data preparation for Stock assessment

An updated data set for GSAs 18 and 19 was provided to the STECF EWG 22 – 03. The data set contained the missing information for the year 2019 for GSA 18. No other differences between the data reported to the DCF and the data provided during the EWG were detected and the group decided to use the updated data set.

GSA 18

In the case of data provided there were questions regarding data for 2019 revised information provided by MS country during the meeting there are now no missing information on total landings in 2019

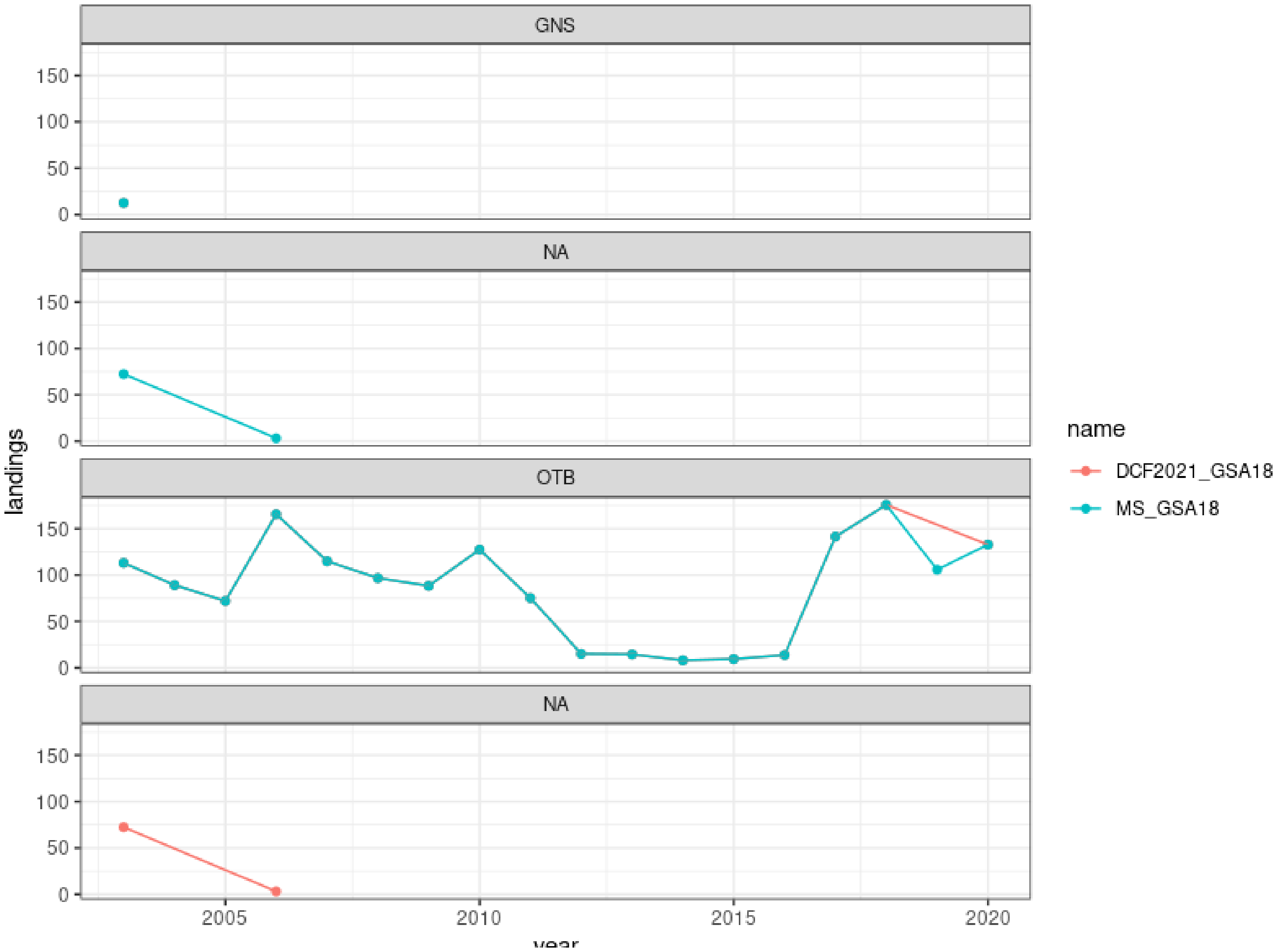


Figure 5.12.1.1: Landings provided through DCF (blue line) and landings provided by MS country during the EWG. Additional information for total landings in 2019 were provided from MS.

GSA 19

In the case of GSA 19 there are no differences in data reported for total landings between DCF 2021 data call and the data provided during the EWG.

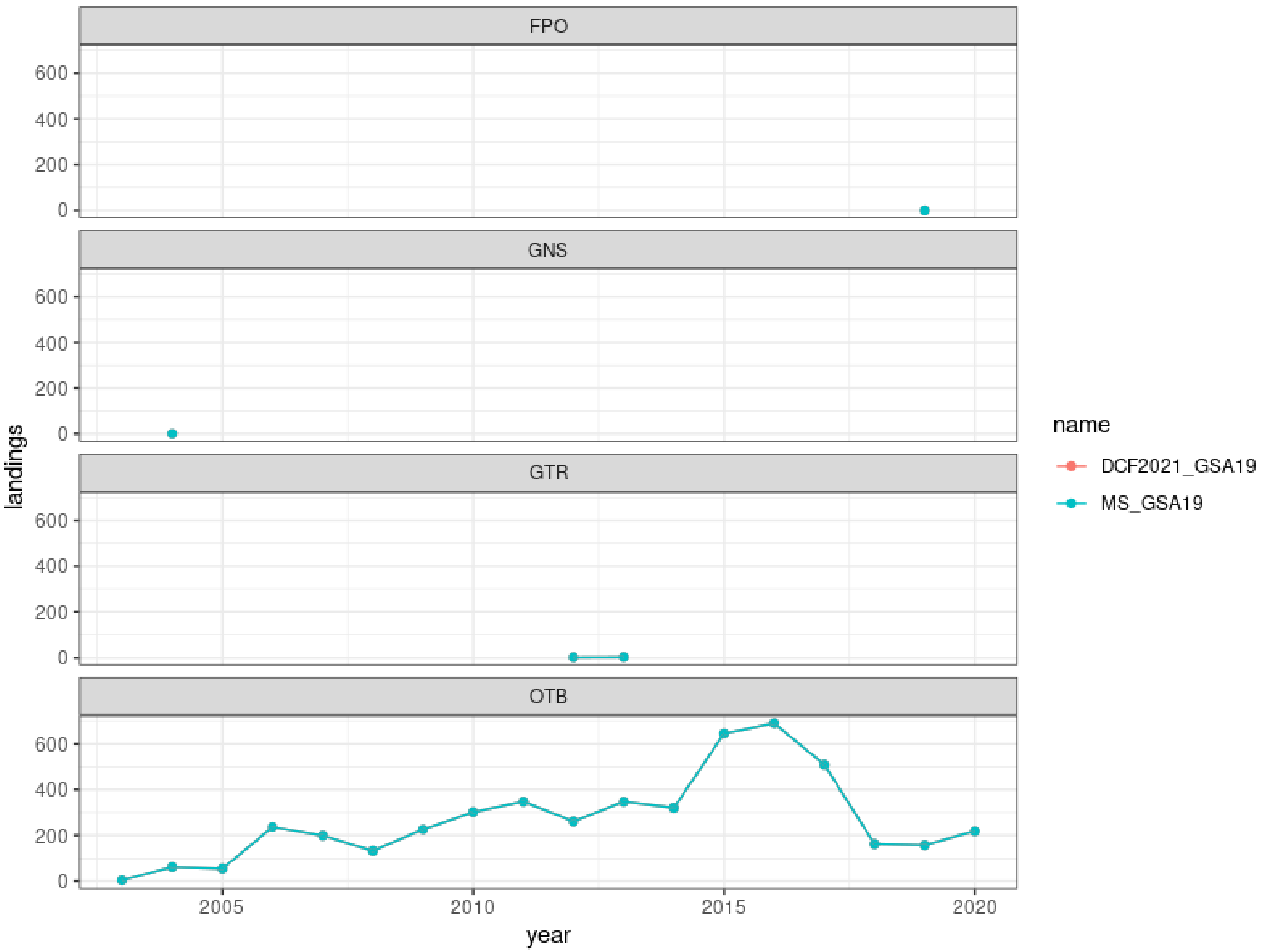


Figure 5.12.1.2: Landings provided through DCF (blue line) and landings provided by MS country during the EWG. No differences detected between the two data sets.

GSA 20

DCF data for landings were not available for Giant red shrimp for GSA 20. The information available was landings for year 2017. The EWG decided to use the landings available in the FDI data call as shown in figure below.

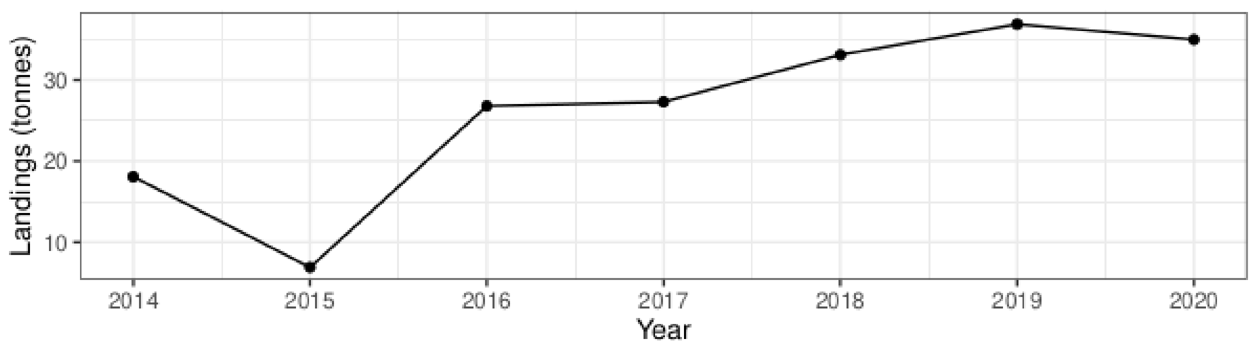


Figure 5.12.1.3: Landings provided through FDI for Greece, GSA 20.

Discards

Very few and sparse information on discards was available from DCF. The EWG decided that the discards for this species can be considered negligible and will not be used for the purposes of an assessment.

Length frequency distributions

For GSA 18 the missing years were from 2003 to 2008, for GSA 19 from 2005 – 2007 and there was no information for length frequency distribution for GSA 20. For the needs of stock assessment, it was decided to use the LFD from GSA 19 for the years 2003, 2004 and 2008 for all the areas, while for the common missing years 2005 – 2007, no reconstruction was decided (Figures 5.12.4.4 – 5.12.4.6)

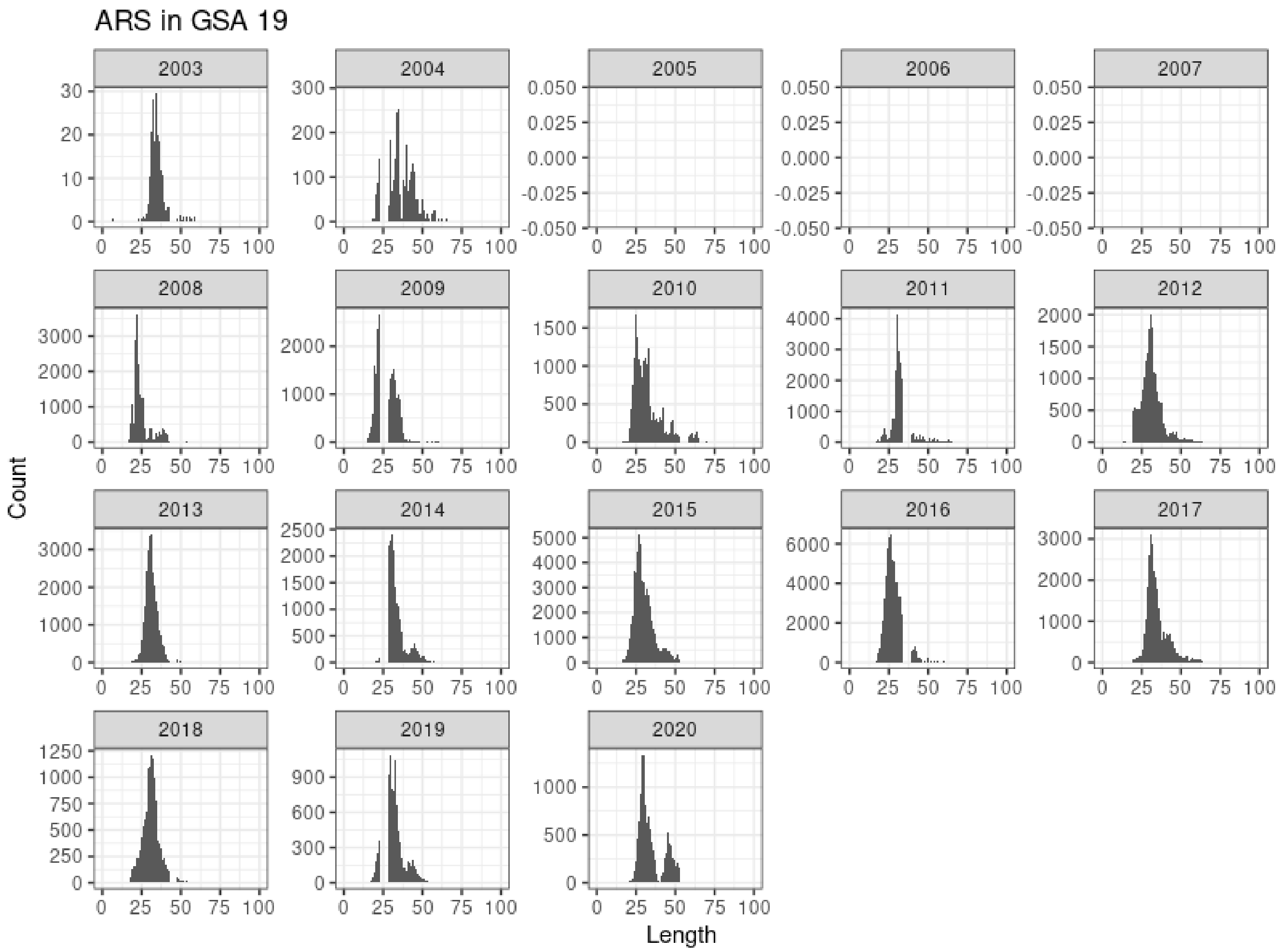


Figure 5.12.1.4: Length frequency distribution in GSA 19.

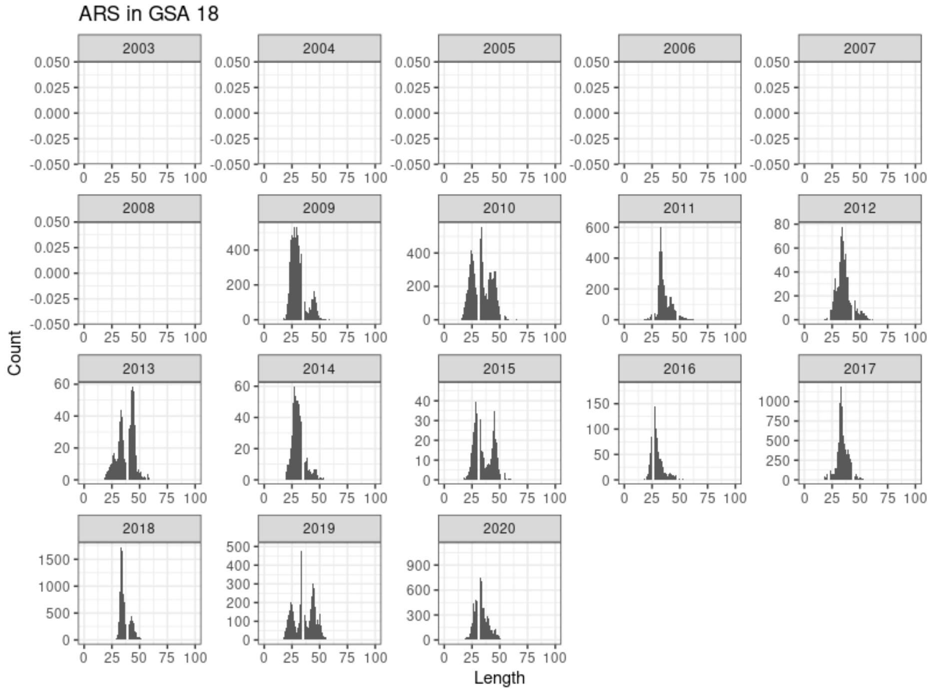


Figure 5.12.1.5: Length frequency distribution in GSA 18.

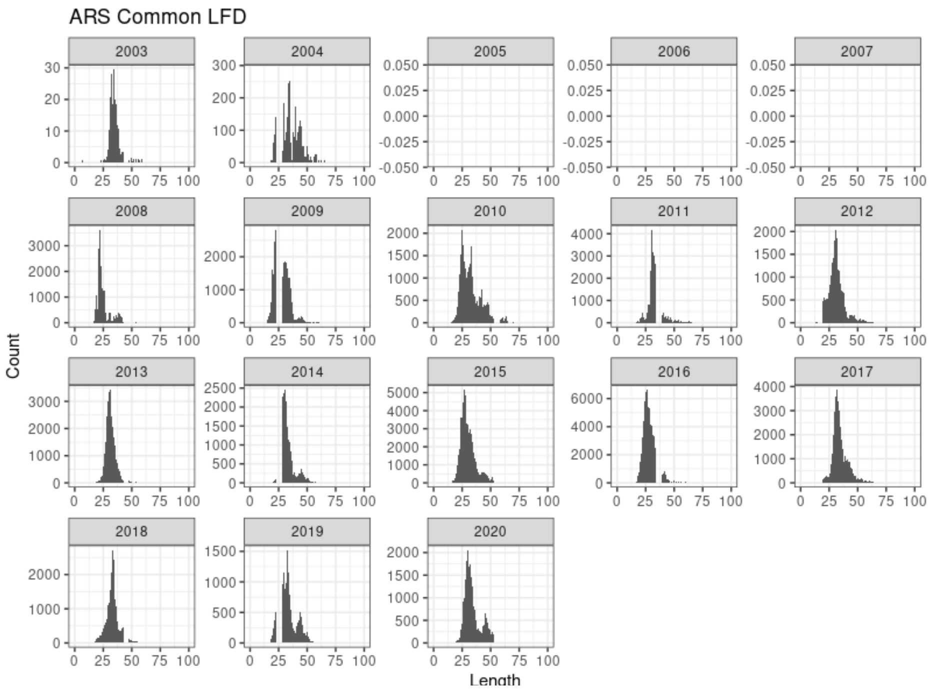


Figure 5.12.1.6: Combined length frequency distribution for GSAs 18, 19, 20

MEDITS GSA 18 – 19 – 20

Regarding the tuning index that will be used for the stock assessment an exploration was performed to investigate the effect of missing years from Greece on the abundance index. In particular, for the truncated time series of MEDITS needed for the assessment (2003 – 2020), Greece is missing 2007, 2009 – 2013, 2015 and 2017. The group decided to include all countries: Albania, Italy, Greece and Italy in a combined MEDITS index.

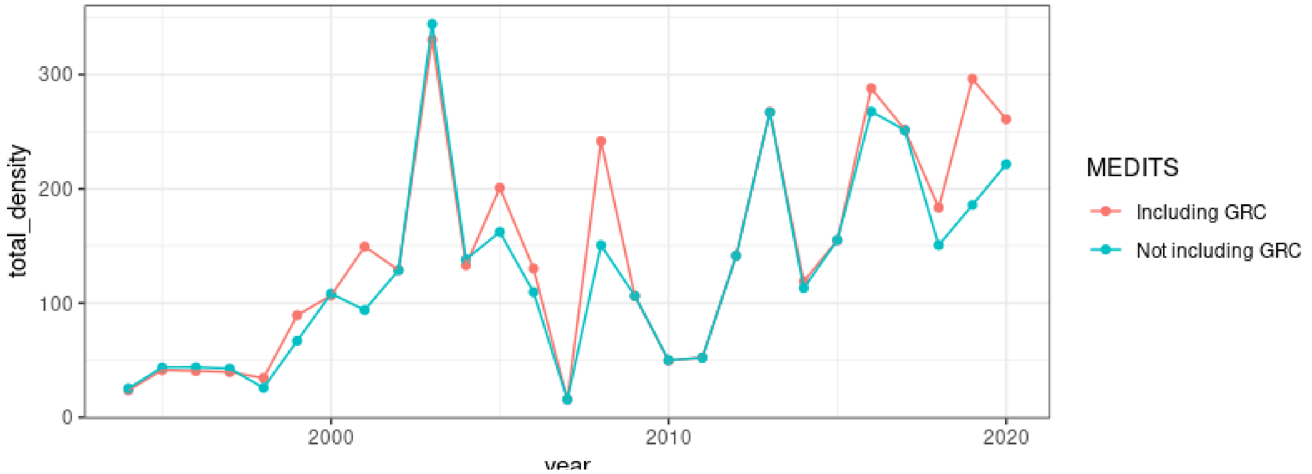


Figure 5.12.1.7: MEDITS biomass index for GSA 18, 19, 20

In Figure 5.12.1.7: MEDITS biomass index for GSA 18, 19, 20a comparison between the abundance index including and not including is presented.

In the Figure 5.12.1.8– Figure 5.12.1.9 the produced biomass and abundance indices are presented as well as the corresponding length frequency distribution.

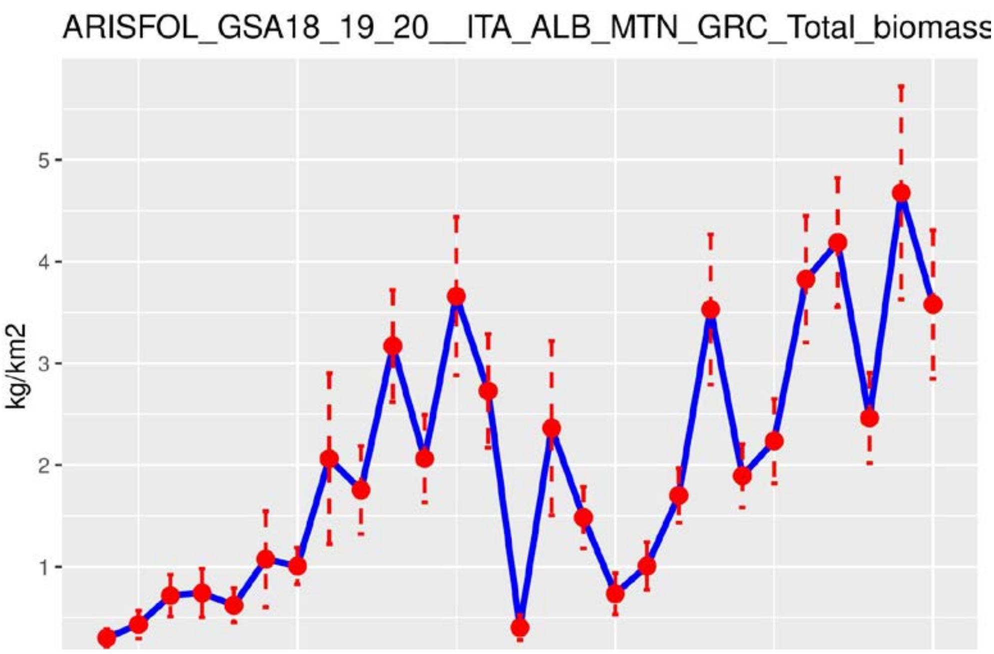


Figure 5.12.1.8: Comparison of MEDITS abundance index including Greece and not including Greece.

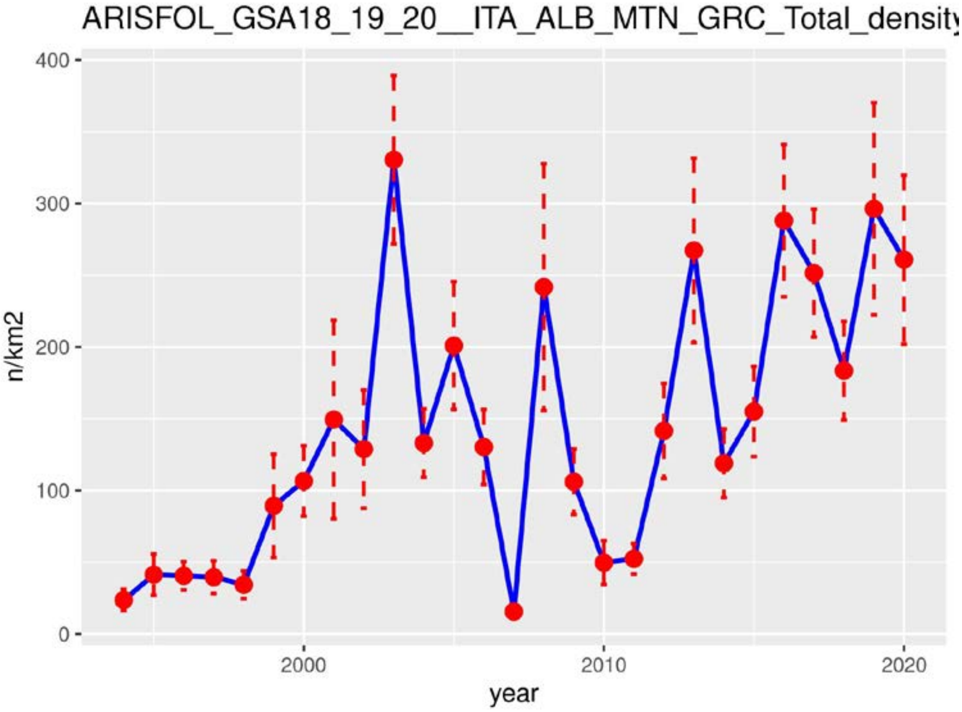


Figure 5.12.1.10: MEDITS abundance index for GSA 18, 19, 20.

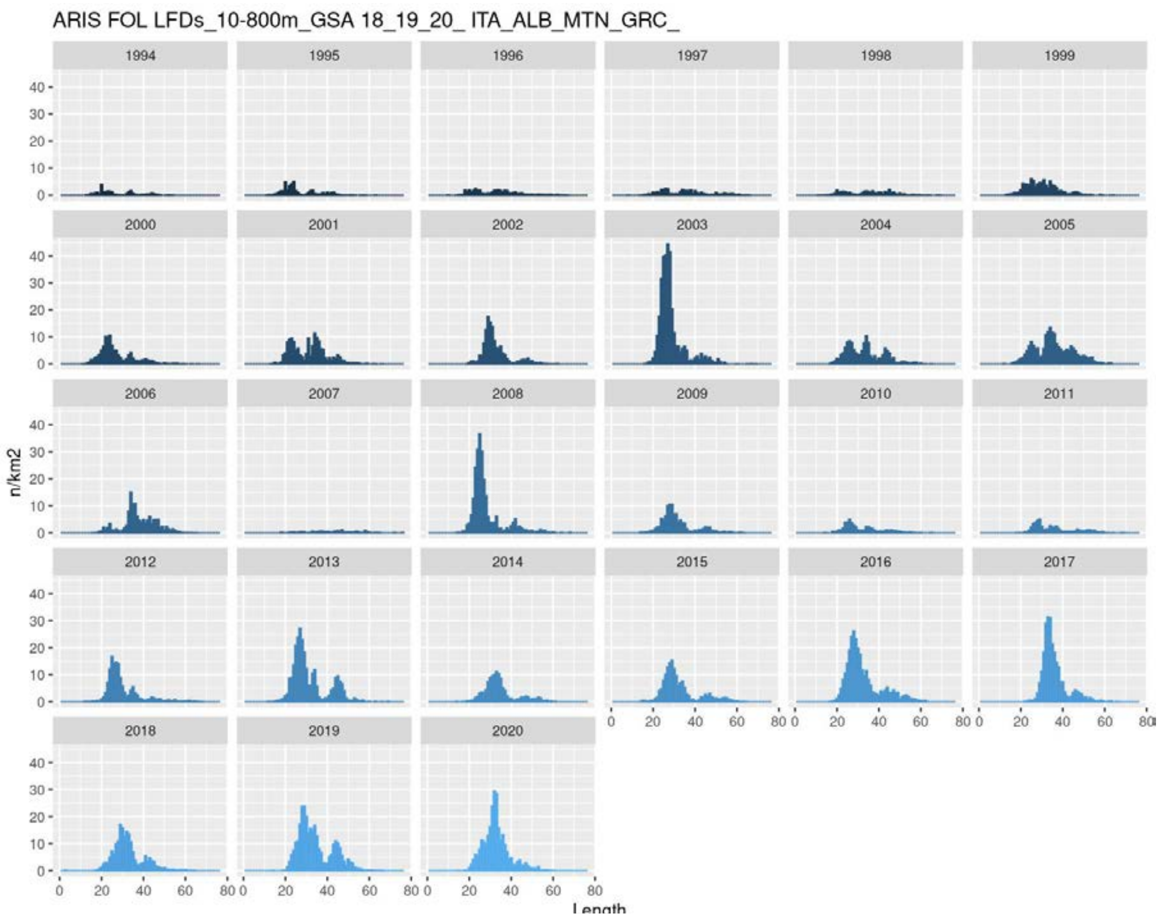


Figure 5.12.1.9 MEDITS length frequency distribution of the index for GSA 18, 19, 20.

Growth parameters

The growth parameters for the Giant red shrimp were provided through the DCF and they were common for GSAs 18 and 19. For GSA 20 no growth parameters were provided and the EWG decided to use the ones from GSA 18 and 19. The growth parameters were provided by sex and it was noted that these species exhibits a strong sexual dimorphism. Table 5.12.4.1 summarizes the values of VBGF.

Table 5.12.1.1: VBGF parameters for males and females.

		Linf	k	t0
VBGF parameters	Males	53	0.36	-0.1
	Females	73	0.438	-0.1

Giant red shrimp spawns during the summer (June – July), thus it was decided to add a correction of 0.5 to the t_0. The following figures demonstrate the exploration of the addition of 0.5 to the $t_0$through the MEDITS length frequency distributions for both males and females.

Figure 5.12.1.11 shows the different growth curves with and without t_0 correction, it also shows the lengths at which transition occurs between age 0 to 1 and age 1 to 2.

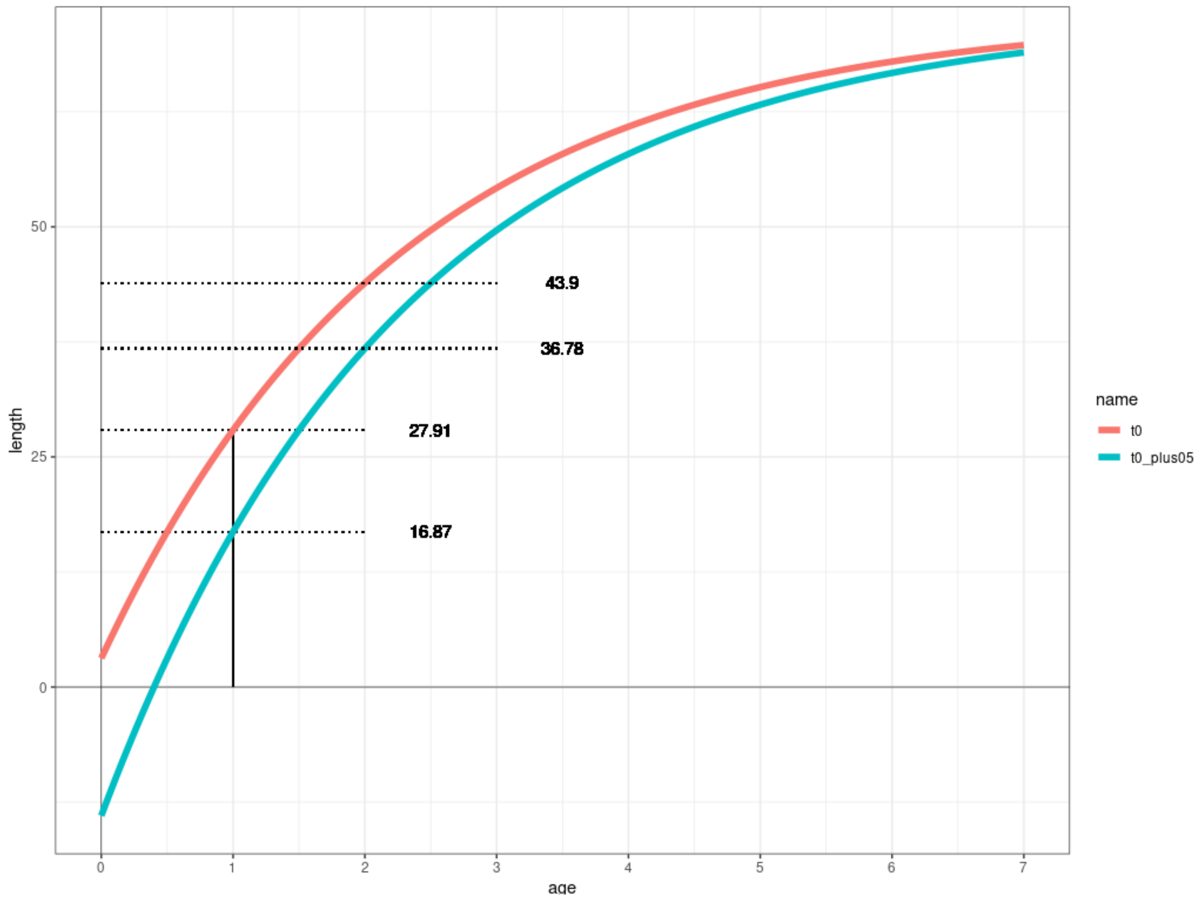


Figure 5.12.1.11: VBGC with and without t0 correction for females with the lengths at transition between age 0-1and 1-2.

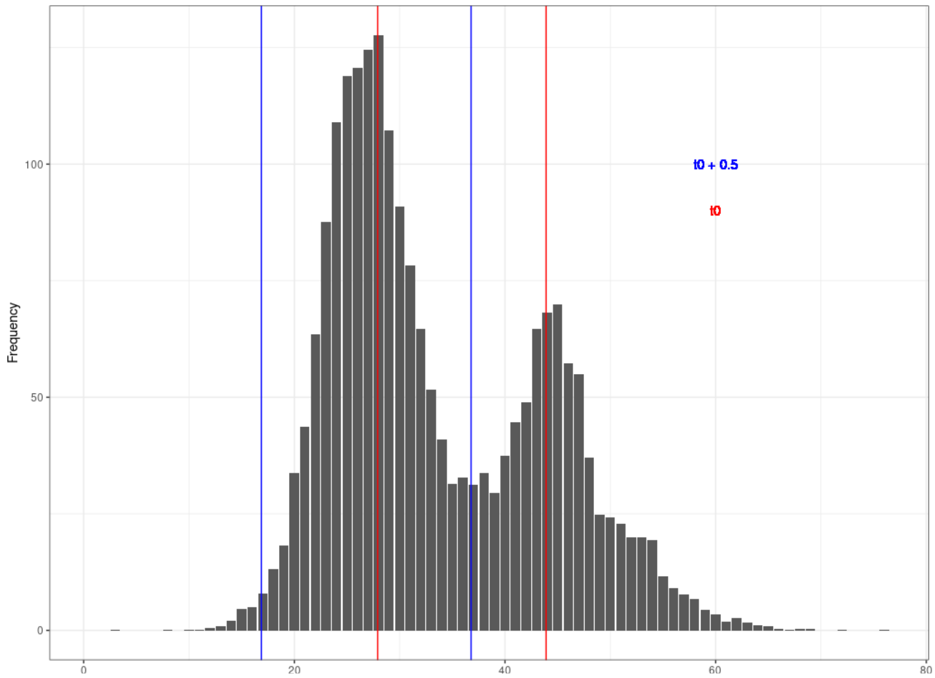


Figure 5.12.1.12: Aggregated length frequency distribution of females in the MEDITS survey from 1994 - 2020. The vertical lines show the lengths that correspond to transition between age 0-1 and 1-2. Blue with t0 correction and red without.

Similar investigation was performed for the male component of MEDITS:

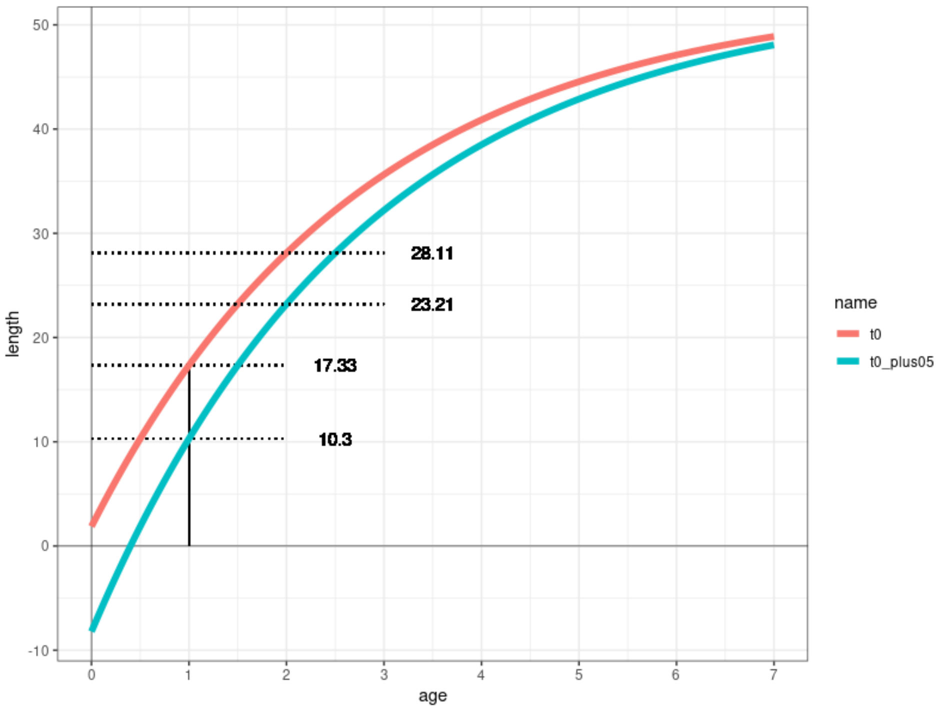


Figure 5.12.1.13: VBGC with and without t0 correction for males with the lengths at transition between age 0-1and 1-2.

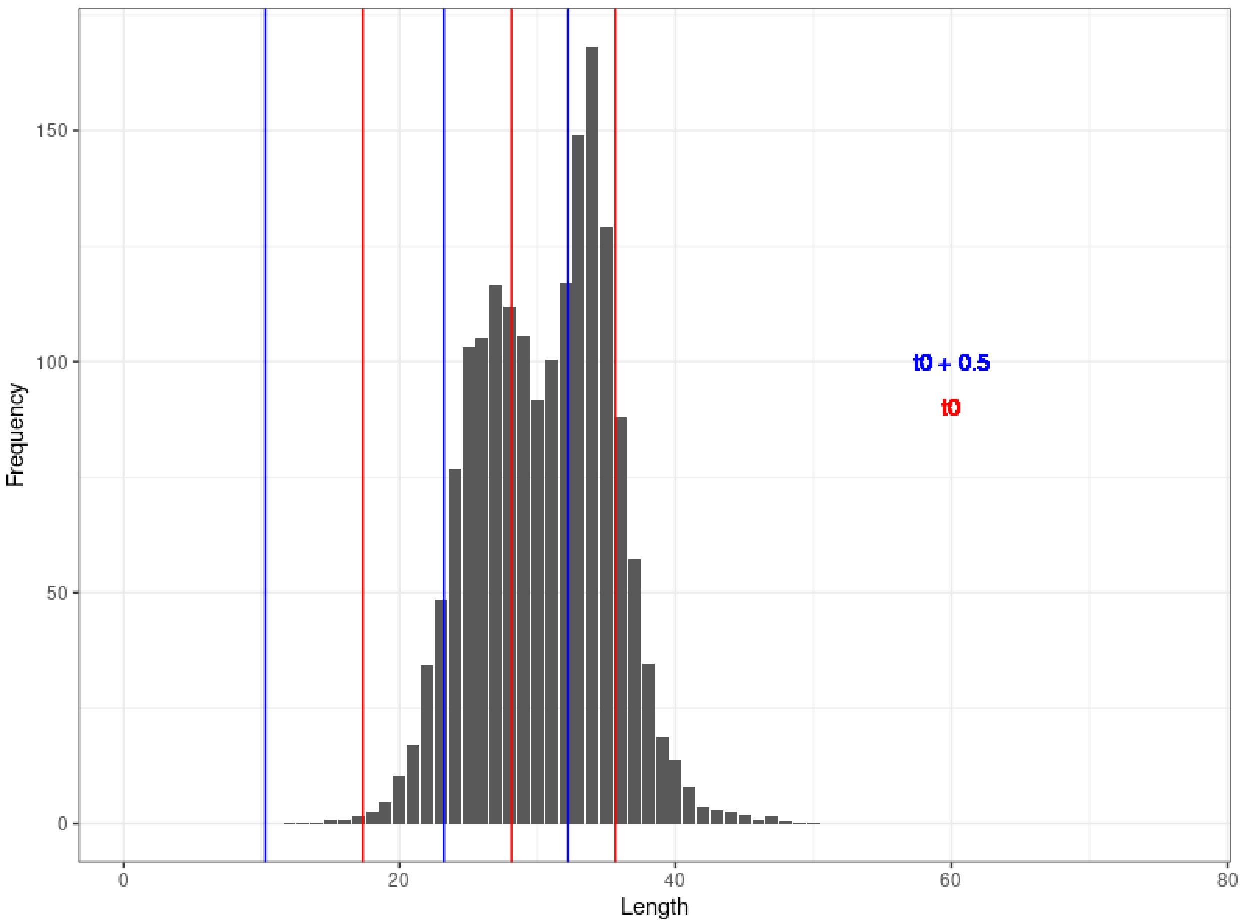


Figure 5.12.1.14: Aggregated length frequency distribution of males in the MEDITS survey from 1994 - 2020. The vertical lines show the lengths that correspond to transition between age 0-1, 1-2 and 2-3. Blue with t0 correction and red without.

The group decided to perform the age slicing using the t0 correction, to account for the spawning in the middle of the year. The following figures show the age composition of MEDITS index by sex and combined along with the cohorts consistency in each case. The differences between the age composition between males and females illustrates also differences in the fishery selection pattern, which will affect the assessment and suggests that probably a sex separated model should be used to estimate the status of the stock.

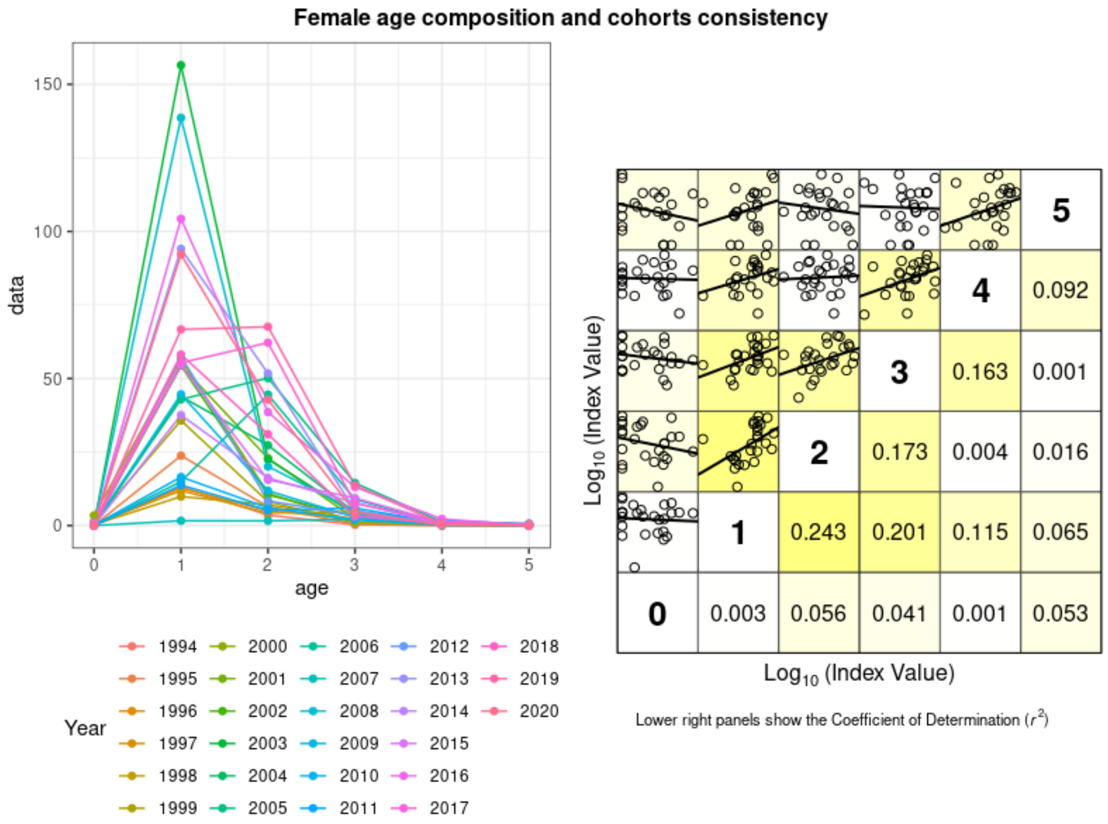


Figure 5.12.1.16: Female age composition by year and cohorts consistency

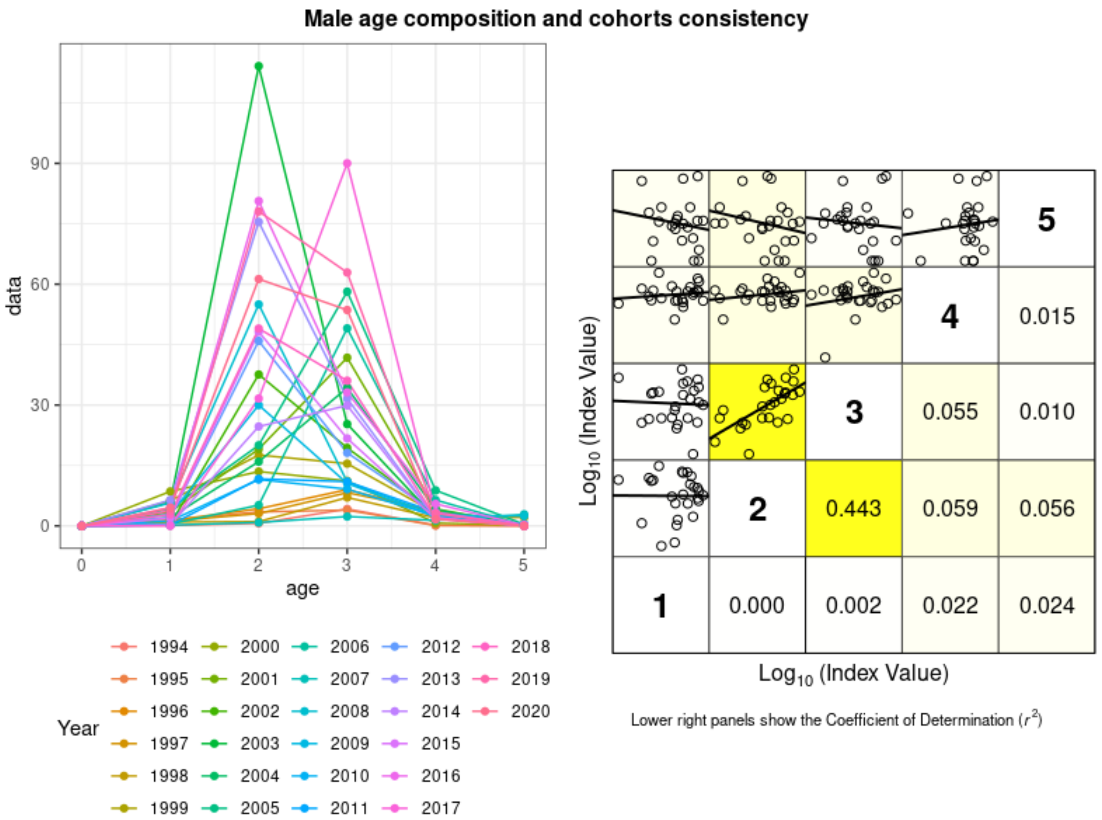


Figure 5.12.1.15: Male age composition by year and cohorts consistency

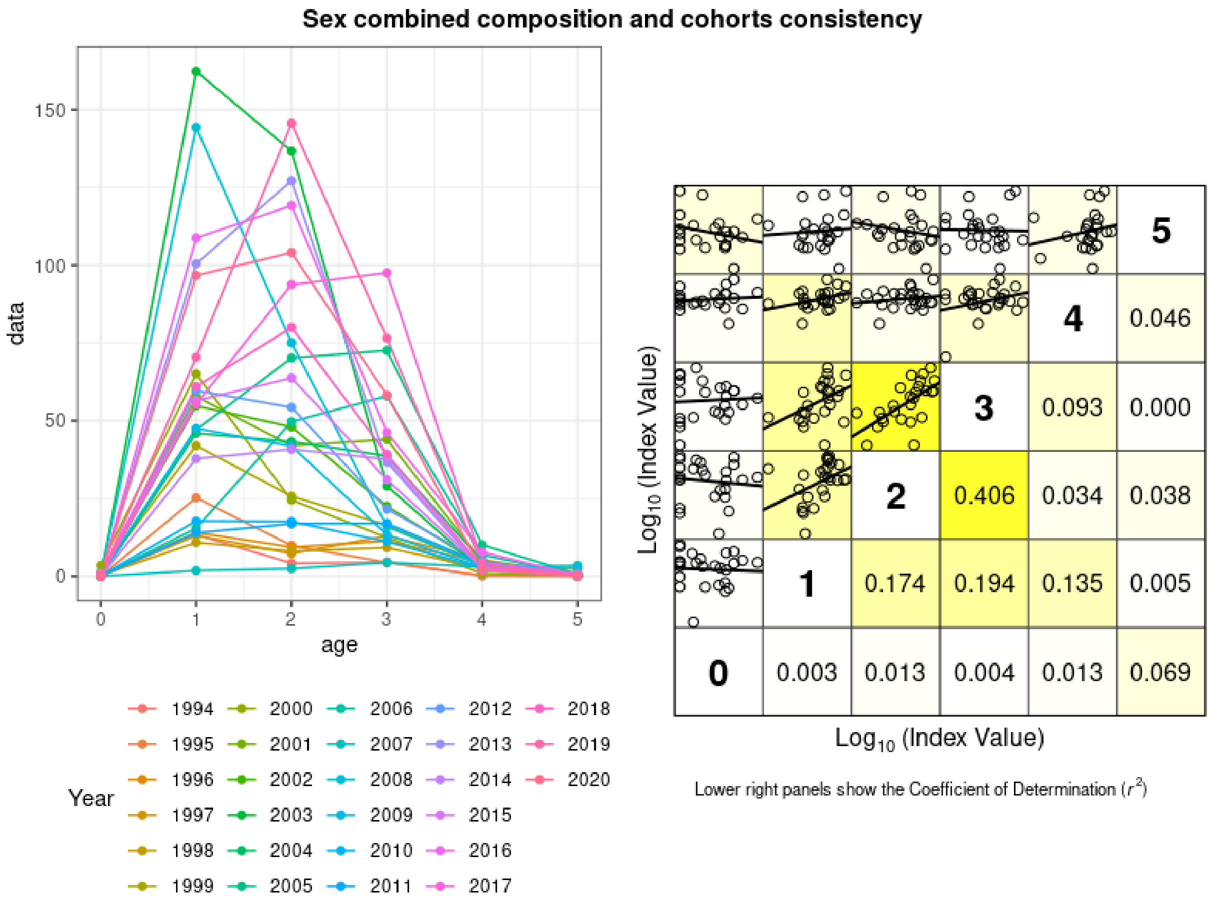


Figure 5.12.1.17: Sex combined age composition by year and cohorts consistency.

Catch length frequency distribution slicing

Sex ratio by length was used to split landings data by sex for areas GSA 18 and GSA 19, for GSA 20 no landings by length provided. The following figures show the obtained length frequency distributions by sex, the age composition after length slicing, by sex and combined and the cohorts consistency.

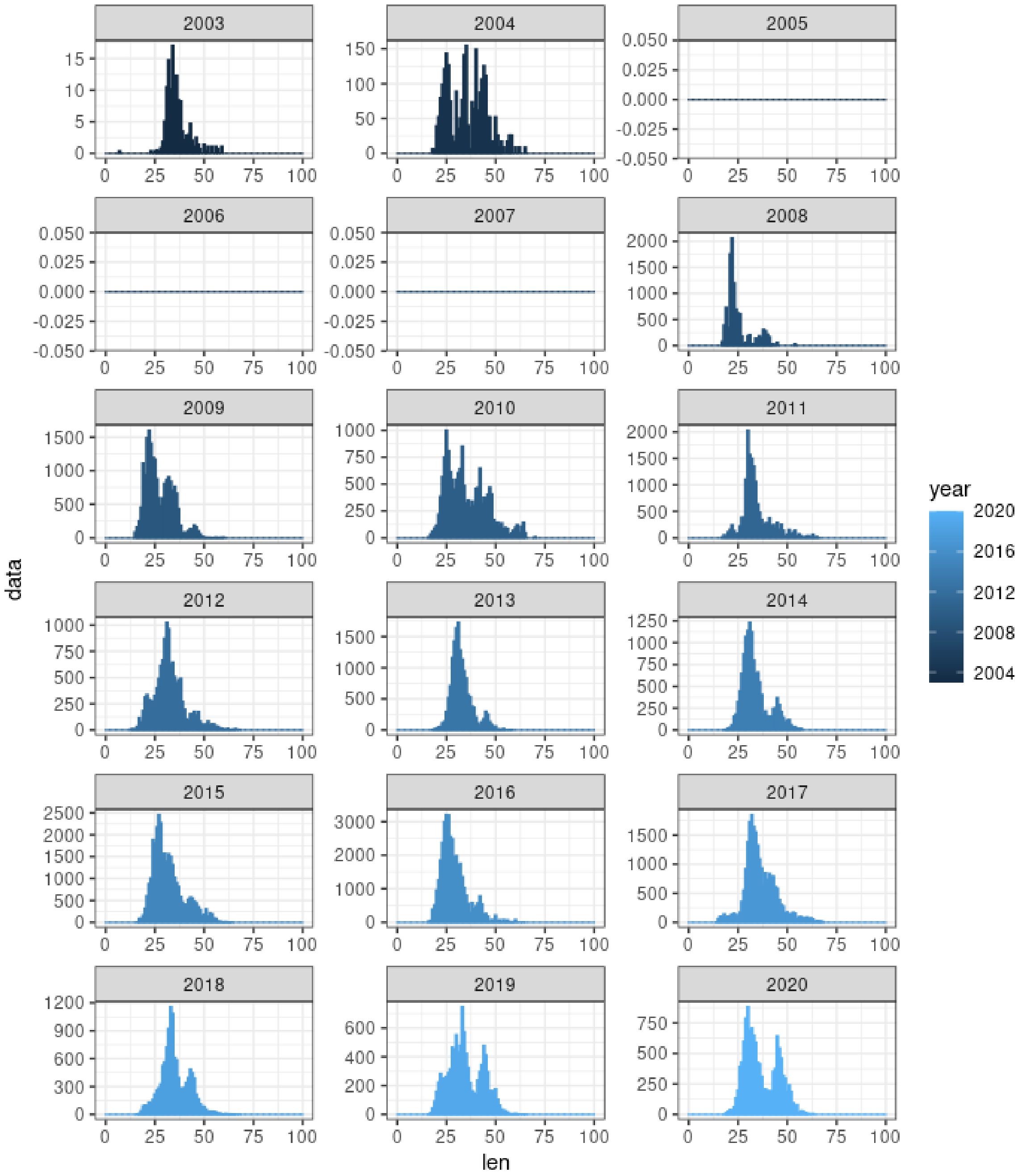


Figure 5.12.1.18: Female landings length frequency distribution.

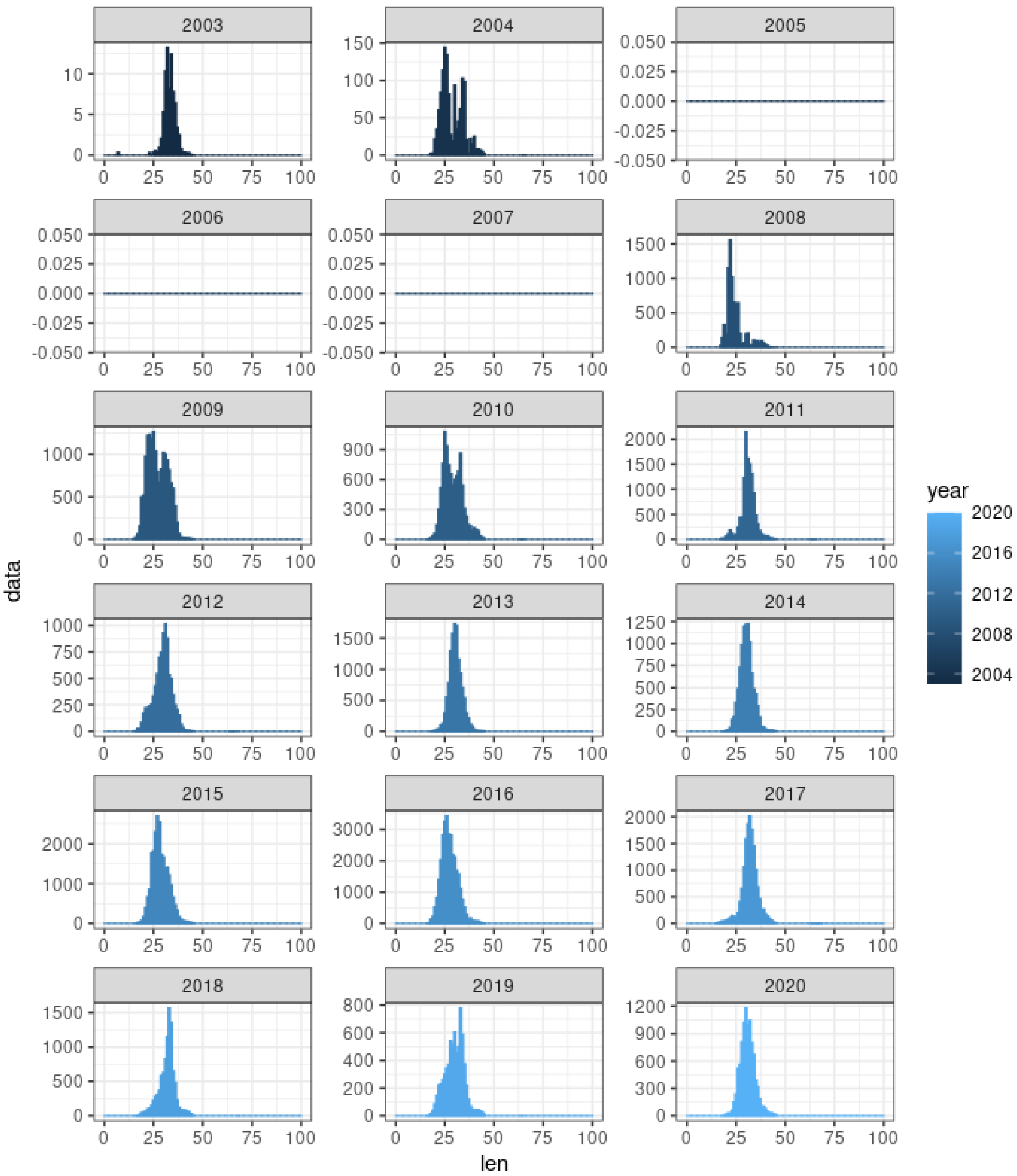


Figure 5.12.1.19: Male landings length frequency distribution.

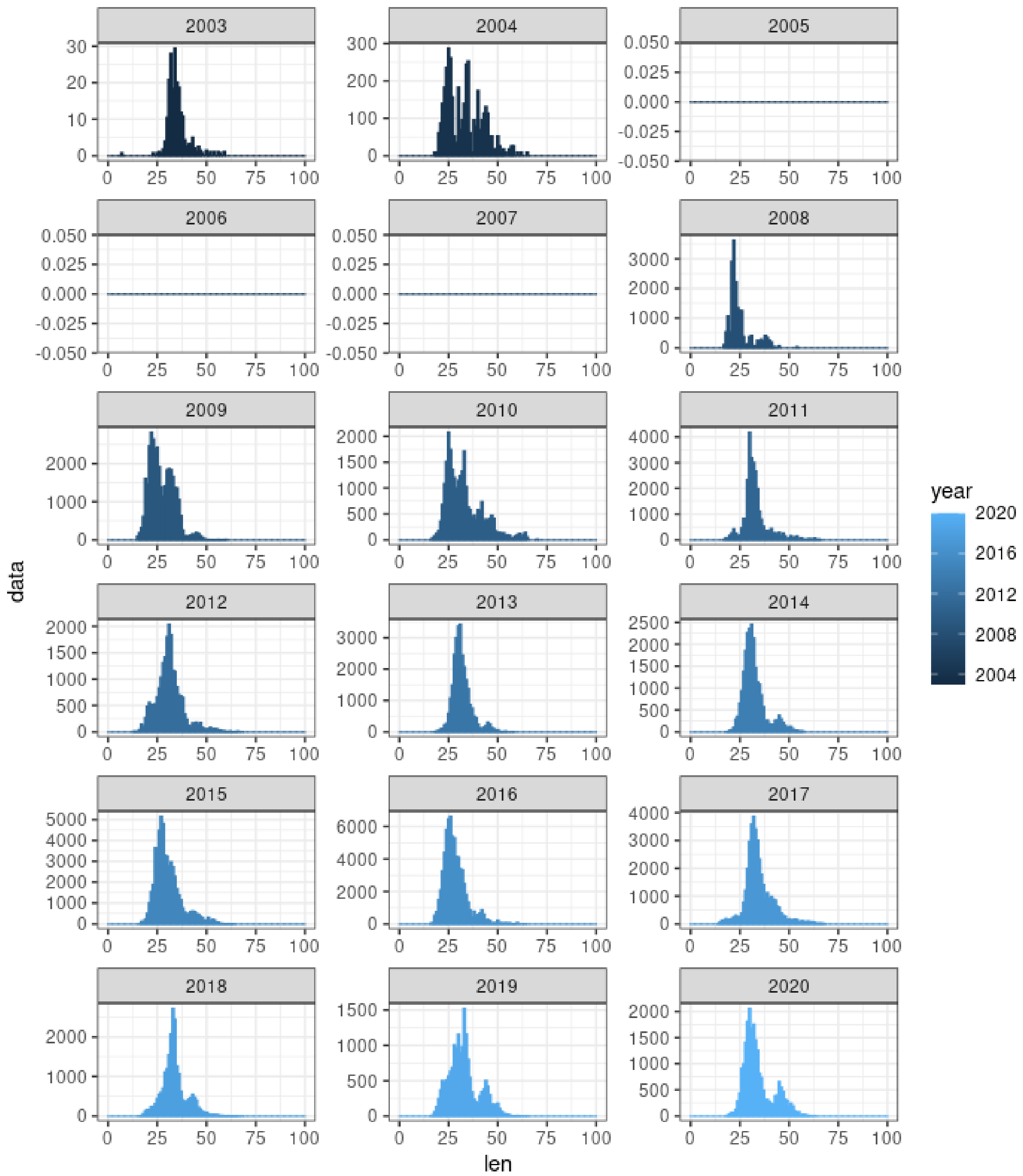


Figure 5.12.1.20: Sex combined landings length frequency distribution.

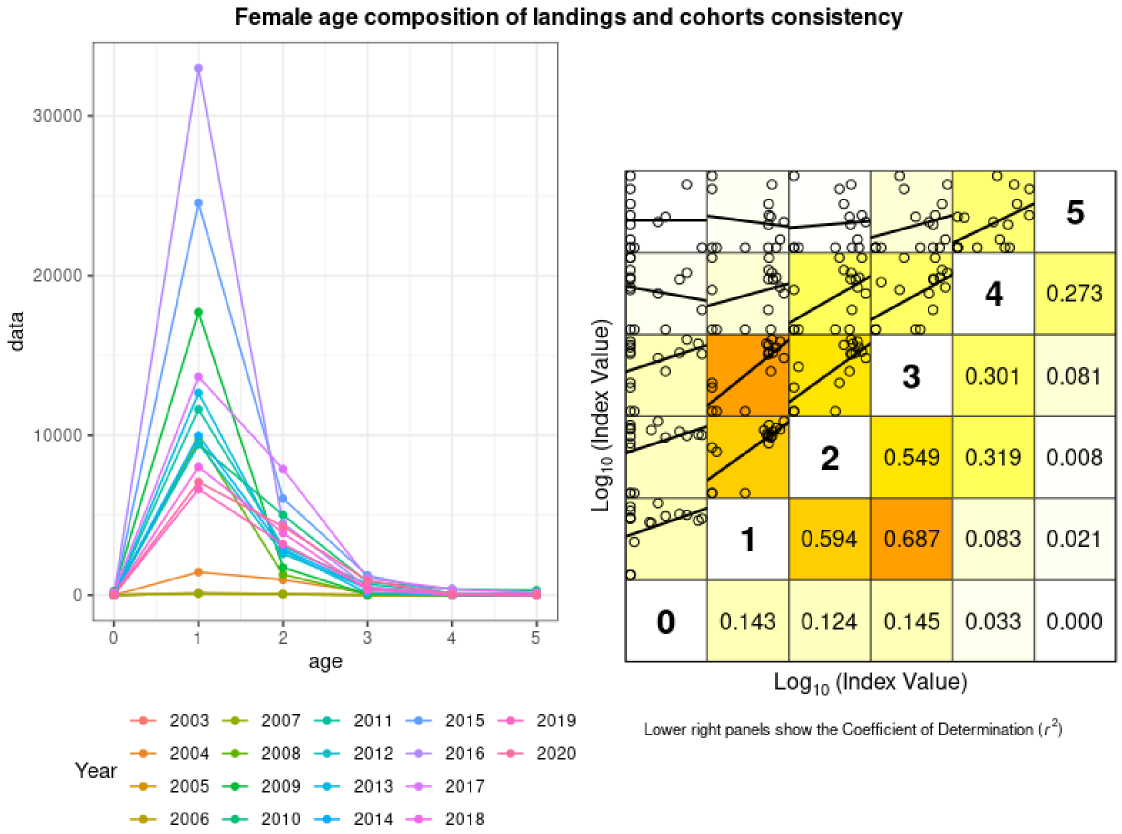


Figure 5.12.1.21:Female age composition and cohorts consistency.

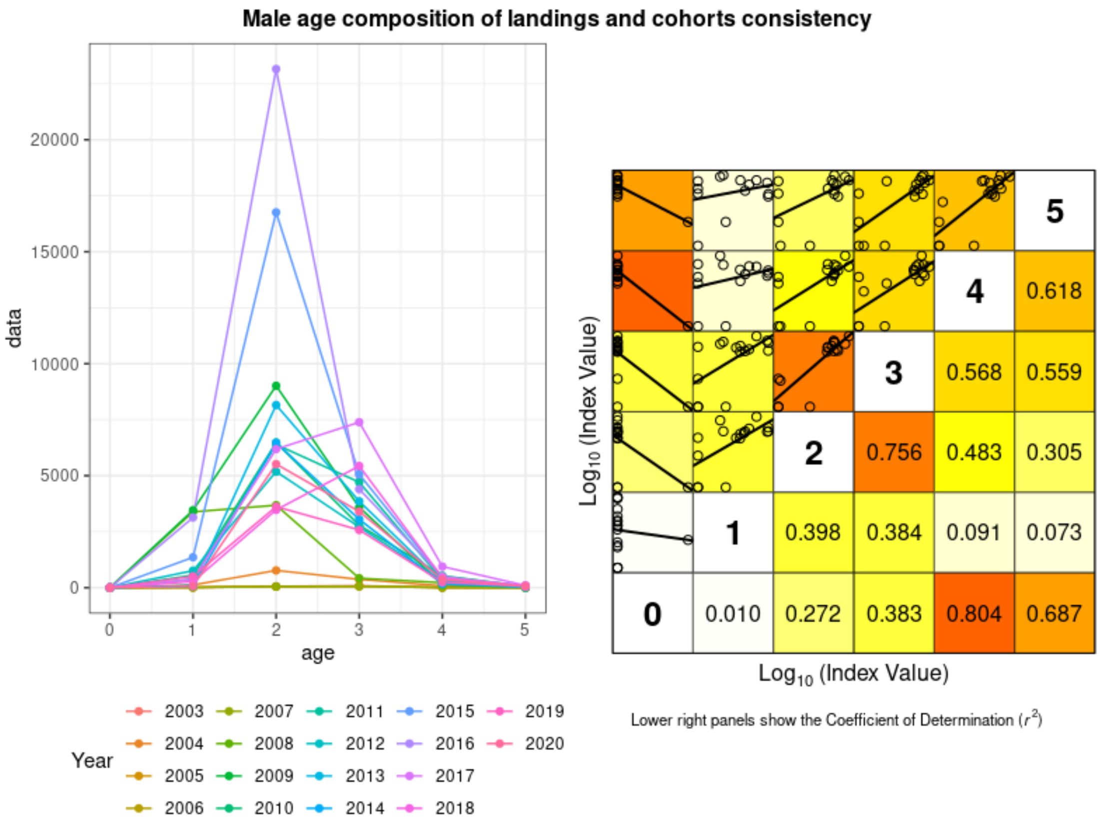


Figure 5.12.1.22: Male age composition and cohorts consistency.

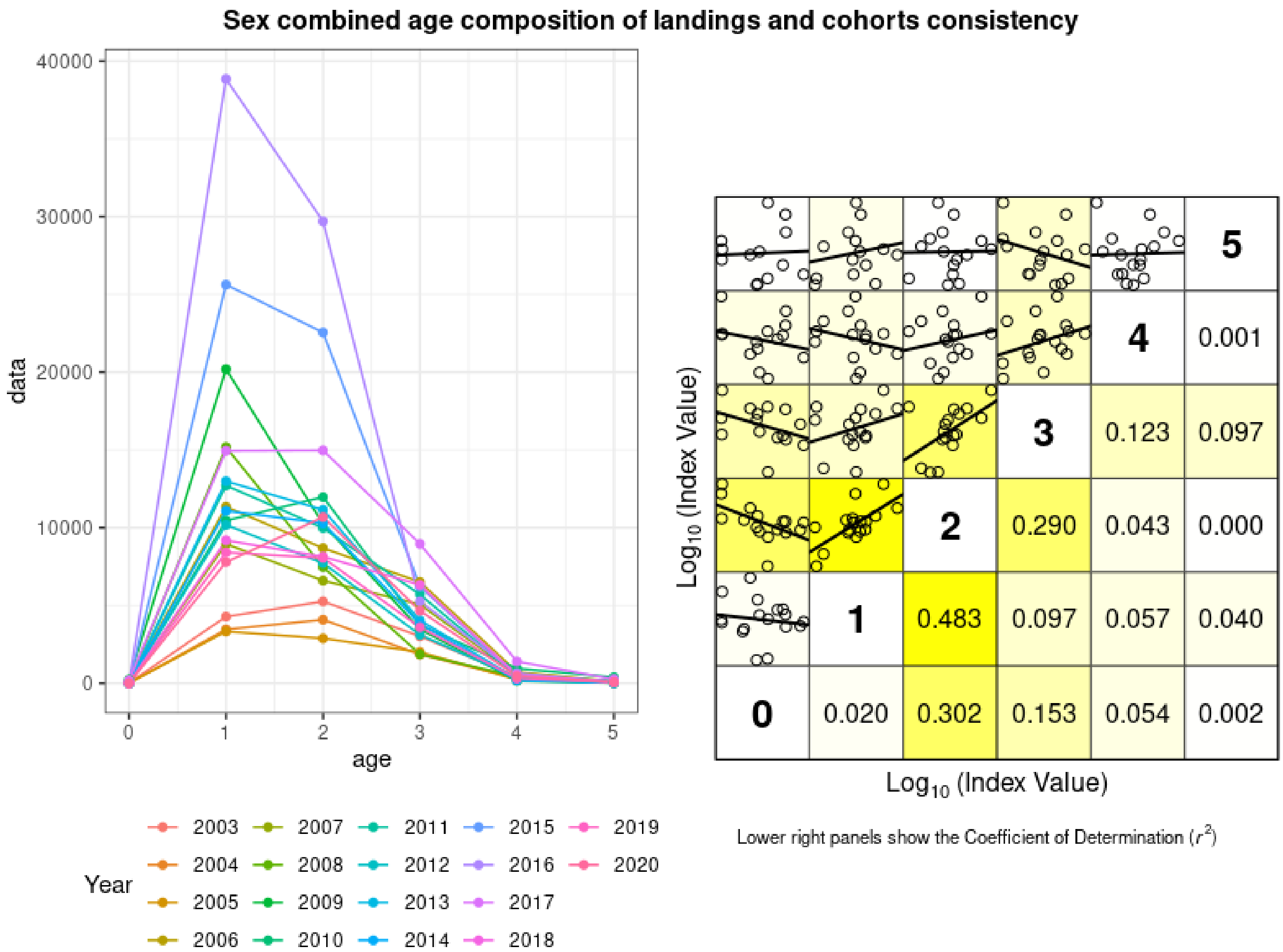


Figure 5.12.1.23: Stock age composition and cohorts consistency

JRC's script for preparing stock object calculates mean weight by age for the sex combined stock object using a weighted mean between mean weight at age for females and males, weighted by numbers for each sex. The large differences of the age distribution between sexes results in large variability in mean weight at age along the years, this might have some implications on the stock assessment (seeFigure 5.12.1.24: Mean weight at age of the stock object). In a future assessment it might be useful to smooth mean weight at age around an average across years.

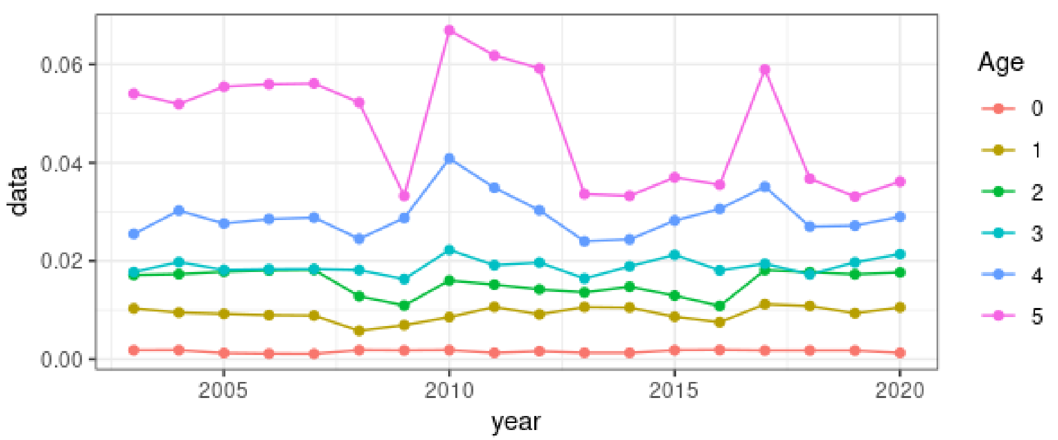


Figure 5.12.1.24: Mean weight at age of the stock object

5.12.5 Preliminary assessment

A preliminary assessment was attempted for Giant red shrimps in areas GSA 18, 19 and 20 using a4a. The following figures summarize these results. A simple separable model described in the table below was used. Natural mortality was calculated using Chen and Watannabe formula and Fbar was set from age 1 to 3.

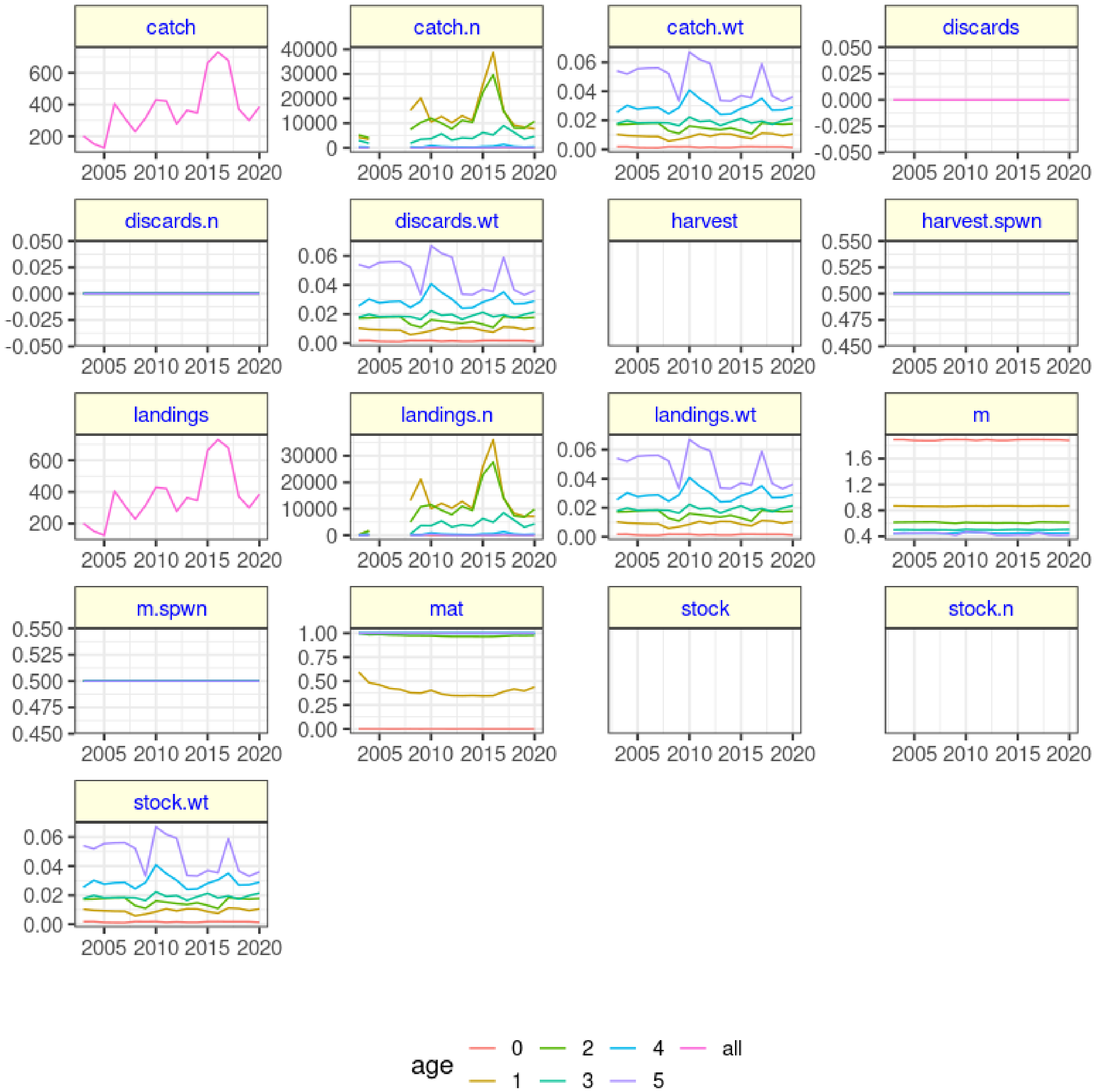


Figure 5.12.1.25: Summary of the stock object.

Table 5.12.1.2: Submodel formulation of the a4a model.

Submodel	
fmodel	~factor(age) + s(year, k = 10)
qmodel	~factor(age)
srmodel	~geomean(CV=0.2)

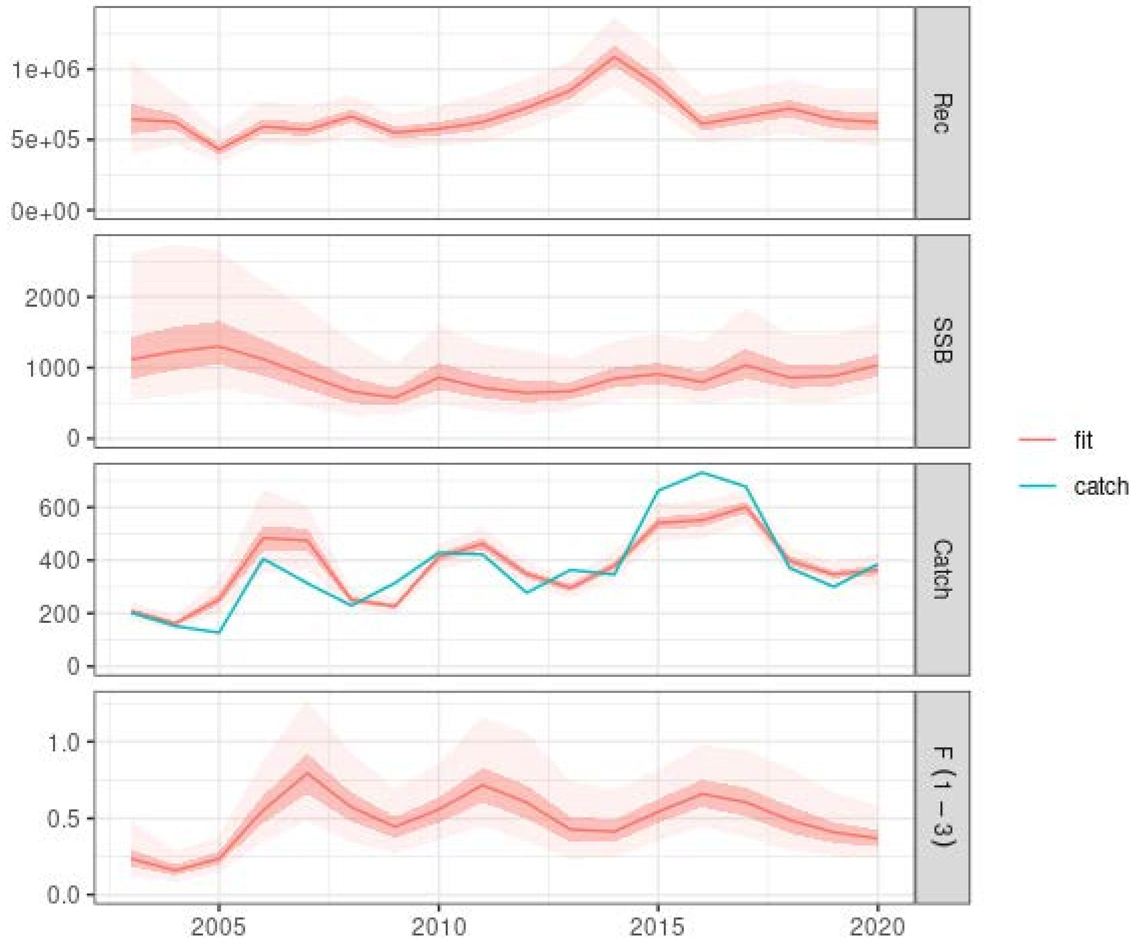


Figure 5.12.1.26: Summary of the stock assessment.

5.13 Blue and red shrimp (ARA) in GSA 18,19 and 20

5.13.1 Data Quality Checking

5.13.1.1GSA 18 Italy

LANDINGS AT LENGTH

Landing data are available for the whole time series with the exception of 2002, 2003 and 2019. Almost all the catches are reported for otter trawlers (OTB) (Figure 5.13.1.1).

Data by quarters available for 2017.

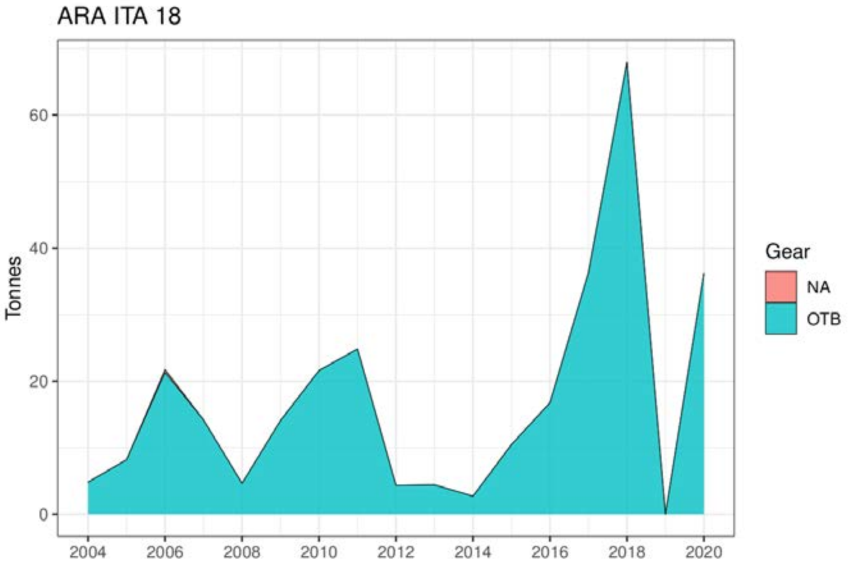


Figure 5.13.1.1: Blue and Red shrimp GSA 18. Total landings by gear in GSA18 (Italy).

DISCARDS AT LENGTH

Discards data are not available for this stock. However, is well know that discards for this species is not expected because the species is a very high price crustaceans and there isn't any reference minimum landings size.

MATURITY AT AGE

Maturity at age data are available in years: 2009,2001,2014 and 2017

SEX RATIO AT AGE

Sex ratio at age data are available in years: 2009,2001,2014 and 2017

GROWTH PARAMETERS

Von Bertalanffy Growth parameters are available for this stock by sex. The parameters are the same in both sexes which is quite uncommon considering the huge sexual dimorphism in this species. Likely the parameters are referring only on female or combined sex. Moreover are almost the same set along the time series (Figure 5.13.1.2)

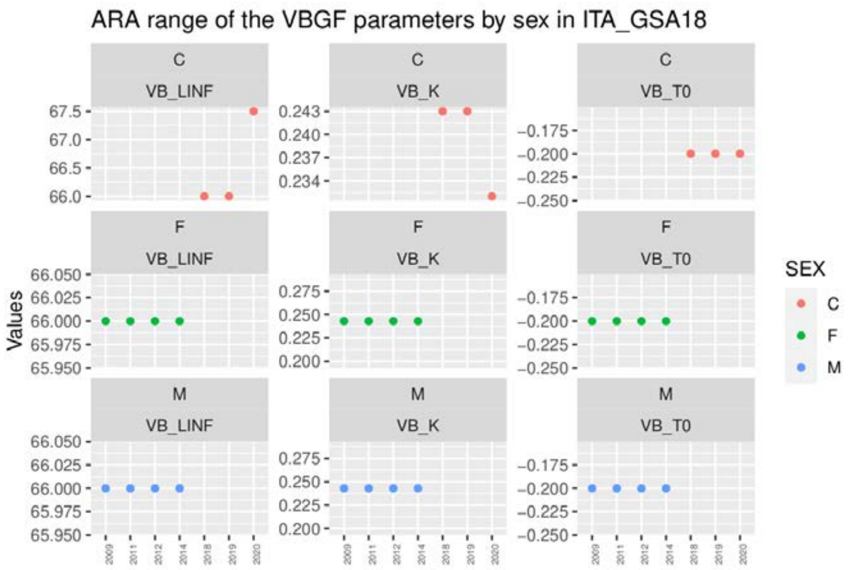


Figure 5.13.1.2: Time series of the Von Bertalanffy Growth parameters of ARA in GSA18 (ITA).

Length weight relationships

Length weight relationships data available for this stock separately by sex and sex combined in 2009, 2011, 2012, 2014, 2018, 2019 and 2020 (Figure 5.13.3).

Length frequencies distributions are not available for all gear and years (Figure 5.13.1.4)

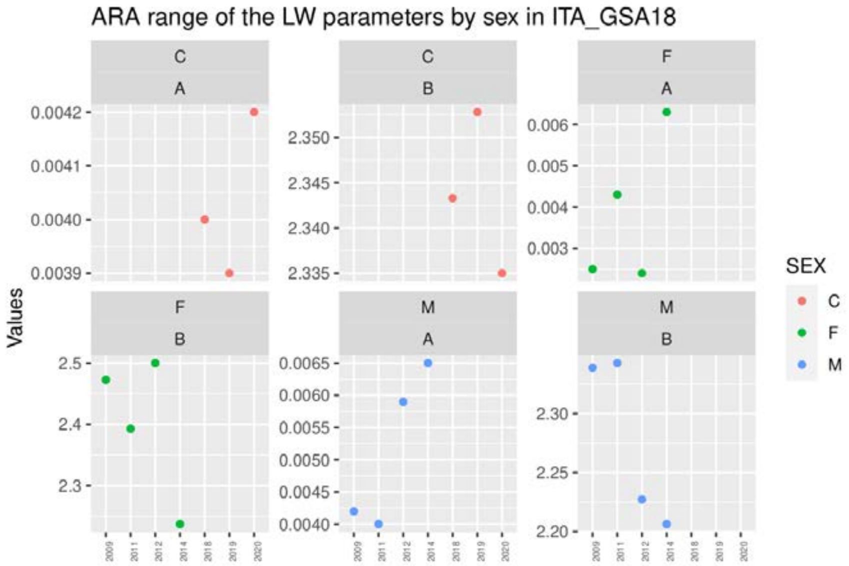


Figure 5.13.1.3: Blue and Red shrimp GSA 18 Time series of the length weight relationships a and b coefficients of ARA in GSA18 (ITA).

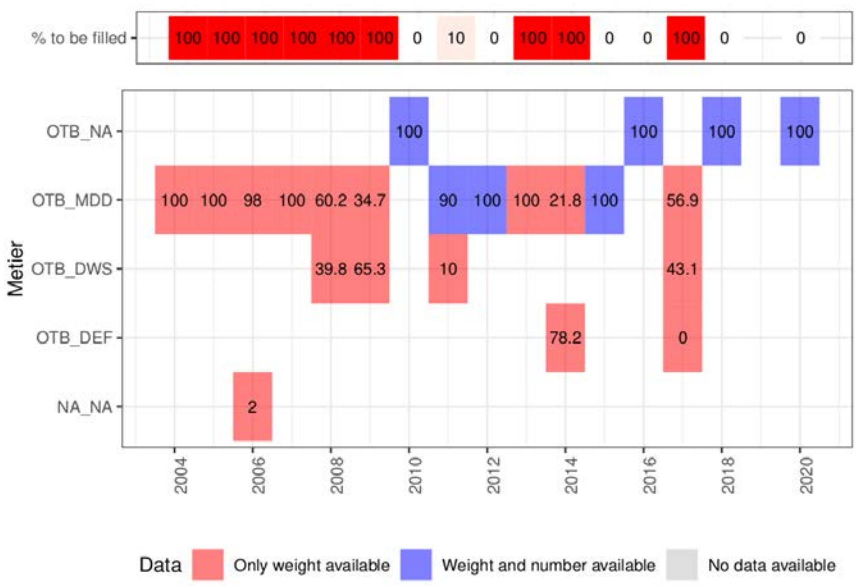


Figure 5.13.1.4: Blue and Red shrimp GSA 18 Missing length data to be filled in landings in ARA in GSA18 (ITA).

5.13.1.2 GSA 19 Italy

LANDINGS AT LENGTH

Landing data are available for the whole time series with the exception of 2002.

Almost all the catches are reported for otter trawlers (OTB) (Figure 5.13.5). Data by quarters available only for 2016-2018.

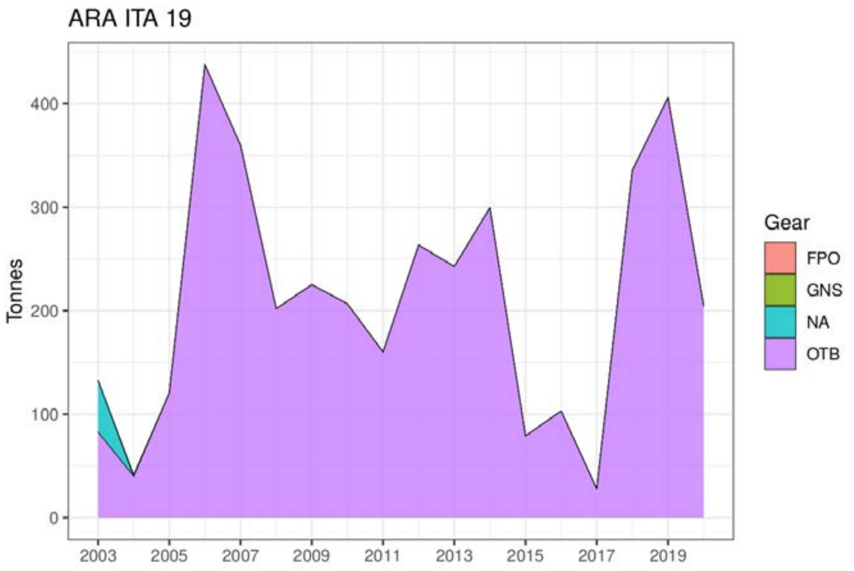


Figure 5.13.1.5: Blue and Red shrimp GSA 19. Total landings by gear in GSA19 (Italy)'

DISCARDS AT LENGTH

Discards data are not available for this stock. However, is well know that discards for this species is not expected because the species is a very high price crustaceans and there isn't any reference minimum landings size.

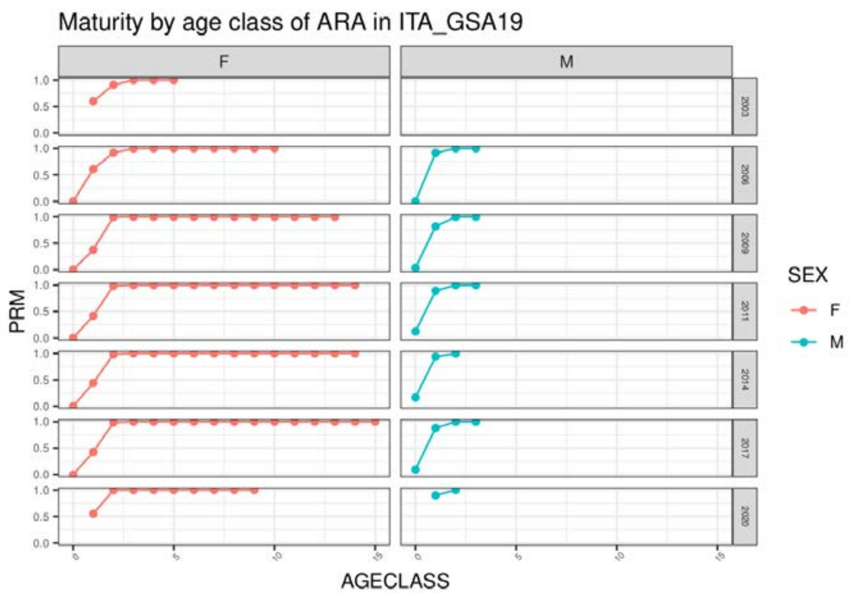


Figure 5.13.1.6: Blue and Red shrimp GSA 19. Maturity at age by sex in ARA in GSA19 (Italy).

MATURITY AT AGE

Maturity at age data by sex are available in years: 2003, 2006, 2009, 2011, 2014, 2017 and 2020 (Figure 5.13.1.6)

SEX RATIO AT AGE

Sex ratio at age data are available in years: 2002, 2003, 2006, 2009, 2011, 2014, 2017 and 2020 (Figure 5.13.7)

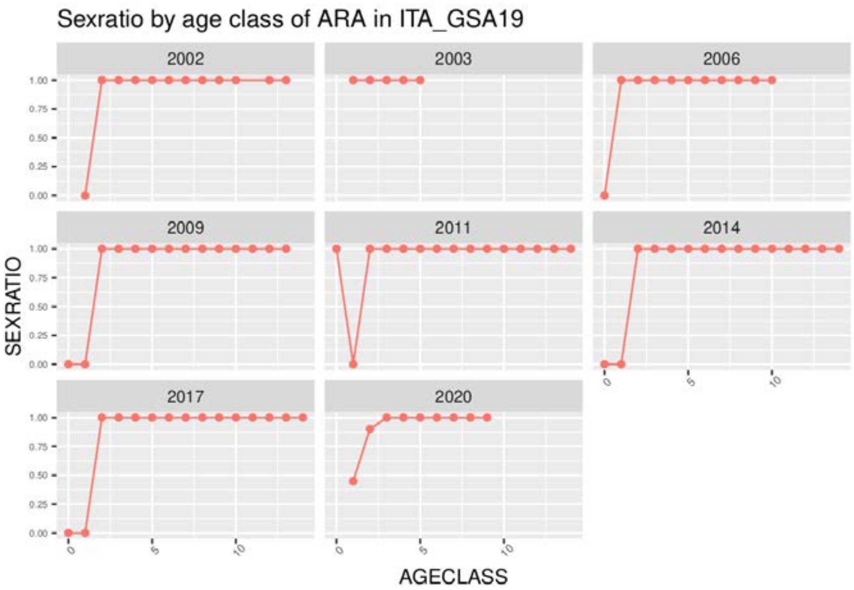


Figure 5.13.1.7: Blue and Red shrimp GSA 19. Maturity at age by sex in ARA in GSA19 (Italy)

GROWTH PARAMETERS

Von Bertalanffy Growth parameters are available for this stock by sex and along the whole period. The parameters are the same in both sexes which is quite uncommon considering the huge sexual dimorphism in this species. Likely the parameters are referring only on female or combined sex. Moreover are almost the same (with the exception of 2020) set along the time series (Figure 5.13.1.8)

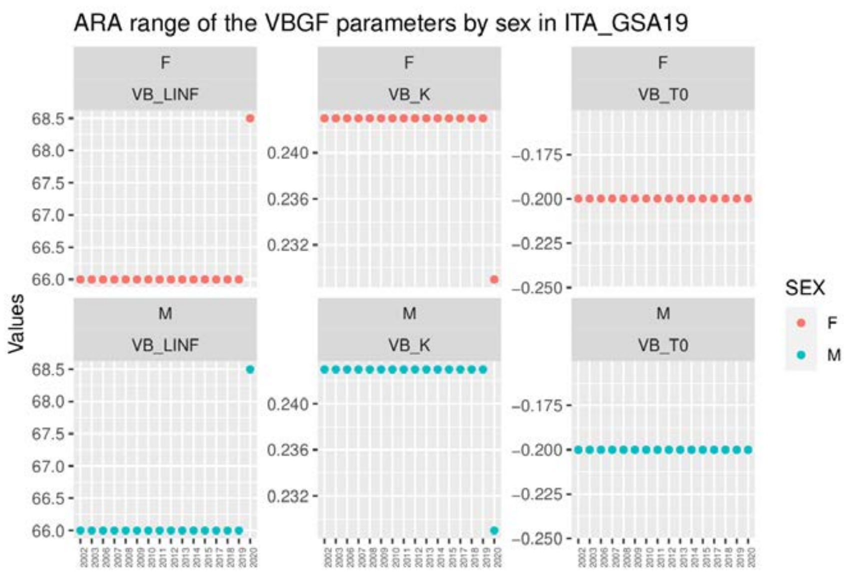


Figure 5.13.1.8: Blue and Red shrimp GSA 19.Time series of the Von Bertalanffy Growth parameters of ARA in GSA19 (ITA).

Length weight relationships

Length weight relationships data available for this stock separately by sex along the whole time series (Figure 5.13.1.9).

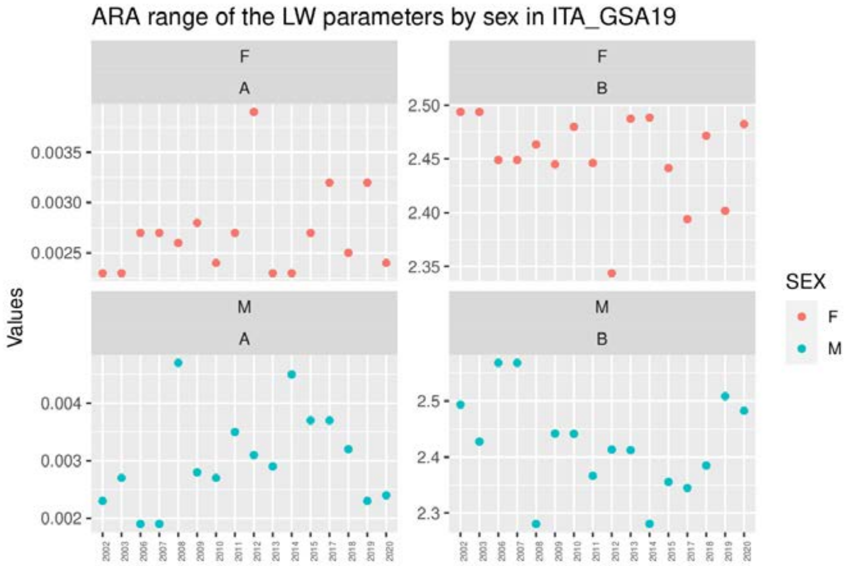


Figure 5.13.1.9: Blue and Red shrimp GSA 19. Time series of the length weight relationships a and b coefficients of ARA in GSA19 (ITA).

Length frequencies distributions are available for all the main metier along the whole time series (Figure 5.13.1.10).

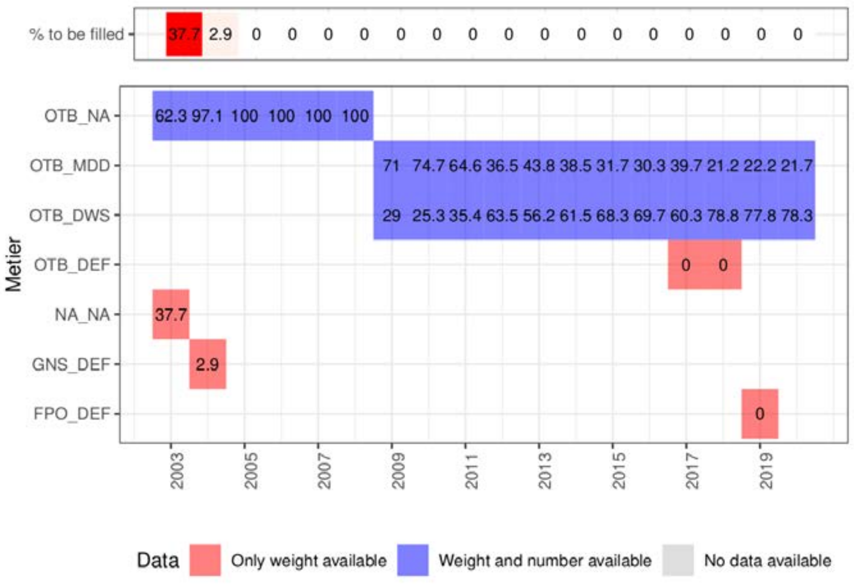


Figure 5.13.1.10: Blue and Red shrimp GSA 19. Blue and Red shrimp GSA 19. Missing length data to be filled in landings in ARA in GSA19 (ITA).

5.13.1.3GSA 20 Greece

No data available for this species in the GSA20. Actually it isn't a target of the Greek fleets in the area.

b) Main issues to be reported in the DTMT

The main issues spotted are shown in Table 5.13.1.1:

Table 5.13.1.1: Main issues to be reported in the DTMT

Data Requested	Issue	Issue Type	Severity
Landings length	GSA_18_ARS. Landings reported under gear GTR in 2003	QUALITY	LOW
Growth parameters	GSA_18_ARA The same growth function have been provided for both sexes which do not growth the same in this species.	QUALITY	LOW
Landings length	GSA_18_ARA. No landings data reported from 2002 to 2007 and in 2019.	COVERAGE	LOW
Growth parameters	GSA_19_ARA The same growth function have been provided for both sexes which do not growth the same in this species.	QUALITY	LOW
Landings length	GSA_19_ARA. No landings data reported for 2002	COVERAGE	LOW

c) MEDITS survey

Any relevant issues have been observed in MEDITS data both in GSA18 and 19 (ITA). Only one minor inconsistencies (not ot be reported in DTMT) has been spotted in GSA20 (GRC) in total weight reported for haul number 67 in year 2016 (see below)

country	area	year	haul_number	totwgB	totnbB	totwgC	totnbC	wgratio	nbratio
GRC	20	2016	67	685	49	685	58.05085	1	0.8440876

Moreover, it is also important remark Greek MEDITS data gaps and Albania and Montenegro data availability which should be take in consideration in creating the final index to be used.

5.13.1.4Exploring the possibility to evaluate the stock status

In GSA19 data are available for almost of the years. Any particular quality issues have been spotted aside the problem in having the same growth rate reported in all the years and for all the sexes.

In GSA18 data are not so complete as in GSA19, however at least landings in weight are available in many years. Considering that GSA18 represent usually less than 10% of the whole landings with exception of 2017 (Table 5.13.2.1) a preliminary stock object could be compiled based only on GSA19 data.

Table 5.13.1.2:. Landing in GSA18 and GSA19 (Italy).

Year	GSA18	GSA19	% GSA18
2002	NA	NA	NA
2003	NA	132.6675	NA
2004	4.80786	41.18954	10.4524603564549
2005	8.1796	120.55164	6.35401321388654
2006	21.75131	437.5653	4.73558097539734
2007	14.16844	359.64837	3.79020943440184
2008	4.62819	201.85337	2.24145439428102
2009	14.07309	225.07701	5.88462643335713
2010	21.59357	206.52542	9.4659239022582
2011	24.8369	159.98559	13.4382455295349
2012	4.32533	263.38747	1.61566051380435
2013	4.41437	242.59773	1.78710678545707
2014	2.69703	299.46032	0.89259122771628
2015	10.4703	78.97126	11.706302975932
2016	16.75666	103.02048	13.9898648439928
2017	**36.31339**	**27.62848**	**56.79125430645**
2018	67.93621	335.59084	16.8356024707637
2019	NA	405.93253	NA
2020	36.21782	204.54908	15.0426906688586

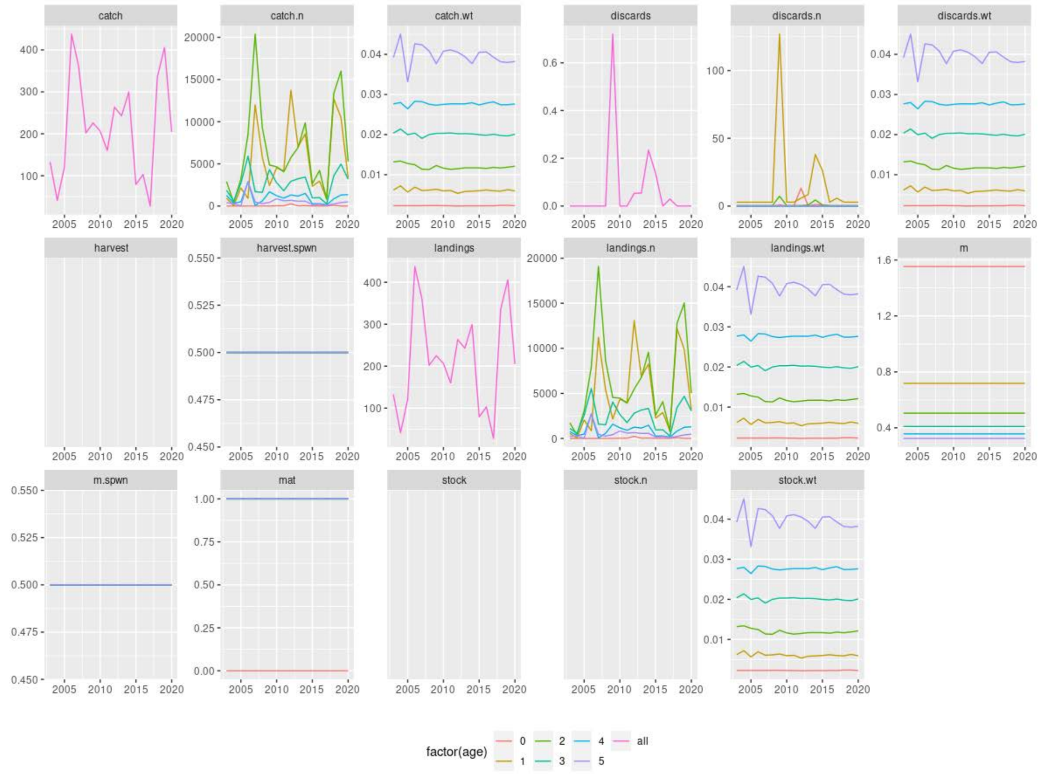


Figure 5.13.1.11: Preliminary stock summary for ARA in GSA19 (Italy).

Resulting stock summary of the GSA19 data for ARA are showed in Figure 5.13.1.11 and catch at age in figure 5.13.2.2.

Although data seem suitable to attempt a catch at age model to evaluate the stock status checking cohort consistencies along years resulting in a very poor fitting (Figure 5.13.2.3-5). Same results have been obtained for the index at age number derived from the MEDITS survey (Figure 5.13.2.6).

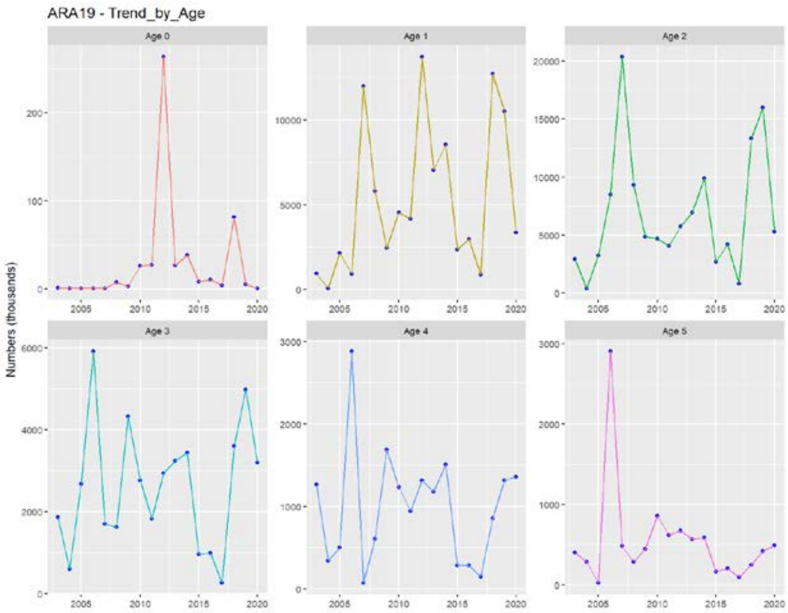


Figure 5.13.1.12: Trend in catch at age numbers in ARA in GSA19 (ITA).

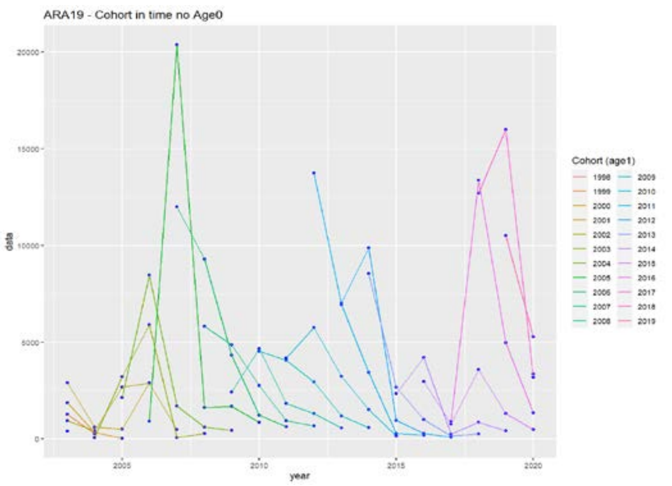


Figure 5.13.1.13: Cohorts in ARA in GSA19 (ITA).

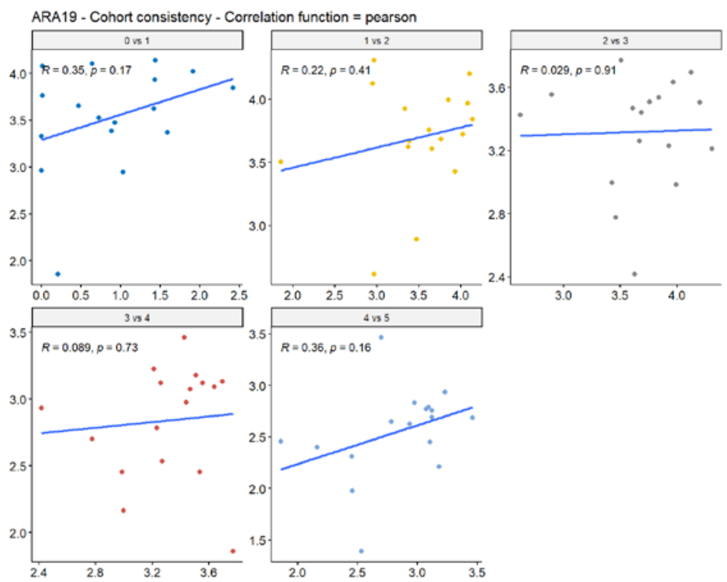


Figure 5.13.1.14:. Cohorts consistencies in catch in ARA in GSA19 (ITA).

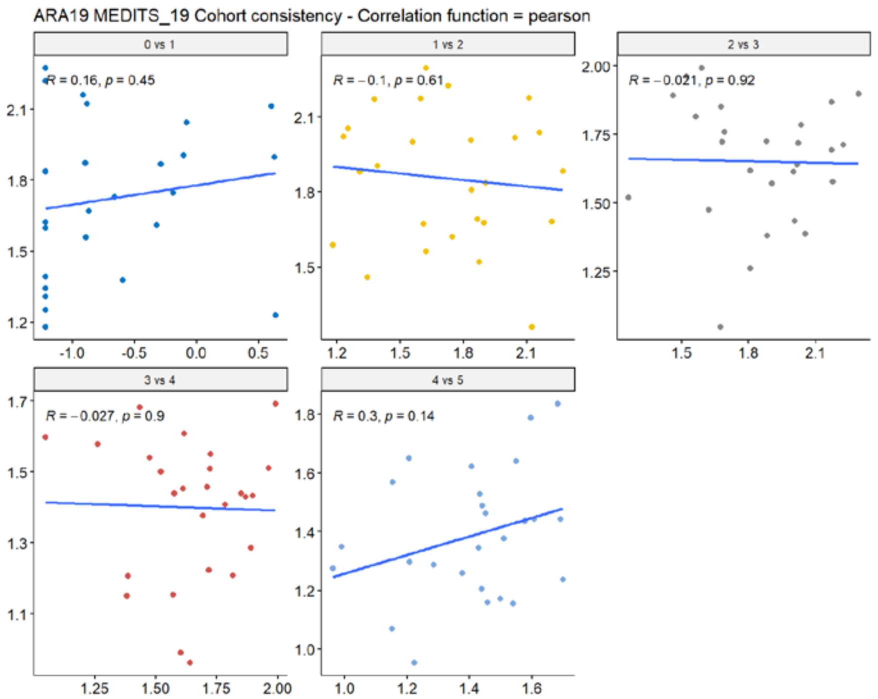


Figure 5.13.1.15: Cohorts consistencies in index in ARA in GSA19 (ITA).

5.13.1.5 Length frequency data investigation towards assessment options.

Consistent length frequency data is only available for the focal area of the fishery, in GSA19. Insufficient information is available from GSA 18, 20 to determine if the information sufficiently consistent between areas to warrant aggregation. Consequently, this section focuses in determining the information content of the data sources available in GSA 19 only.

Growth:

Italy provides von Bertalanffy growth parameters for both sexes. As pointed out in a previous section, parameters are identical for both sexes and it was suggested that this represents a sexes combined growth curve, which is sensitive to the level of exploitation given the strong sexual dimorphism of this species. Only a single growth curve is provided for the entire time series, which will at least complicate the conversion of length into age for the combined sex commercial length frequencies. Despite these obvious shortcomings, and to illustrate the point, in this analysis we evaluate the data as provided.

Survey length frequencies by sex:

Length frequencies from the survey are provided by sex. Plotting annual female survey length frequencies proportional to the annual total catches suggest that given the growth curve, selectivity is still partial at age 1 certainly in the early years. More recently a larger proportion of the survey catches has been observed at age 1. If survey consistency in terms of stations and gear are as high as suggested one has to conclude that these observed changes are either due to temporal changes in distribution, changes in survey timing, recent higher recruitment or a depletion of the adult stock. With total survey abundance rather stable, and maximum observed size near L_{inf}, neither a recent increase in recruitment nor a prolonged period of increased exploitation are likely. Average size is decreasing slightly recently, but this would also be consistent with changes towards earlier selectivity.

The length frequency histogram at the bottom of the Figure 5.13.1.16 depicts an expected length frequency distribution for an equilibrium population for a survey with knife-edge selection at age 2, a standard deviation of 0.15 on the log size-at-age and total mortality (Z=0.6). The different colours in the stacked length frequencies indicate the contributions of the different simulated cohorts. The setting are chosen by eye to mimic the average observed distribution as an example. Problematic for an age-based assessment is the large degree of overlap between the cohorts. Age slicing as currently common in the MED assessments will dampen any cohort signal in the data and hence weaken information on stock scale. Taking the moderate variance in log size-at-age (0.15) suggest there is low to moderate exploitation of the stock even considering low values of M.

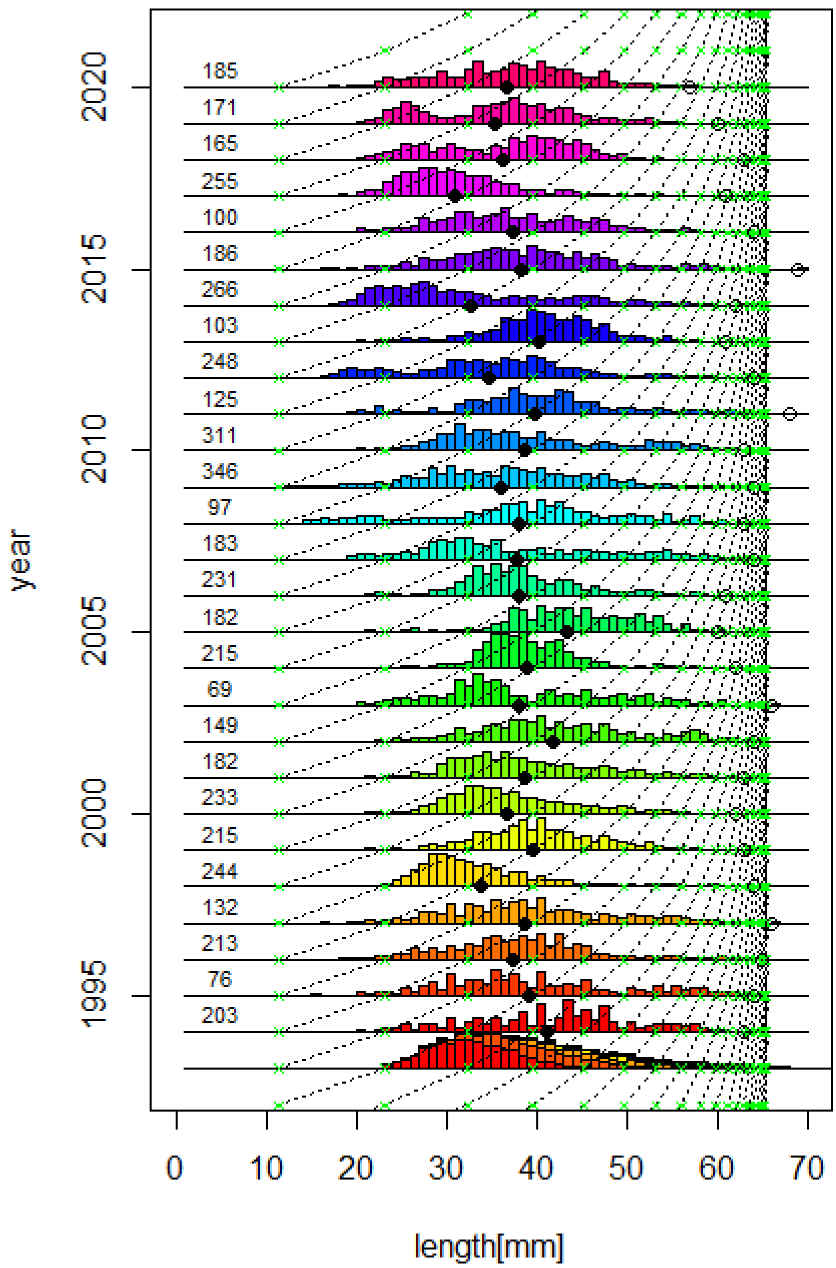


Figure 5.13.1.16: Proportional female length frequency plots for 1994-2020 by year from survey data. Dashed lines indicate the expected mean growth rate for each cohort with green x's marking the expected mean length-at-age. Filled black circles indicate the annual mean weighted length and open black circles mark the largest individuals observed in a given year. Numbers shown at the left indicate the number of individual measured. Bottom multicoloured histogram (1993 on x-axes) shows the expected contribution of an equilibrium population with SD=0.15 on log length-at-age and a total mortality of 0.6 and knife-edge survey selectivity at age 2.

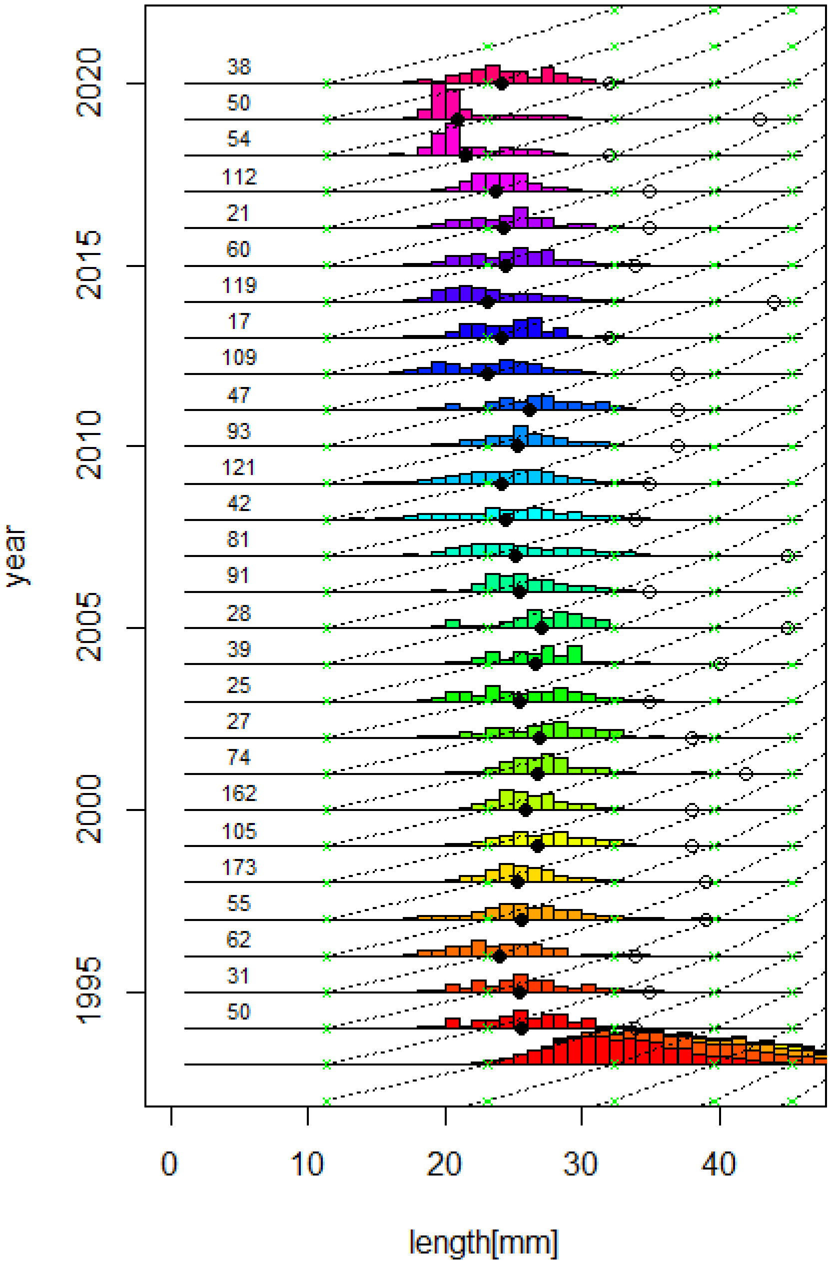


Figure 5.13.1.17: Proportional male length frequency plots for 1994-2020 by year from survey data. Dashed lines indicate the expected mean growth rate for each cohort with green x's marking the expected mean length-at-age. Filled black circles indicate the annual mean weighted length and open black circles mark the largest individuals observed in a given year. Numbers shown at the left indicate the number of individual measured. Bottom multicoloured histogram (1993 on x-axes) shows the expected contribution of an equilibrium population with SD=0.15 on log length-at-age and a total mortality of 0.6 and knife-edge survey selectivity at age 2.

Male survey length frequencies using the provided growth function suggest that almost all individuals taken by the survey are age 1. The maximum size observed is very variable as expected for rare individuals, but does tend to suggest some systematic decline over the time-period and has been far below the Linf (Figure 5.13.1.17). Mean size is more stable and indicates some decline in recent years. Clearly, the growth curve is implausible or survey and/or fishery selectivity differ strongly between the sexes at the larger ages. The expected male length frequency distribution shown at the bottom of the figure uses the same setting as one might assume if spatial distribution and gear are consistent between the sexes. At similar levels of exploitation would require dome shaped selectivity to be consistent with observed survey length distribution, or alternatively the availability of males to the fishery is much greater than female availability.

The relationship between female and male selectivity and population trends.

The sex ratio at length of survey catches give strong indications that growth rates differ between males and females, virtually all individuals greater than about 32mm are female (Figure 5.13.1.18. Below 15 mm length, we see large fluctuations in the proportion female though females dominate overall. At 15mm few individuals are taken resulting in the large fluctuations and this likely is the result of gear selectivity. The dominance of females is somewhat surprising. If selectivity at length is the same for both sexes and male growth is slower than female growth then we should observe a dominance of males at this size because they will grow through the interval more slowly, i.e. have a higher proportion of the population. The effect can only occur when growth differs between the sexes so that the interaction between gear selectivity and sex-specific size-at age means that the largest 1 year-old female are selected before the males reach that age.

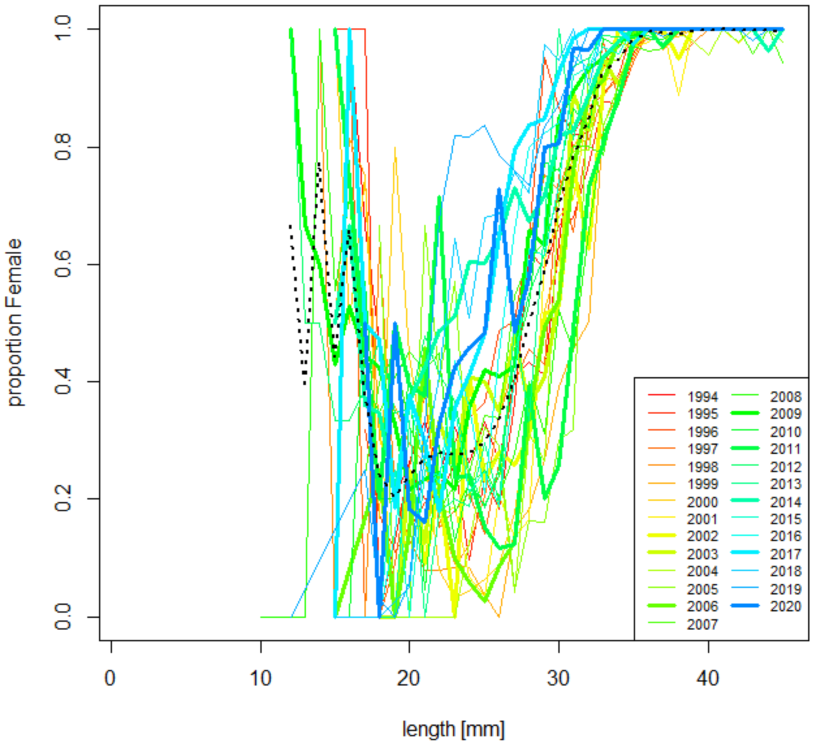


Figure 5.13.1.18: Proportion female-at-length for survey catches by year, thick lines indicate the availability of sexratio-at-length information from catches for corroboration and dashed black line indicates the overall mean over time.

From 15-18mm males make up the dominant proportion of survey catch (up to 80% at 18mm averaged over all survey years). Historically that proportion has been greater, while recent surveys indicate a reduced availability of males between 22-28mm. Given sex-specific growth, differences and a 50% sex ratio at hatching this would be consistent with an increase in recent exploitation as also suggested by the reduction in mean length for males, but makes less likely possibility that recent recruitments have increased systematically.

There are few other consistencies in the data between the sexes, except the striking coherence in the interannual variability in mean size. Figure 5.13.1.19 shows a near linear relationship between mean size of males and mean size of females historically, while more recent years, particularly 2018-19 indicate a more severe decline in male compared to female mean size. The consistency has some implications for the assumption regarding the sample variability. If sampling variability were high we might still expect to see correlation of mean size by sex informative on trends in exploitation, but here there is consistency between individual years suggesting there is consistent information on cohort strength, i.e. scale for the assessment to pick up if the length can be translated to abundance-at-age appropriately. An alternate explanation of systematic selectivity changes in the survey as discussed previously seem less likely given reported survey consistency and the differences in growth rate between sexes. However, survey timing may play an important role since particularly for females, survey timing / earlier spawning / faster growth is likely to impact the proportion of 1 group individuals encountered. This may also occur in males, although it is difficult to assess in the absence of an appropriate growth curve.

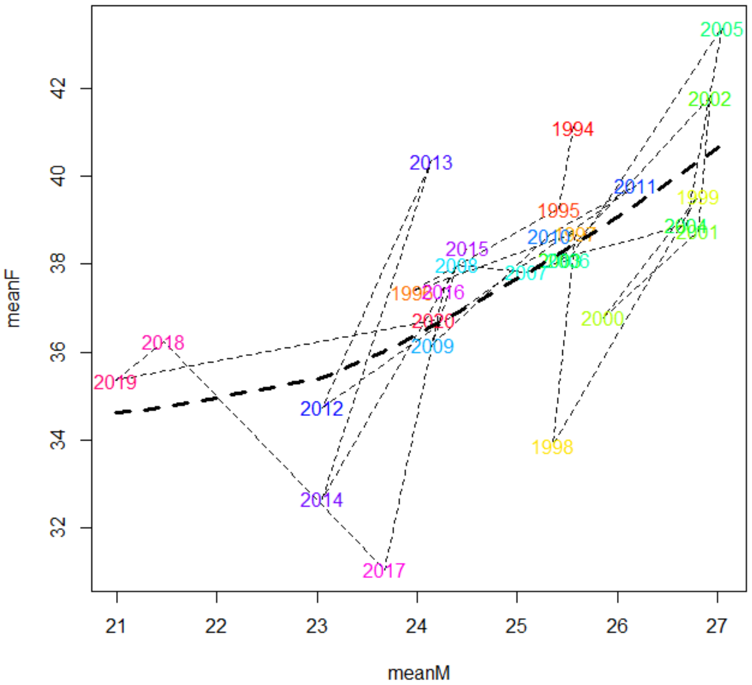


Figure 5.13.1.19: Relationship between mean size of males and females in survey catches suggesting higher values in the early 2000's with intermediate values prior and after and comparatively low values in the recent period. The thick dashed black line represents a 3-df spline through the data.

Commercial length-frequency data:

Annual and sex aggregated fisheries length frequency data for ARA19 was available since 2003 (Figure 5.13.1.20). The minimum size for selection appears to be consistent with the survey selection at around 15mm. However, the portion of small individuals rises more steeply than in the surveys data so that the proportion of small individuals in the catches is likely to be higher in the fishery.

Until 2006 length-frequency data is more variable, probably because of low sampling levels (number of individuals measured as well as few landings sampled). Since then sampling levels have increased substantially and smoother length frequencies are available and there is little in the way of long-term trends in mean size observable, nor is it possible to derive clear modal patterns in the data that might suggest cohort information. The growth rate with a reasonable variation in length-at-age as in the survey data makes recognition of cohorts complicated. In this case, there is the additional problem of trying to identify cohorts due to sex specific growth and the unknown temporal variability in sampling which unlike the survey can be spread out throughout the year. Where some sort of node is visible (for example in 2010, 2017 and 2019) they do not line up well with the growth curve which is shifted to the left. This would suggest that the main part of the fishery occurs later in the year than the growth pattern assumes (half way through the year) or that the sex specific cohort pattern overlay in such a way that the information cannot be appropriately interpreted for a single growth function.

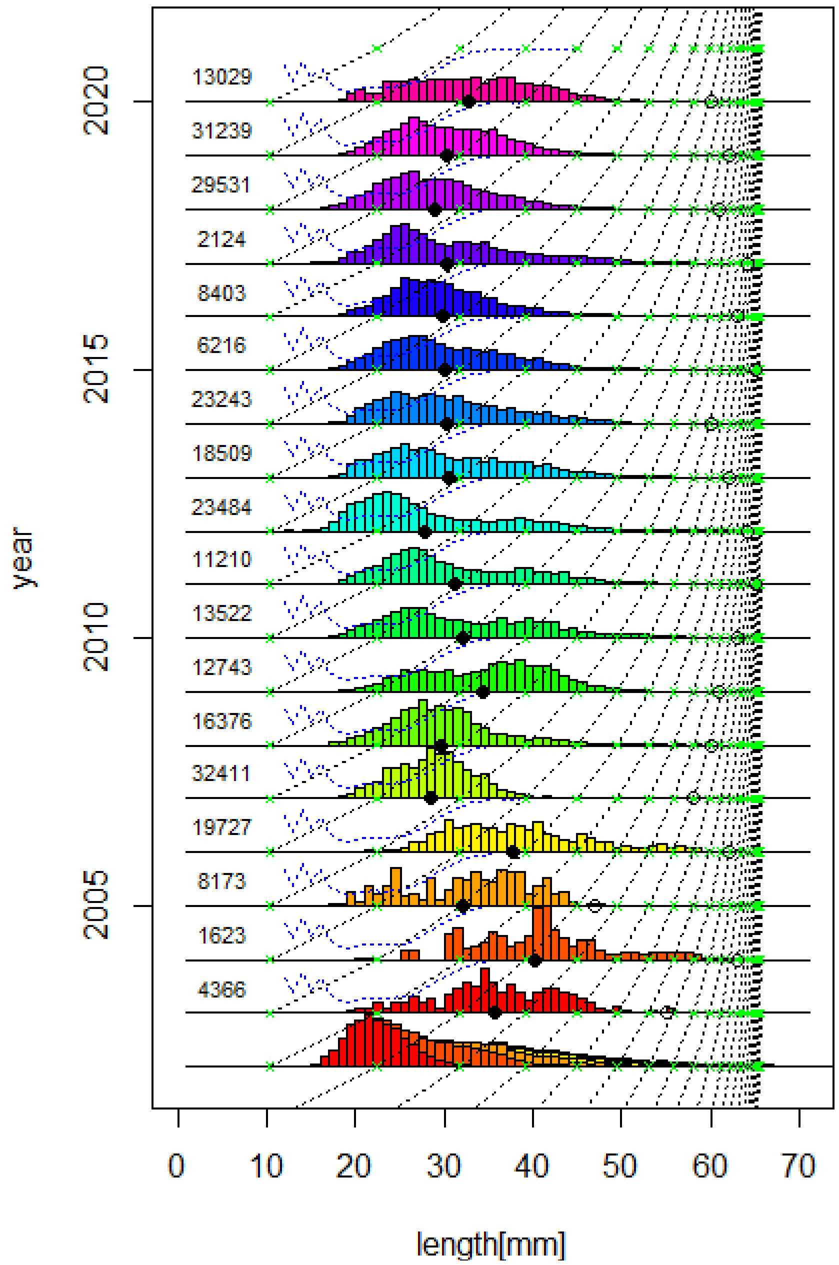


Figure 5.13.1.20: Proportional sex aggregated length frequency plots for 1994-2020 by from catches. Dashed lines indicate the expected mean growth rate for each cohort with green x's marking the expected mean length-at-age. Filled black circles indicate the annual mean weighted length and open black circles mark the largest individuals observed in a given year. Numbers shown at the left indicate the number of individual measured. Bottom multicoloured histogram (1993 on x-axes) shows the expected contribution of an equilibrium population with SD=0.15 on log length-at-age and a total mortality of 0.6 and knife-edge survey selectivity at age 2. Blue dashed line shows the average survey proportion female at length suggesting an important proportion of males in the catches assuming similar selectivity.

The average sex ratio at length from the survey suggests that a significant portion of the catches at the lower sizes must be from males. Where the sex ratio at length is available for commercial samples we see a similar pattern as the survey with dominant selectivity for females at the smallest and largest sizes (Figur 5). While certainly the majority of catches are of females, the highest proportion of males also coincides with the most frequent lengths so one has to assume a significant portion of males make up part of the catch and a single sex assessment will be difficult. The size at which the largest proportion of the catch is male ranges between 18 and 25 over the time-period and is very small in 2019, but does not show any consistent temporal signal. It is likely that the variation is predominantly driven by the timing of samples rather than changes in the selection or changes in the abundance-at-length ratio of availability.

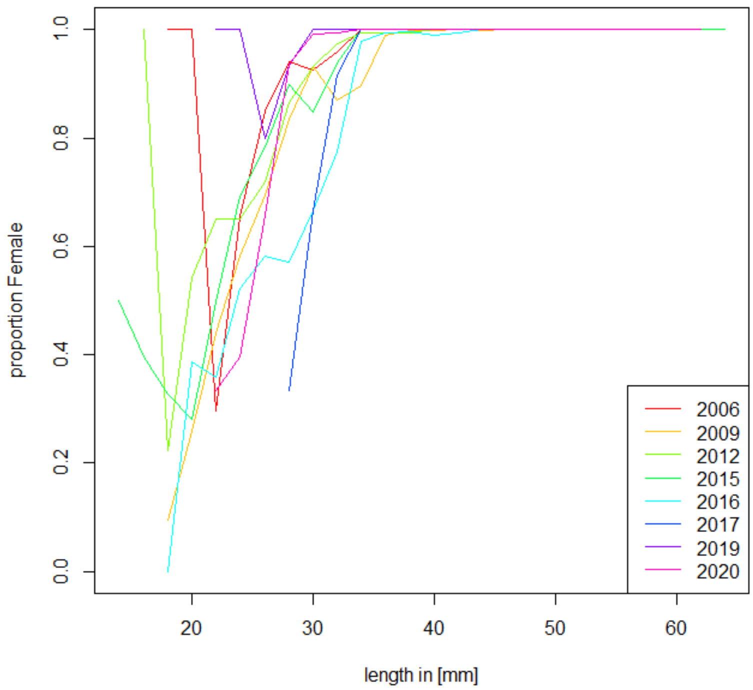


Figure 5.13.1.21: Figure showing temporal evolution of sex ratio-at-length in catches where such data are available. The variability at the smaller sizes is most likely associated with samples taken at different times of the year so that differences in the proportions a

Under these circumstances, it is difficult to see how the length slicing method as applied in the previous section will lead to an adequate representation of relative cohort strength as also suggested by the cohort consistency information provided above.

How to move to a provision of advice:

In the first instance, in terms of management need there is little indication that the stock shows strong indications of decline so it should be considered what level of priority should be given to the development of a full assessment.

If an assessment is needed, what level of precision / accuracy is required? Given the data a biomass dynamic model represents considerably less detailed information this is an option particularly since the accuracy of the combined growth function as well as the combined commercial length frequencies are not an issue. However, without a clear trend in the size of landings / catches and little signal in the survey index it is unlikely that the model will find an appropriate scale. Consequently, the most likely outcome will be of a stock with high productivity and comparatively little exploitation. The conclusion is not necessarily wrong, but if the stock was exploited at the beginning of the time series, reference points may not be appropriate.

Developing a suitable age-based model is considerably more involved, due to the inability to age individuals higher temporal resolution length-frequency catch data is necessary, as well as sex specific growth functions and possibly better sex-ratio-at-length data. Some of this information may already be available at the national level (Italy) but this would require further investigation.

Also critical to such a development is either an improved age slicing method or the use of a statistical catch-at-age model that can deal with the missing information and uses a length based likelihood, i.e. does the length slicing internal to the model.

5.13.1.6 Conclusions

Data are availability and quality is quite good especially in GSA19 (ITA) suggesting the possibility to attempt to evaluate the stock status by a catch at age model. However checking consistencies in length data suggested for this stock results would be quite weak, and may not be sufficient to provide advice strong enough to be considered in a management scenario.

Considering that survey data are available for a long period (1994 onward) having the possibilities to collect historical landings (discards is really negligible for this species) for GSA18, GSA19 and GSA20 a production model approach and/or other model (Jabba Bayesan approach) may provide more suitable results. In this contest having also information for Albania and Montenegro would be advisable.

6 WESTERN MED REFERENCE POINTS

The stocks listed in ToR 2 are evaluated below by species. The procedures described in Section 4.2 have been followed for all of 14 stocks for which assessments are available. For the remaining 5 stocks, where analytical assessments are not available, these have been briefly examined in terms of harvest rate proxies (HR) and where possible compared with other using the MEDITS survey.

6.1 Hake

6.1.1 European hake (HKE) in GSAs 1, 5, 6 and 7

6.1.1.1 Stock assessment

The assessment of European hake, *Merluccius merluccius*, carried out during the STECF EWG 21-11 considered the stock shared by the GSAs 1, 5, 6 and 7 (Figure 6.1.1.1).

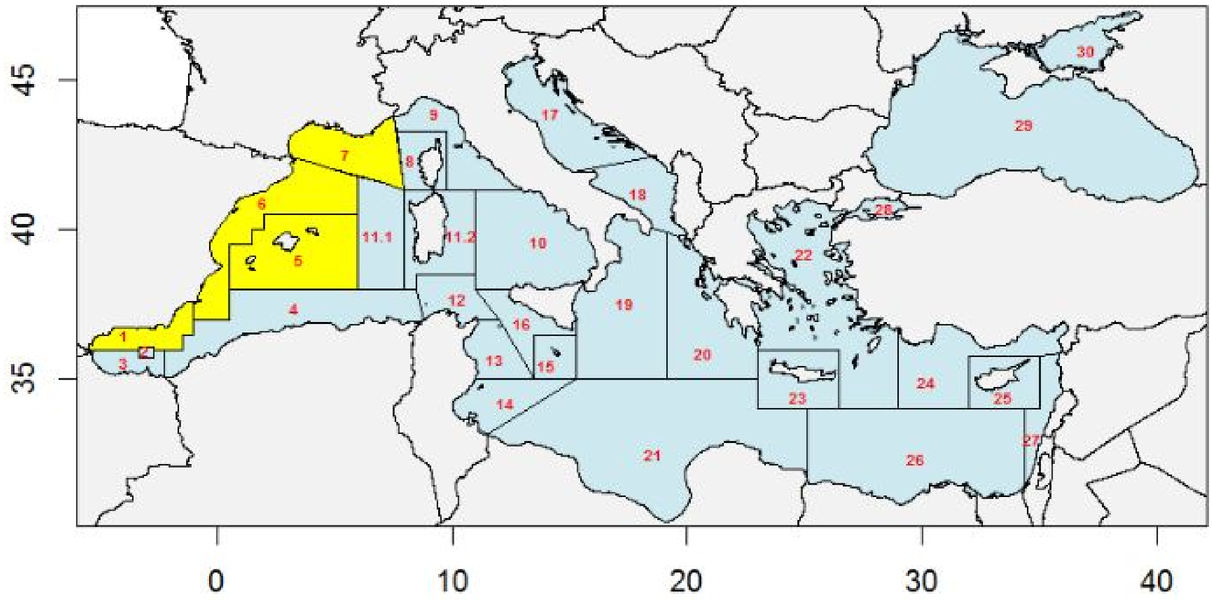


Figure 6.1.1.1: European hake in GSAs 1, 5, 6 and 7. Limit of Geographical Sub-Areas (GSAs) 1, 5, 6, 7.

A statistical catch-at-age assessment was performed for this stock, using data from the period 2007-2020 for catch data and tuning file, as survey indices data were available only from 2007 for GSA 5. The assessment was performed using the Assessment for All Initiative (a4a) method (Jardim et al., 2015). The outputs of the assessment done at EWG 21-11 are summarized inFigure 6.1.1.1.

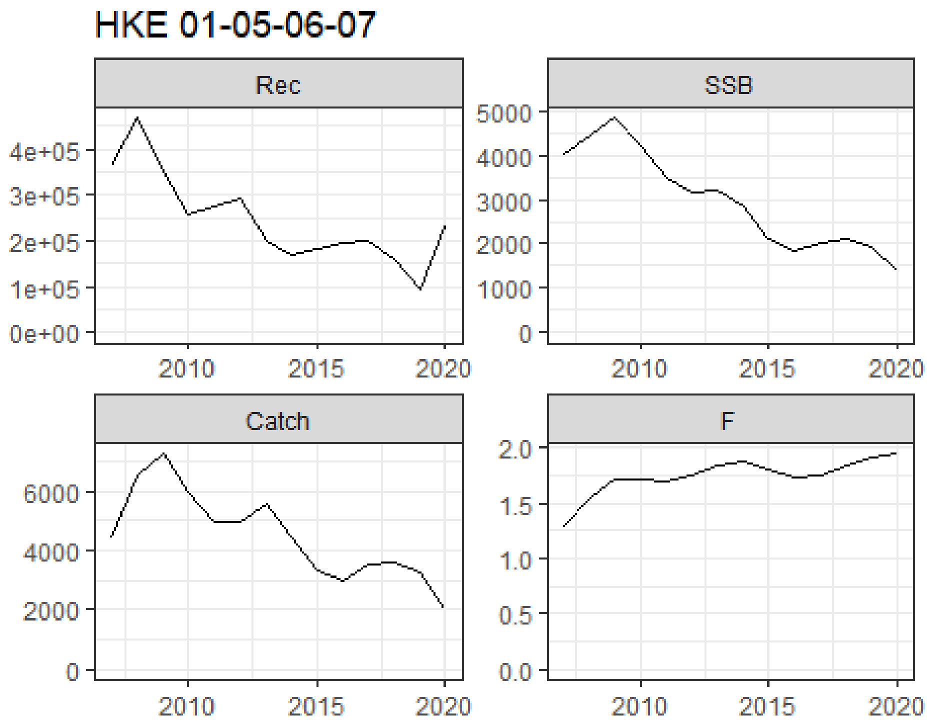


Figure 6.1.1.2: European hake in GSAs 1, 5, 6 and 7. Stock summary from the final a4a model.

An overview of the input data used in the assessment and outcomes is provided in \figure 6.1.1.3 – Figure 6.1.1.5

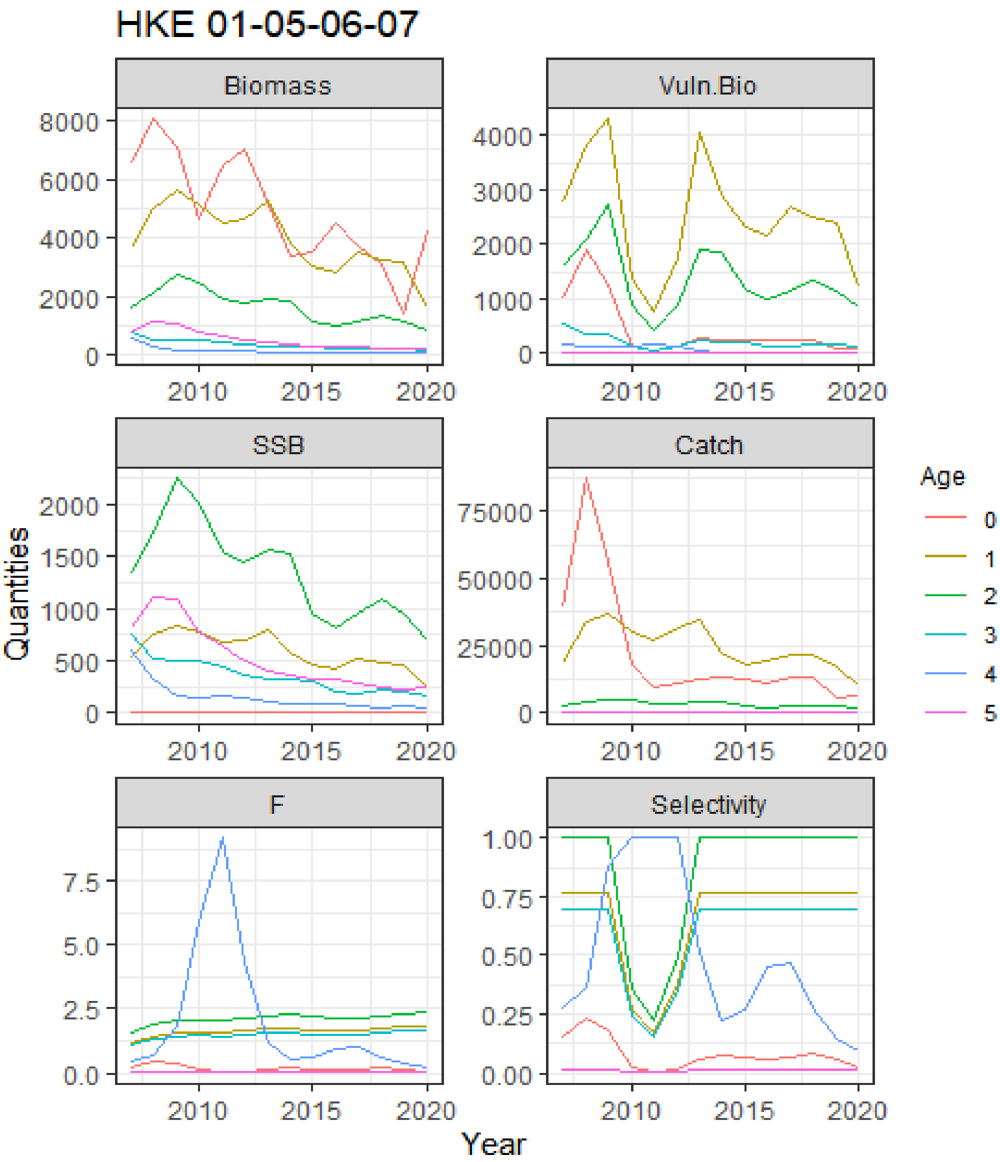


Figure 6.1.1.3: European hake in GSAs 1, 5, 6 and 7. Stock assessment trajectories at age.

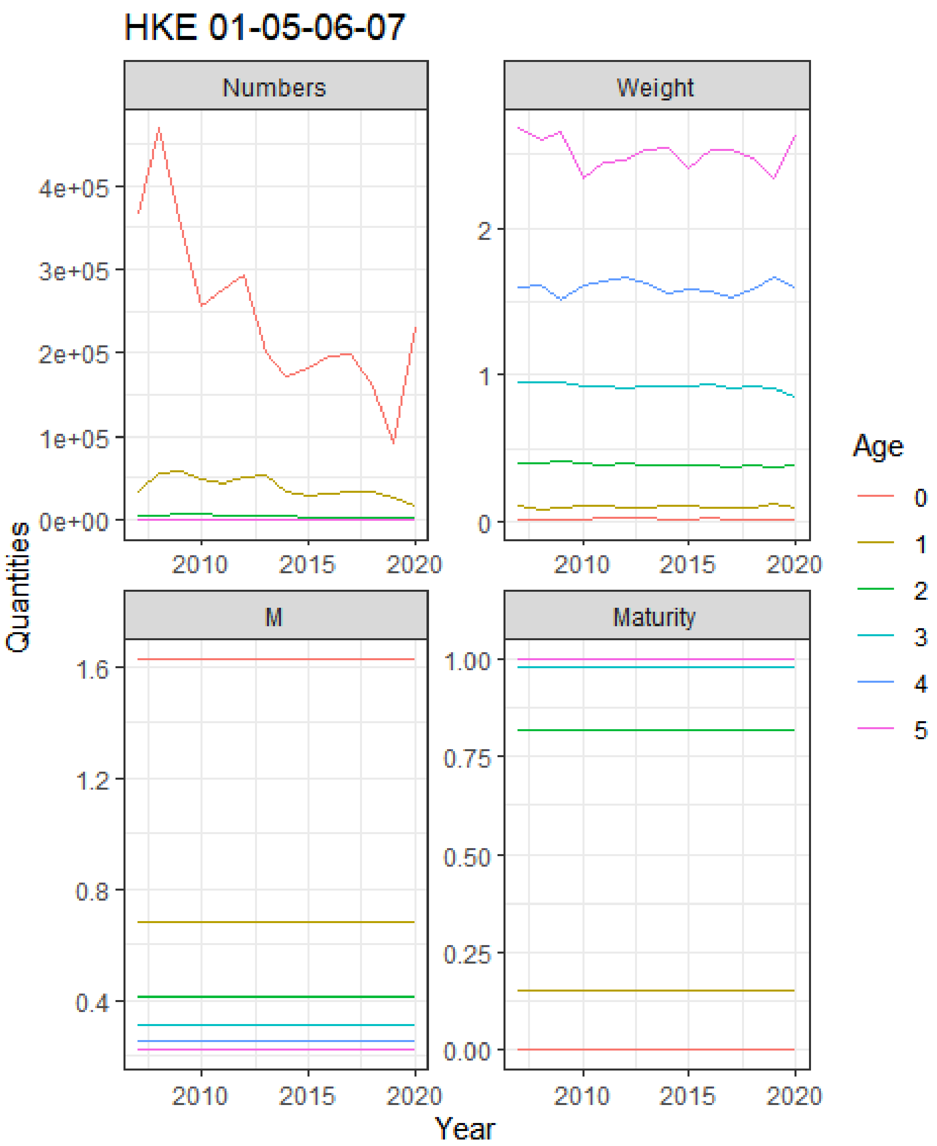


Figure 6.1.1.4: European hake in GSAs 1, 5, 6 and 7. Stock biology trajectories at age.

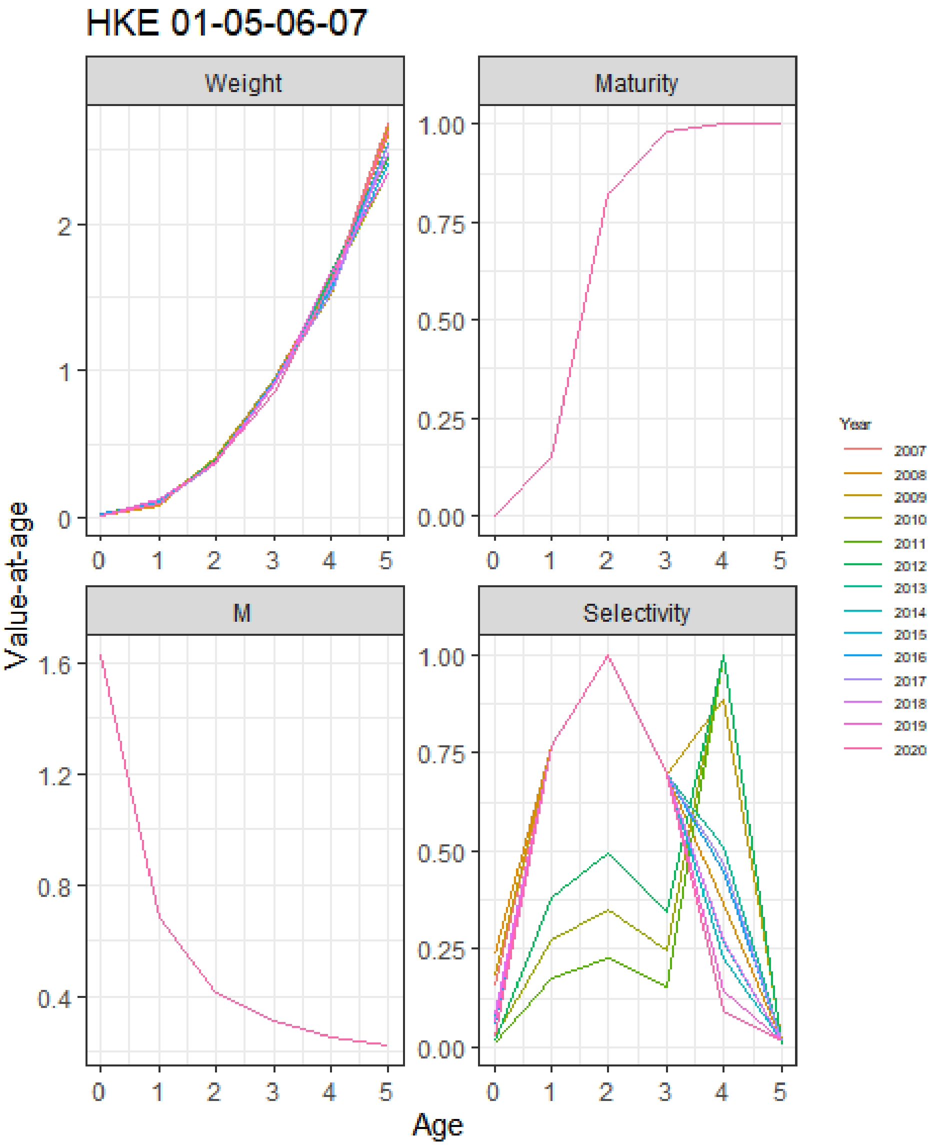


Figure 6.1.1.5: European hake in GSAs 1, 5, 6 and 7. Annual stock quantities at age: individual weights at age, fraction mature at age, natural mortality at age and selectivity at age in the fishery.

6.1.1.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.1.1.1 andFigure 6.1.1.7.

Table 6.1.1.1: European hake in GSAs 1, 5, 6 and 7. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.4445	0.1714	0.0428	0.9801	0.0221	0.6427

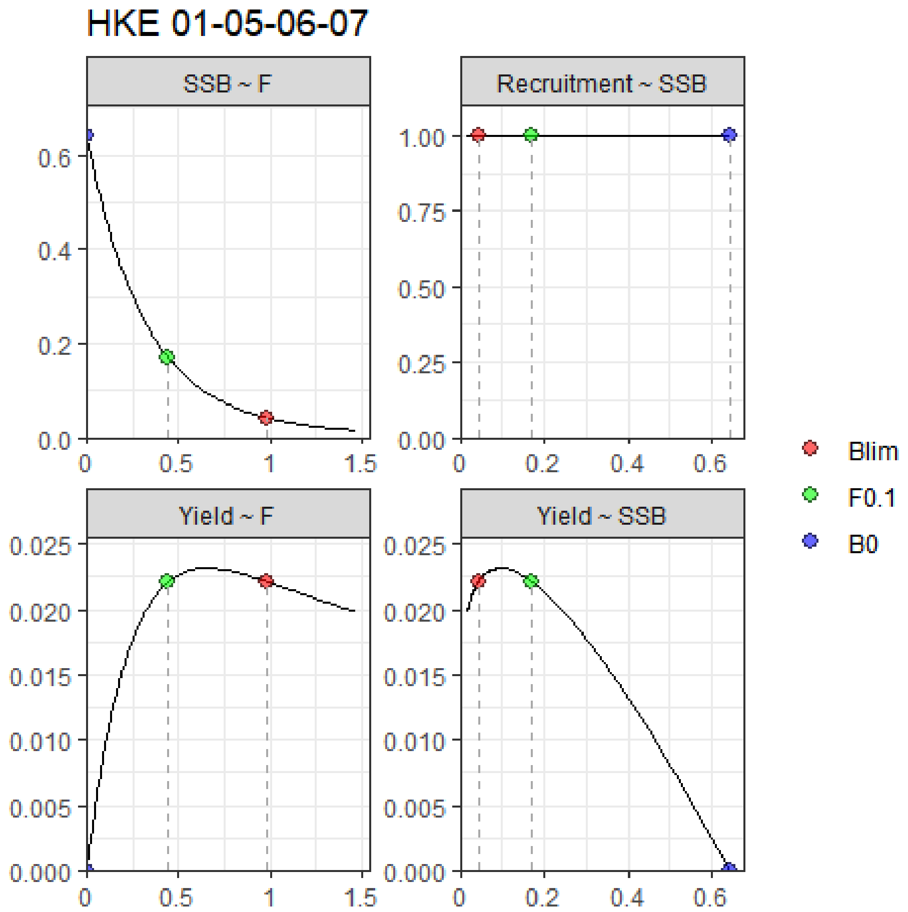


Figure 6.1.1.6: European hake in GSAs 1, 5, 6 and 7. Per-recruit analysis.

Figure 6.1.1.6 shows the trajectories of the assessment outputs relative to the per-recruit reference points R_0, SPR_0, YPR at $F_{0.1}$ and B_{Lim}. SSB by year is below the equilibrium biomass at $F_{0.1}$ ($B_{F0.1}$) and the B_{Lim} for the whole time series. At the same time, F is well above $F_{0.1}$ and Flim, and the trend is increasing in the whole time series, reaching the highest value in 2020.

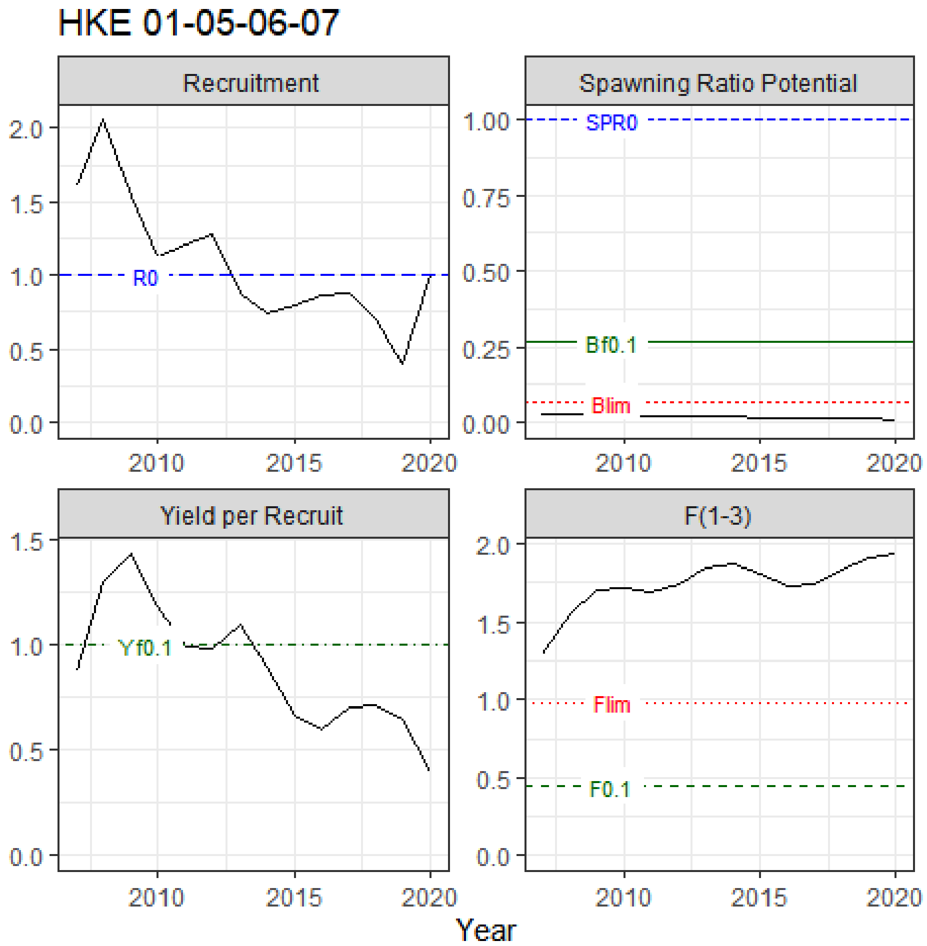


Figure 6.1.1.7: European hake in GSAs 1, 5, 6 and 7. Per-recruit analysis: outcomes of the a4a assessment relative to the per-recruit reference points.

Figutr 6.1.1.8 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario. This illustrates how overfished the population is from a yield per recruit perspective.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean)
2. Hockey-Stick (model=segreg)
3. Beverton-Holt (model=bevholtSV)
4. Ricker (model=ricker)

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ratio potential SRPlim = SPRlim/SPR$_0$. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP 0.1–20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R$_0$ were estimated given the input SPR$_0$y.

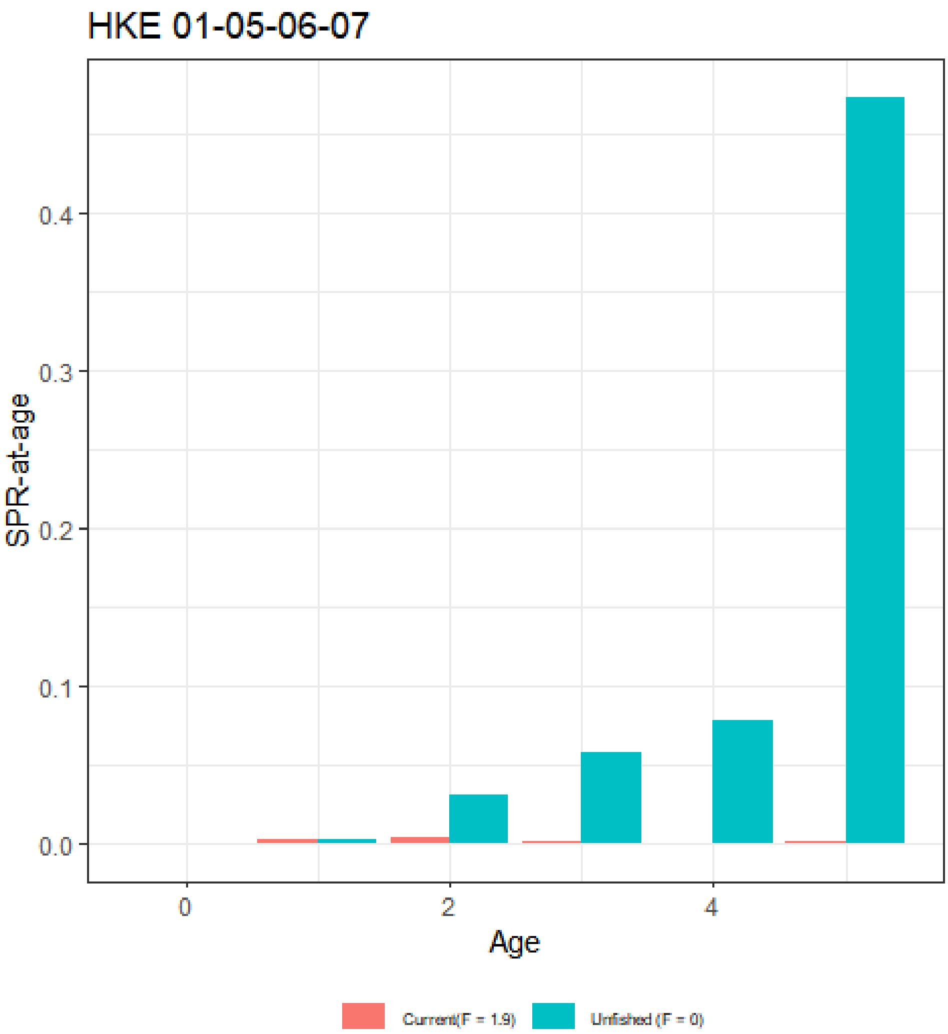


Figure 6.1.1.8: European hake in GSAs 1, 5, 6 and 7. Comparison of the spawning biomass per recruit SPRF at current F (average of last 3 years) and SPR0 with F = 0.

Table 6.1.1.2: European hake in GSAs 1, 5, 6 and 7. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.408911	227679.5	0.615522	146330.5
Hockey-stick	NA	0.309083	347580.1	-0.21976	223391.1
Beverton-Holt	0.947242	0.300918	910966.2	-0.1221	585481.4
Ricker	5.624471	0.283667	92203.17	-0.17759	59259.33

The observed SR data are sitting in the centre and to the right part of the R-SSB plot, and the breakpoint estimated by the HS model is within the observed values.

The break-point of the hockey-stick is estimated at b = 4140 corresponding to a SRPlim = 0.0185. The breakpoint from the Hockey-Stick (Table 6.1.1.2 and Figure 6.1.1.9) comes from within the data, quite close the upper range of observed recruitment.

Figure 6.1.1.11 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.8 – 0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates. Values below the fitted steepness miss the data. It is not possible to obtain consistent values of steepness from the given the available data. Use of the Beverton-Holt model gives what are considered unrealistically high values of R_0 at twice highest observed R max. The models with constrained steepness do not conform to the data.

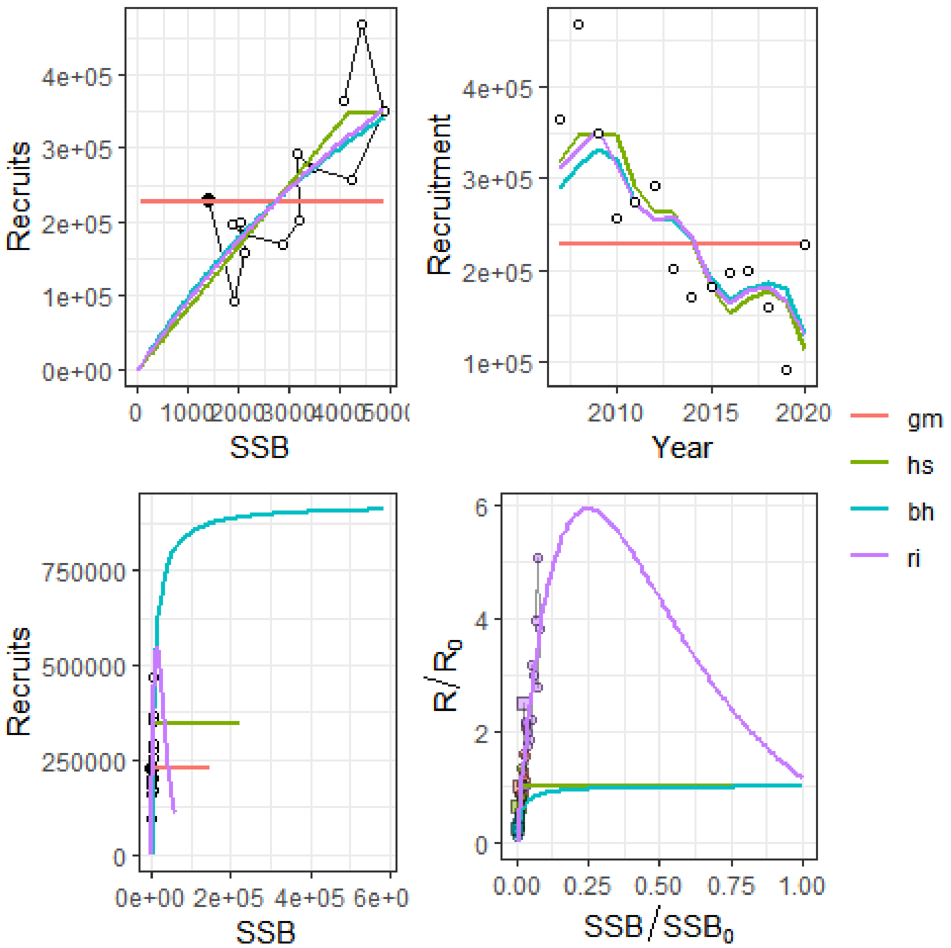


Figure 6.1.1.9: European hake in GSAs 1, 5, 6 and 7. Summary of the four SR models.

An investigation of the available historical landings was performed to evaluate whether the results of stock recruit models are in compatible with the past production of the stock. Historical landings (years 1970-2017) were provided during the GFCM European hake benchmark, and they are summarized in Figure 6.1.1.10.

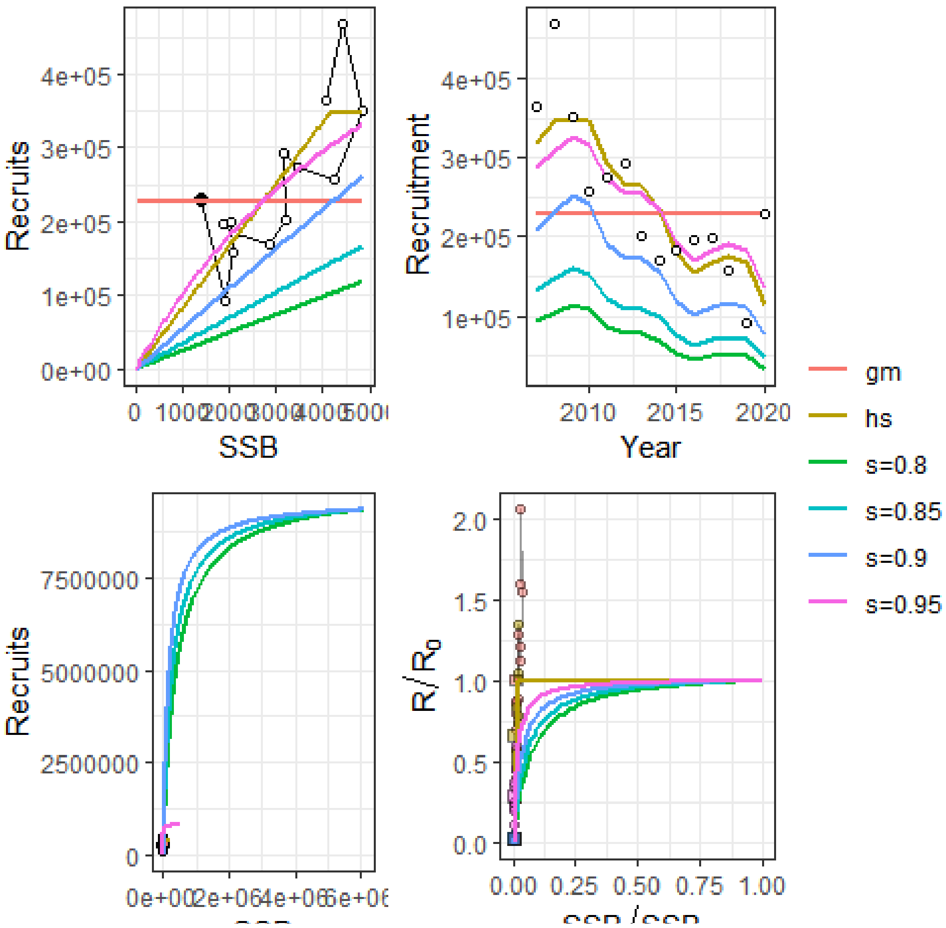


Figure 6.1.1.11: European hake in GSAs 1, 5, 6 and 7. Equilibrium yield analysis with different slope (s, steepness) scenarios for the Beverton-Holt model.

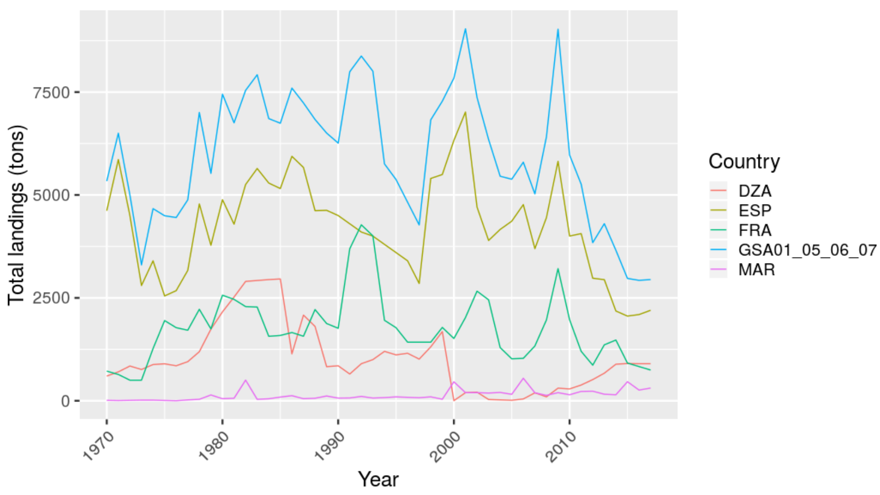


Figure 6.1.1.10: European hake in GSAs 1, 5, 6 and 7. Historical landings (tonnes) by country.

Historical landings (prior to 2002) are probably slightly underestimated at the beginning of the time series. Higher catches in the earlier period would be consistent with fishing above MSY and slowly depleting the stock. In this perspective, the landing of the species could be in line with some of the higher R results of the SR analysis, but it seems unlikely to be as high as the recruitment of the fitted Beverton-Holt model which implies safe long term average yield at MSY of 17000 (Figure 6.1.1.12). In contrast the Geometric Mean model using recruitment since 2002 implies long term yields of only 5000 tonnes (Figure 6.1.1.12), which is well below any observed catch and is not considered plausible. With the exception of some dips in 1973, 1996 and in the last years, with production below 5000 t, the landings of the species are usually above the GM value. This strongly supports the view that current recruitment, represented by the geometric mean, is indeed depleted relative to the past. A higher recruitment would be in line with the results of the SR analysis based on a Hockey-stick model. This indicates a long term equilibrium yield of around 8000 tonnes (Figure 6.1.1.12).

Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Hockey-stick approach the most appropriate to estimate the biomass reference points for the stock of European hake in GSAs 1, 5, 6 and 7. Table 6.1.1.3 summaries the reference point values based on the Hockey-Stick model fitted to the data. B_{pa} is set to 2* B_{Lim} (See section 4.2). The implied dynamics are illustrated in Figure 6.1.1.12 and the historic assessment information is shown in this context in Figure 6.1.1.13 and Figure 6.1.1.14. In conclusion the stock is considered to be below B_{Lim} in 2020.

Table 6.1.1.3: European hake in GSAs 1, 5, 6 and 7. Final reference points based on Hockey-Stick stock recruit model fitted to the data.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.4445	4140	8280	59561	223391	1.261

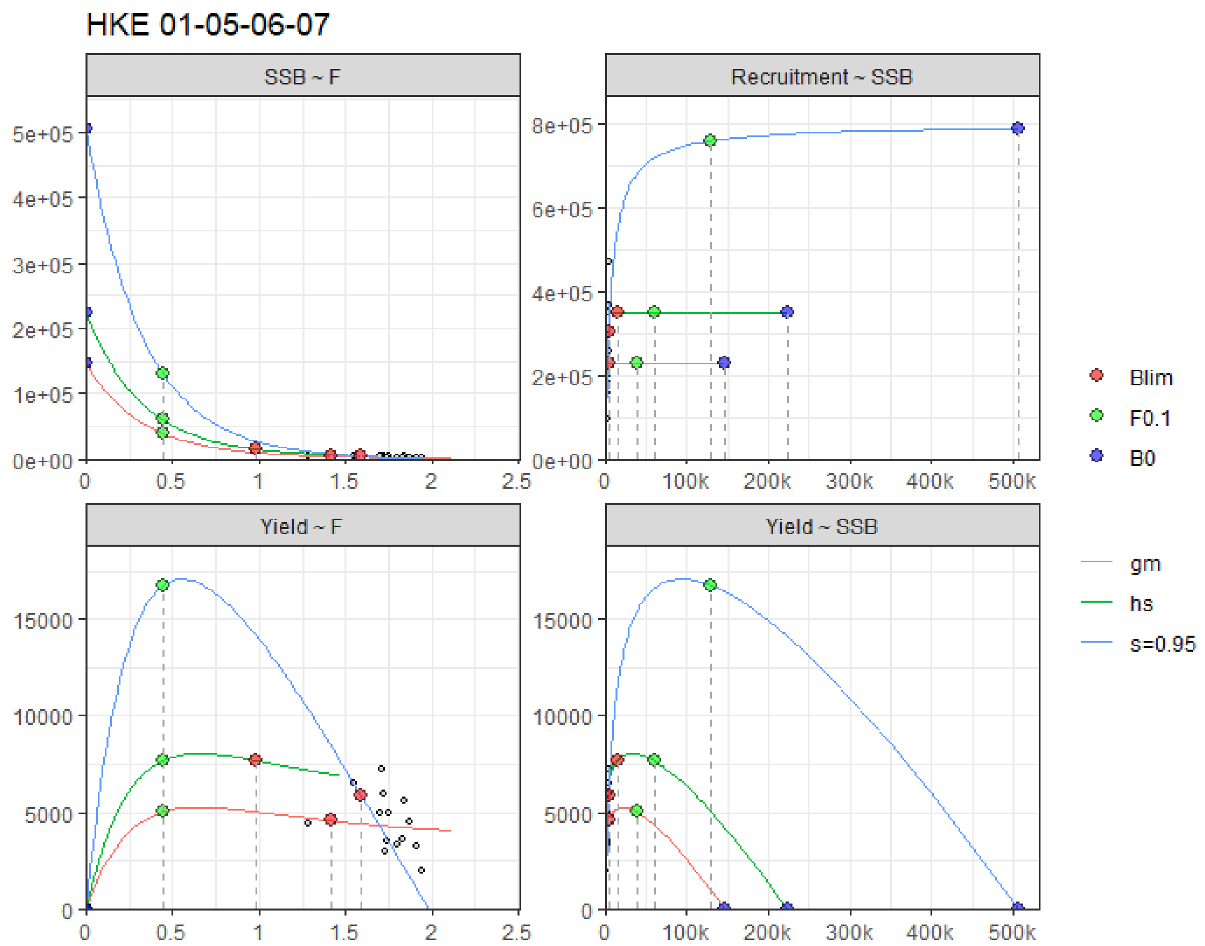


Figure 6.1.1.12: European hake in GSAs 1, 5, 6 and 7. Long Term equilibrium evaluations for different S-R models.

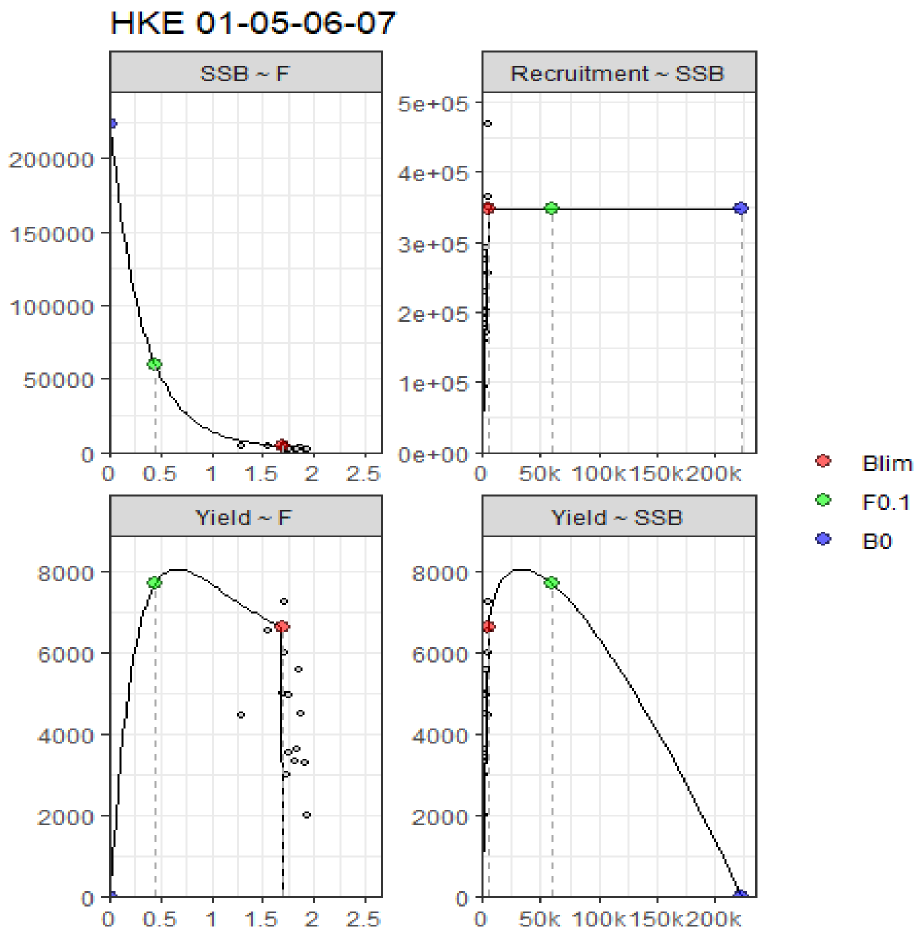


Figure 6.1.1.13: European hake in GSAs 1, 5, 6 and 7. Equilibrium yield analysis with HS model

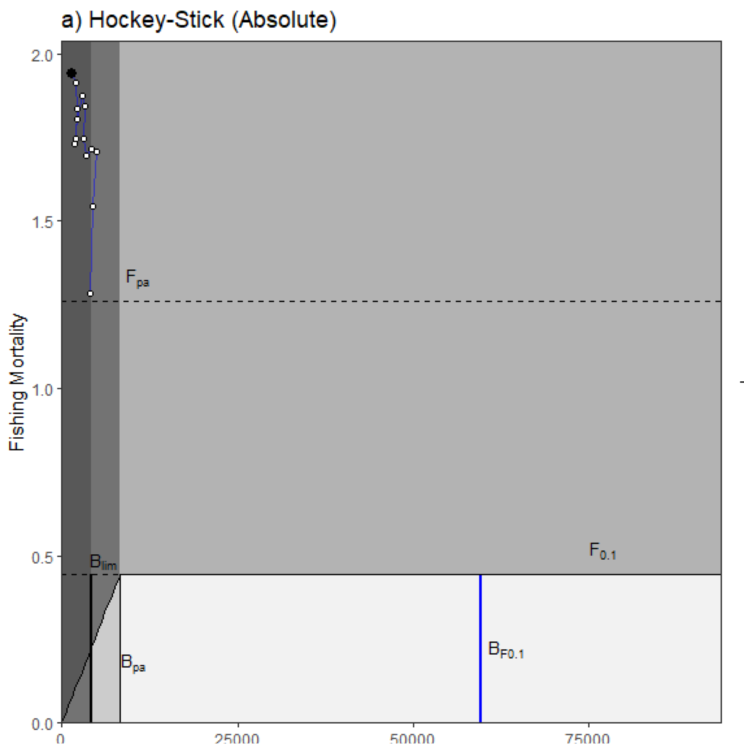


Figure 6.1.1.14: European hake in GSAs 1, 5, 6 and 7. Advice Rule plots, with B_{Lim} fitted to the data and B_{pa} = 2 B_{Lim}

6.1.1.3 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above are illustrated in figure 6.1.1.11. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.95 (Figure 6.1.1.15).

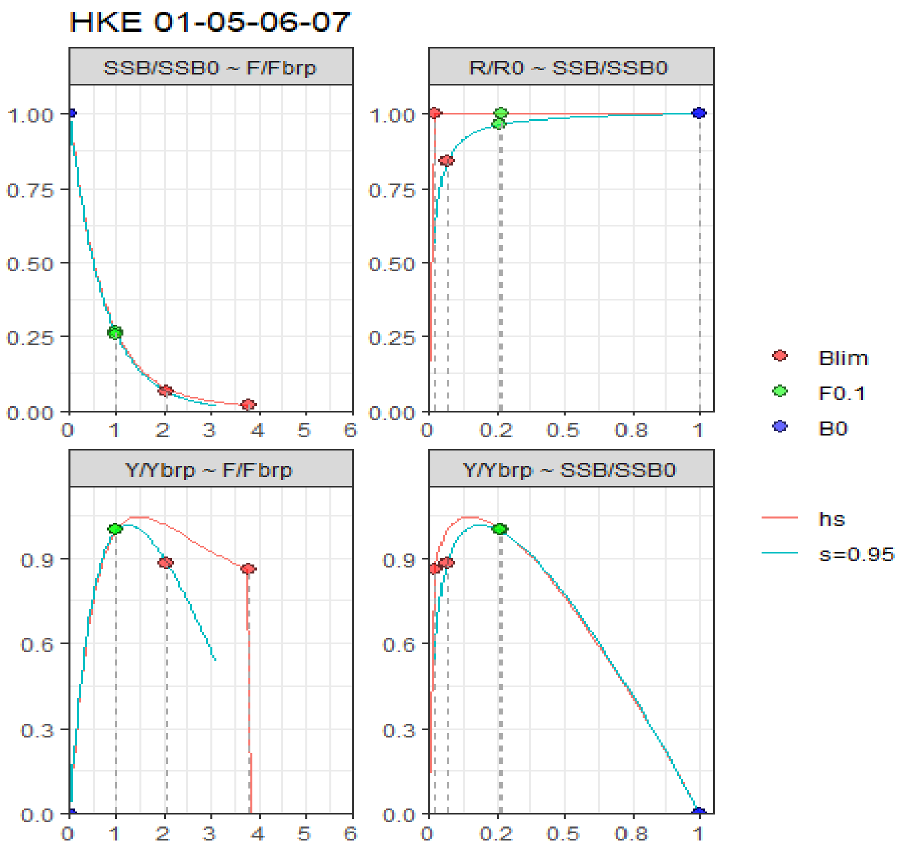


Figure 6.1.1.15: European hake in GSAs 1, 5, 6 and 7. Equilibrium yield analysis: relative reference points for HS and BH (steepness 0.95) models.

6.1.2 European hake (HKE) in GSAs 8, 9, 10 and 11

6.1.2.1 Stock assessment

The assessment of European hake, *Merluccius merluccius*, carried out during the STECF EWG 21-11 considered the stock shared by the GSAs 8, 9, 10 and 11 (Figure 6.1.2.1).

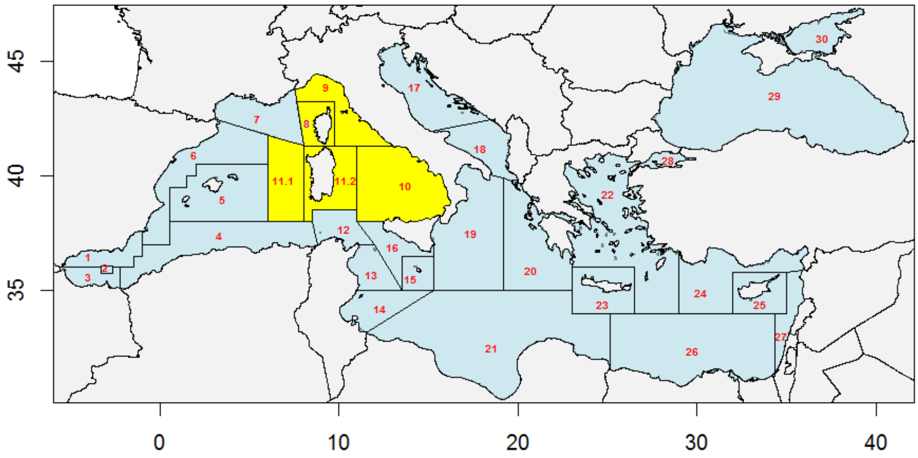


Figure 6.1.2.1: European hake in GSAs 8, 9, 10 and 11. Limit of Geographical Sub-Areas (GSAs) 8, 9, 10, 11.

A statistical catch-at-age assessment was performed for this stock, using data from the period 2005-2020. The catch-at-age data from commercial fisheries were tuned with the index-at-age data from the MEDITS survey in GSAs 8, 9, 10 and 11. The assessment was performed using the Assessment for All Initiative (a4a) method (Jardim et al., 2015). The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.1.2.2.

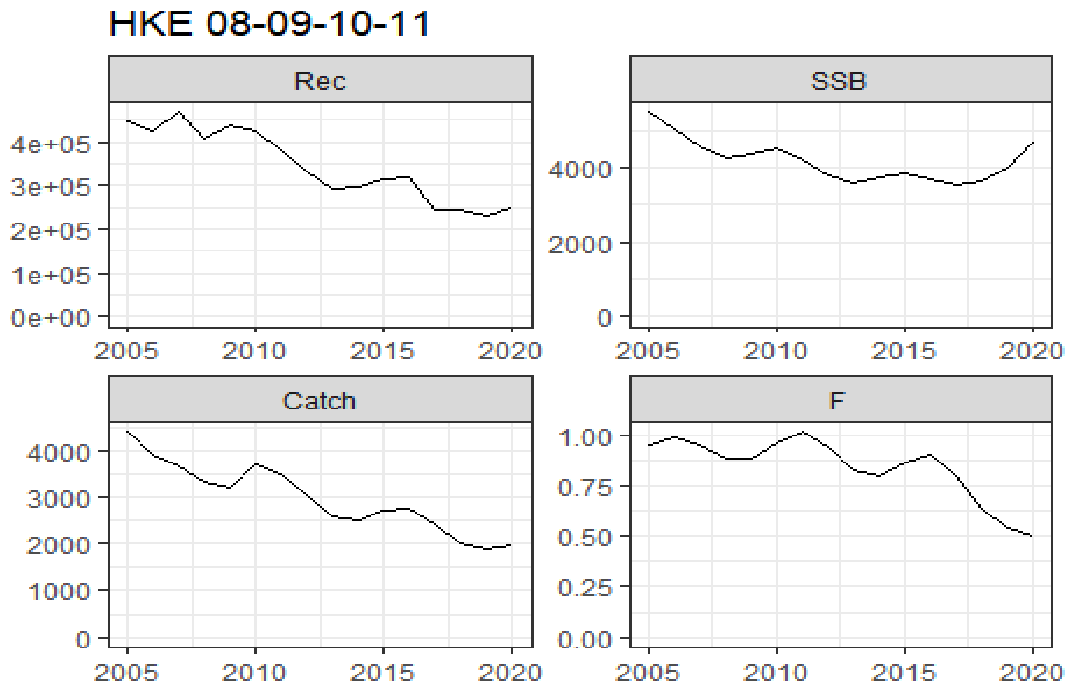


Figure 6.1.2.2: European hake in GSAs 8, 9, 10 and 11. Stock summary from the final a4a model.

An overview of the input data used in the assessment and outcomes is provided in Figure 6.1.2.3 - Figure 6.1.2.7

Figure 6.1.2.3: European hake in GSAs 8, 9, 10 and 11. Stock assessment trajectories at age.

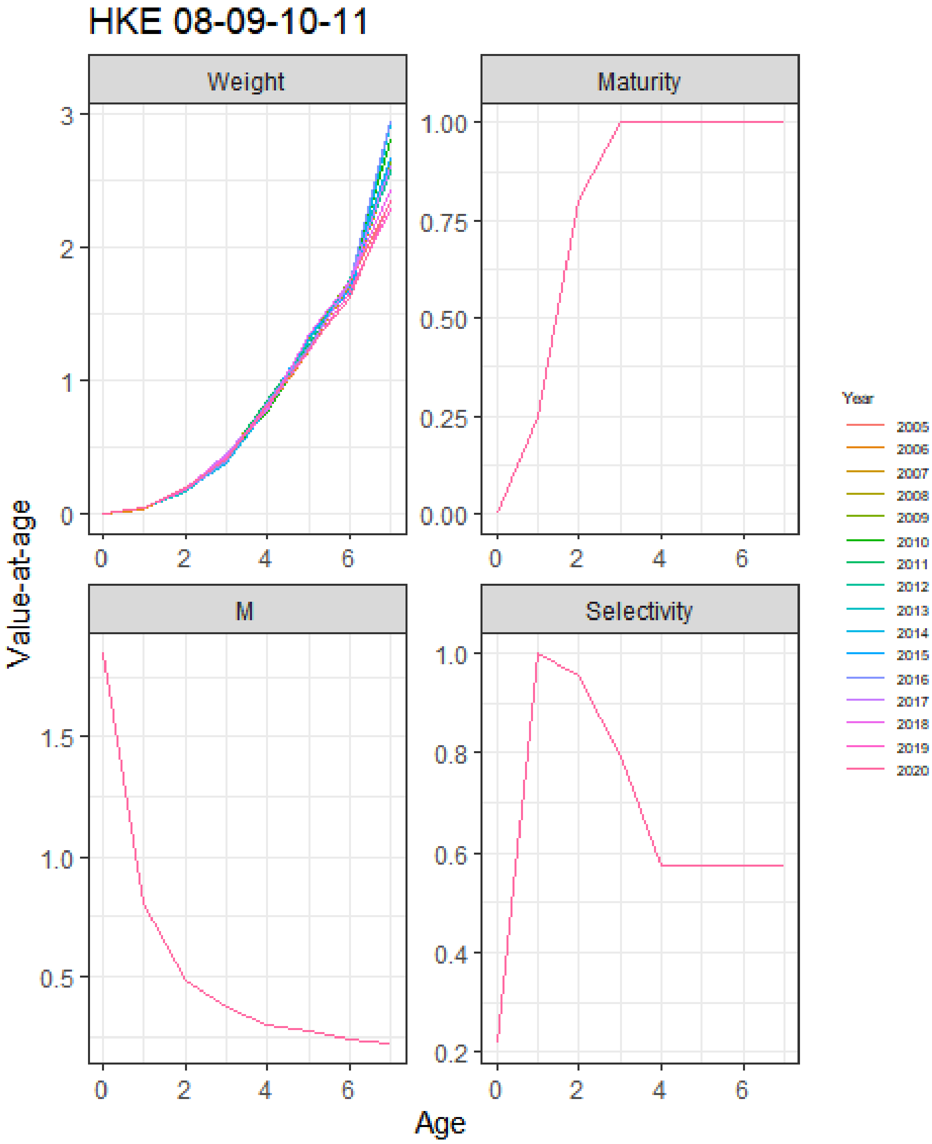


Figure 6.1.2.5: European hake in GSAs 8, 9, 10 and 11. Annual stock quantities at age: individual weights at age, fraction mature at age, natural mortality at age and selectivity at age in the fishery.

6.1.2.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.1.2.1.

Table 6.1.2.1: European hake in GSAs 8, 9, 10 and 11. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.168	0.1140	0.0285	0.5284	0.0117	0.2733

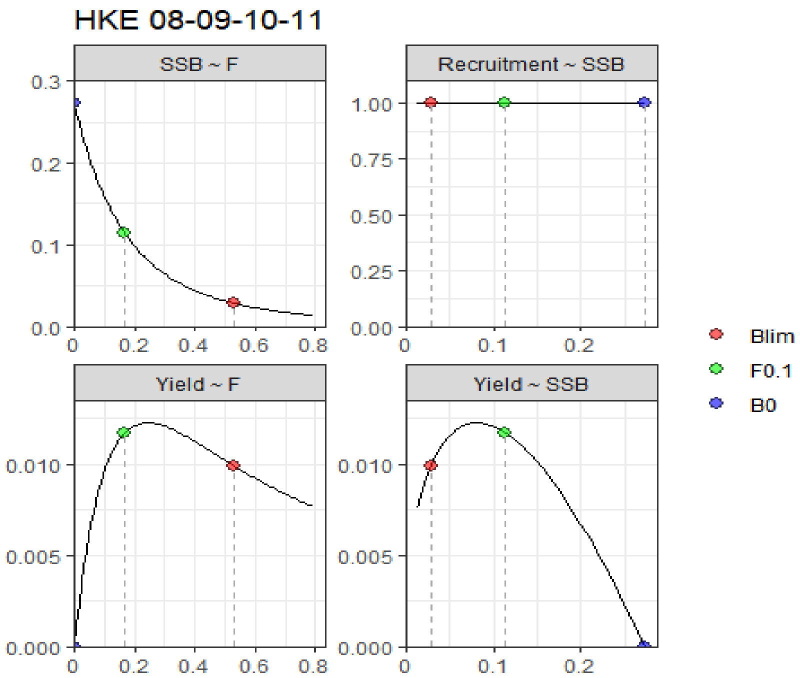


Figure 6.1.2.6: European hake in GSAs 8, 9, 10 and 11. Per-recruit analysis.

Figure 6.1.2.7 shows the trajectories of the assessment outputs relative to the per-recruit reference points R_0, SPR_0, YPR at $F_{0.1}$ and B_{Lim}. SSB is below the equilibrium biomass at $F_{0.1}$ ($B_{F0.1}$) and the B_{Lim} for the whole time series. At the same time, F is well above $F_{0.1}$ and Flim, with a sharp decrease in the last years, which brings F to be around the Flim values in 2020.

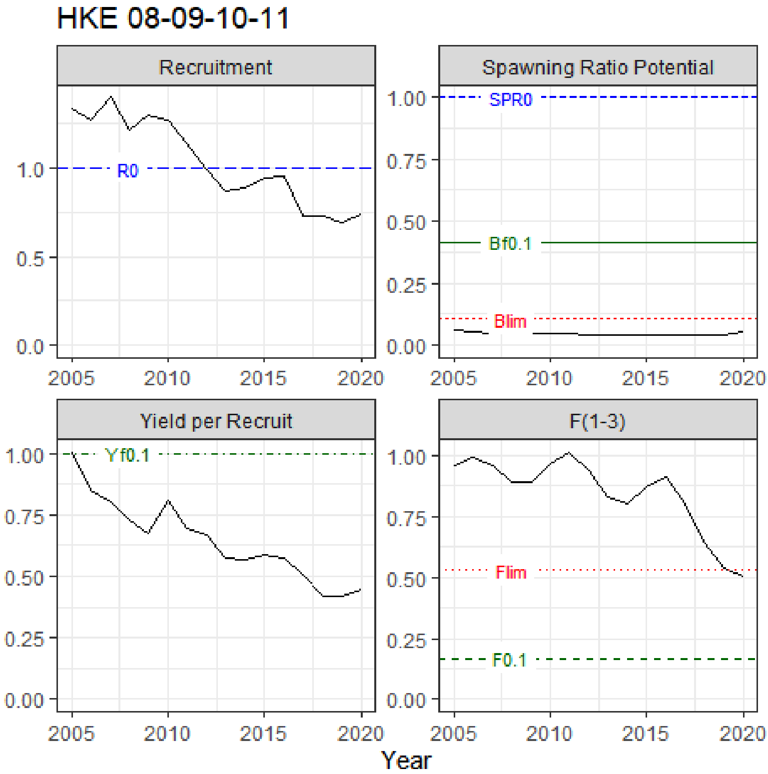


Figure 6.1.2.7: European hake in GSAs 8, 9, 10 and 11. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

Figure 6.1.2.8 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario. This figure supports a view of a stock that is over fished; the extent of overfishing appears to be less than that observed for hake in GSA 1, 5, 6 and 7.

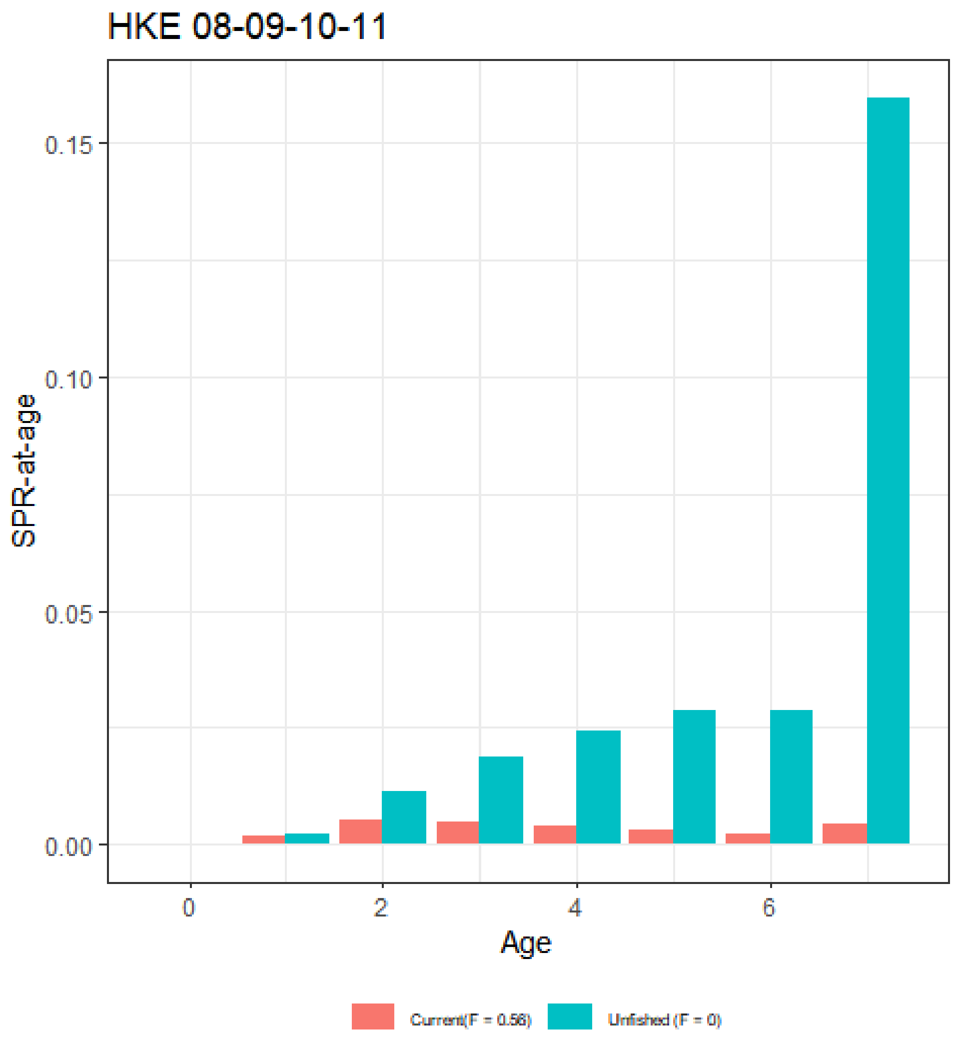


Figure 6.1.2.8: European hake in GSAs 8, 9, 10 and 11. Comparison of the spawning biomass per recruit SPRF at current F (average of last 3 years) and SPR0 with F = 0.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean)

2. Hockey-Stick (model=segreg)

3. Beverton-Holt (model=bevholtSV)

4. Ricker (model=ricker)

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly un constrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y. The results of the fits are given in Table 6.1.2.2 and Figure 6.1.2.9

Table 6.1.2.2: European hake in GSAs 8, 9, 10 and 11. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.246535	334757.6	0.910279	91479.74
Hockey-stick	NA	0.207391	379350.9	0.878428	103665.8
Beverton-Holt	0.885048	0.209228	1342544	0.8658	366879.2
Ricker	2.489579	0.184917	773625.3	0.878372	211409.8

The observed SR data are sitting on the left side of the R-SSB plot, and the breakpoint estimated by the HS model is within the observed values.

The break-point of the hockey-stick is estimated at b = 4316 corresponding to a SRPlim = 0.0416. The breakpoint from the Hockey-Stick comes from data and fits near the middle of the cloud of data points.

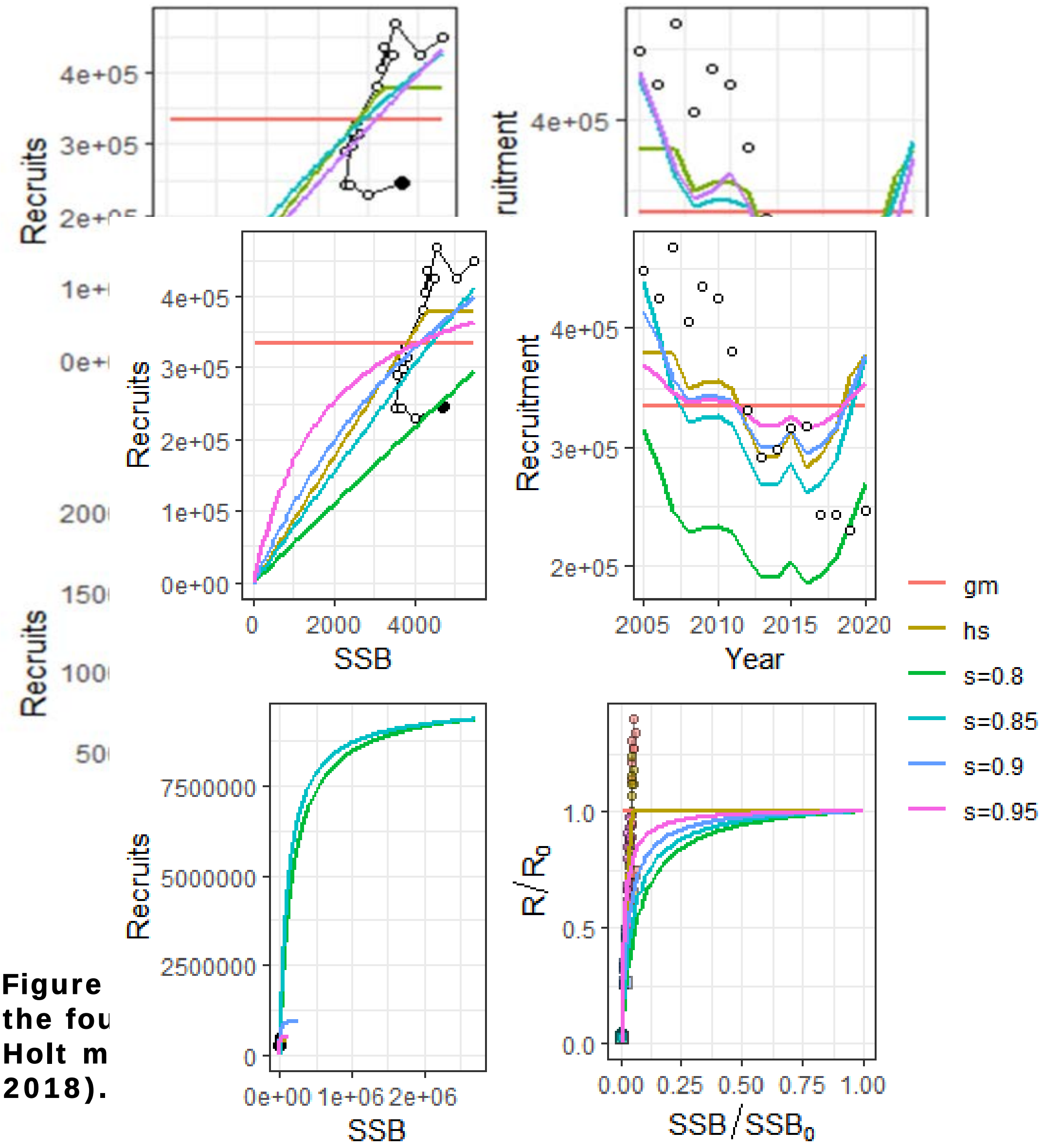


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Figure 6.1.2.10: European hake in GSAs 8, 9, 10 and 11. Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

Figure 6.1.2.10 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.8 – 0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates. Steepness's of 0.85 to 0.95 fit through the data, steepness of 0.8 or below do not. It is not possible to obtain consistent values of steepness from the given the available data.

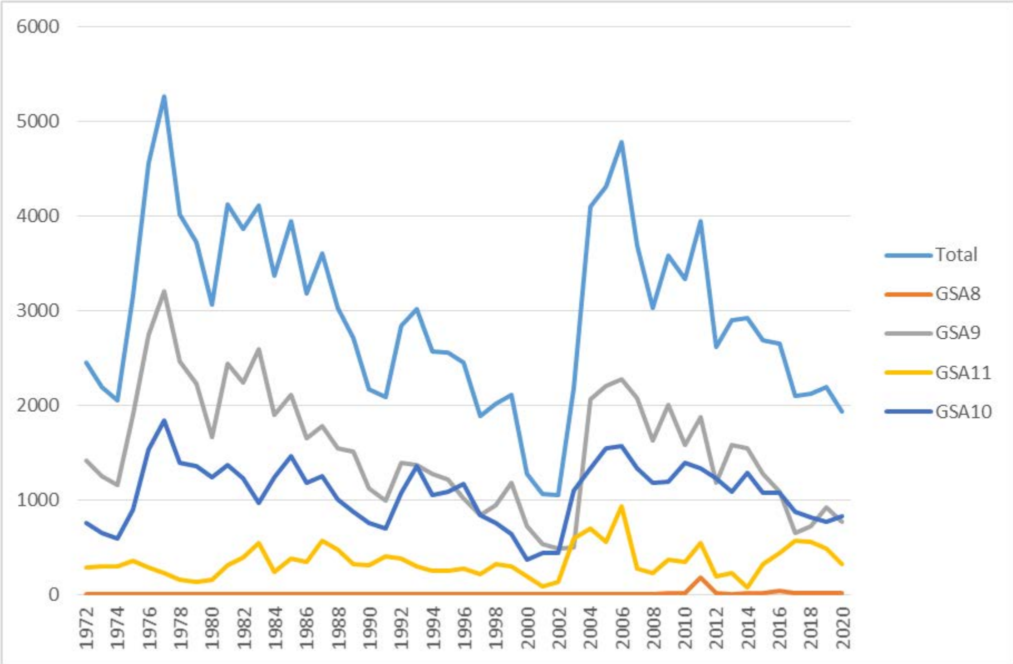

Figure 6.1.2.11: European hake in GSAs 8, 9, 10 and 11. Historical landings (tonnes) by GSA and total landings, and EU DCF landings of European hake in GSAs 8-9-10-11.

Historical landings were gathered from the Italian national official statistics (ISTAT) as collected and stored in the RECFISH project (Ligas, 2019). Landings for European were available from 1972 to 2001 and they are summarized in Figure 6.1.2.11, together with the EU DCF time series (2002-2020).

Historical landings are probably underestimated. The trend of the time series until 2001 and the one of the time series since 2002 appear to be similar; this could be the evidence of a misreporting of landings in the years preceding the DCF implementation and could support the shifting of the total landing before DCF to higher values. The different models (GM, HS and BH) give a small range of potential long term yields 4000 to 5600 (Figure 6.1.2.12) which are relative similar to one another, in the context of the uncertainty in historic landings. In this perspective, the landing of the species is in line with the results of the SR analysis. This also suggests some overfishing ($F > F_{0.1}$) and higher yields in the past with the potential for long term yields in the region of 4500 tonnes (Figure 6.1.2.12), consistent with the HS model. This information also supports the view that the stock is depleted but recent recruitment (GM) is not far below expected long term average recruitment at MSY (Figure 6.1.2.12).

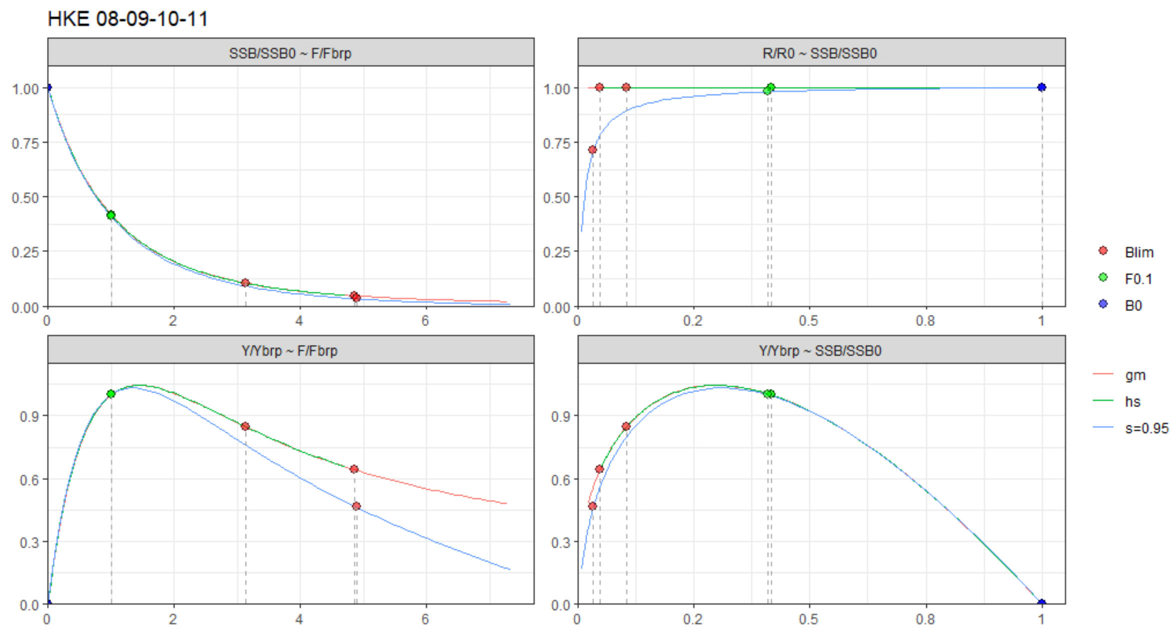

Figure 6.1.2.12: European hake in GSAs 8, 9, 10 and 11. Long Term equilibrium evaluations for different S-R models showing similarity

6.1.2.3 Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Hockey-stick approach the most appropriate to estimate the biomass reference points for the stock of European hake in GSAs 8, 9, 10 and 11. Table 6.1.2.3 summaries the reference point values based on the Hockey-Stick model fitted to the data. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics are illustrated in Figure 6.1.2.14, and the historic assessment information is shown in this context in Figure 6.1.2.13 and Figure 6.1.2.15. In conclusion the stock is considered to be just above B_{Lim} in 2020.

Table 6.1.2.3 European hake in GSAs 8, 9, 10 and 11. Final reference points based on Hockey-Stick stock recruit model fitted to the data.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.168	4316	8632	43255	103665	0.602

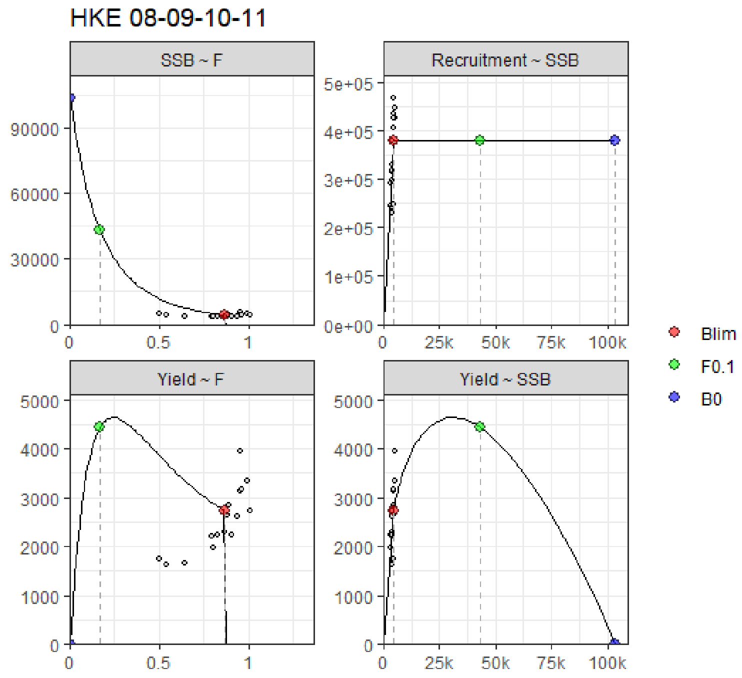

Figure 6.1.2.14: European hake in GSAs 8, 9, 10 and 11. Equilibrium yield with HS model.

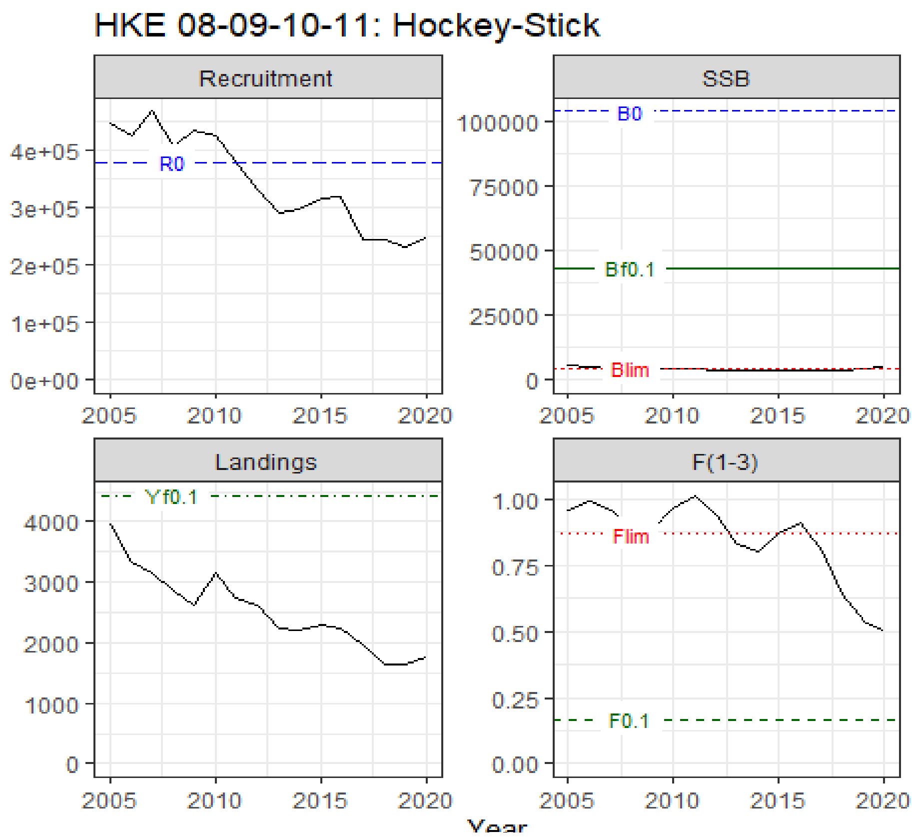

Figure 6.1.2.13: European hake in GSAs 8, 9, 10 and 11. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

6.1.2.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above are illustrated in Figure 6.1.2.10. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.95 (Figure 6.1.2.16).

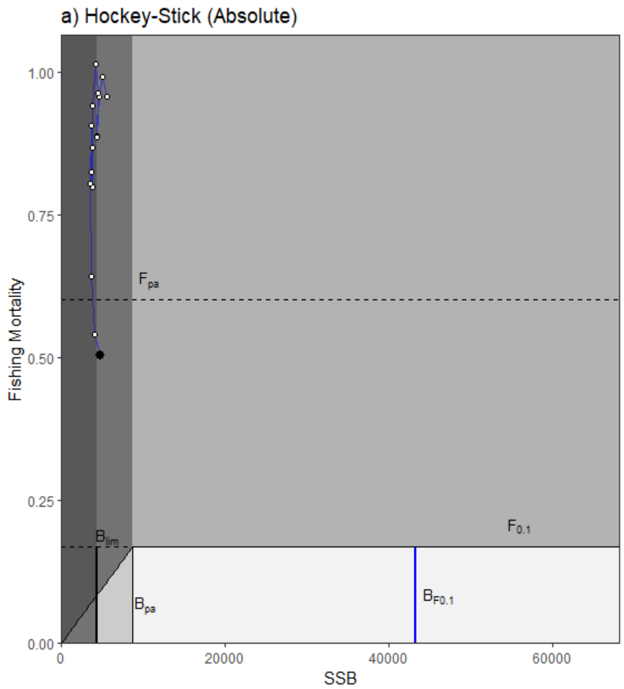

Figure 6.1.2.15: European hake in GSAs 8, 9, 10 and 11. Advice Rule plots, with Bpa = 2 BLim and BLim based on fit to the data.

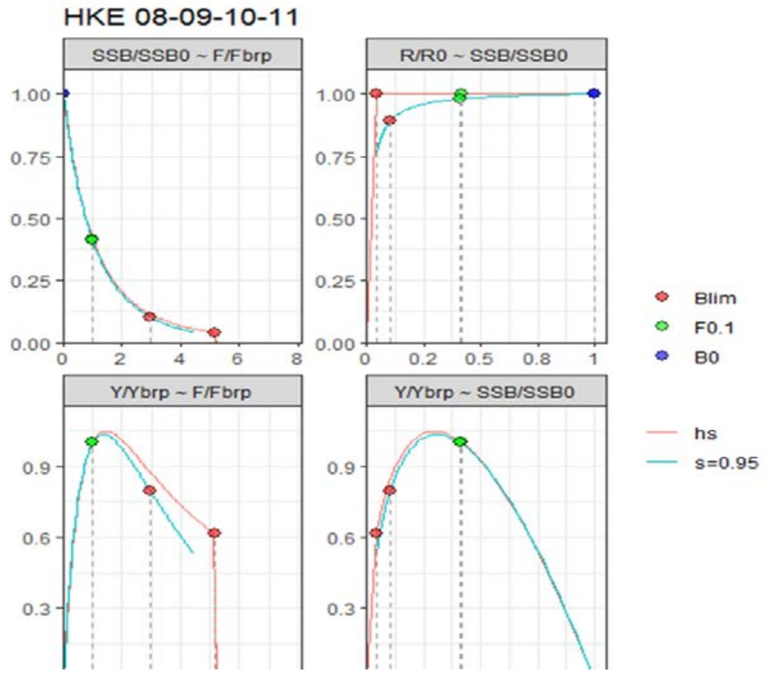

Figure 6.1.2.16: European hake in GSAs 8, 9, 10 and 11. Advice Rule plots, with Bpa = 2 BLim and BLim based on fit to the data.

6.2 Deepwater Rose Shrimp

6.2.1 Deep water rose shrimp (DPS) in GSAs 9, 10 and 11

6.2.1.1 Stock assessment

The assessment of deep water rose shrimp, *Parapenaeus longirostris*, carried out during the STECF EWG 21-11 considered the stock shared by the GSAs 9, 10 and 11 (Figure 6.2.1.1). No information from GSA 8 was included in the assessment, it is considered unlikely that the small catches (if any) from GSA 8 will change the perception of this stock, but final B_{Lim} value will need to be adjusted if other catch is added.

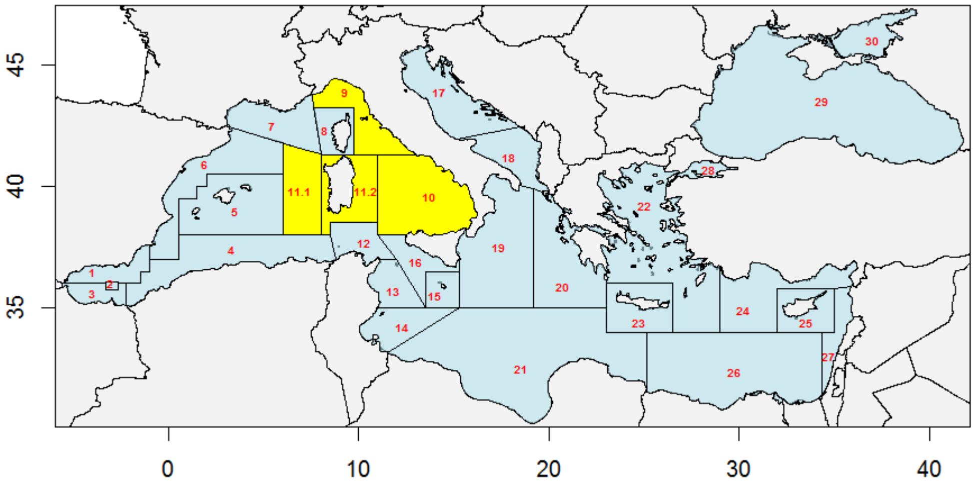

Figure 6.2.1.1: Deep water rose shrimp in GSAs 9, 10 and 11. Limit of Geographical Sub-Areas (GSAs) 9, 10, 11.

The assessment was performed using catch-at-age data from commercial fisheries in the period 2009-2020, tuned with the index-at-age data from the MEDITS survey in GSAs 9, 10 and 11 (2009-2020). The assessment was performed with SCAA using a4a. The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.2.1.2.

During EWG 22-03, the maturity vector was changed from that used by EWG 21-11: a maturity proportion equal to 0 was used at age-0, instead of 0.45 as used by EWG 21-11. This modification was adopted as it is believed to be more consistent with the biology of the species.

The outputs of the assessment done at EWG 21-11 with the new SSB pattern are summarized in Figure 6.2.1.2.

n overview of the input data used in the assessment and outcomes is provided in Figure 6.2.1.3 - Figure 6.2.1.5

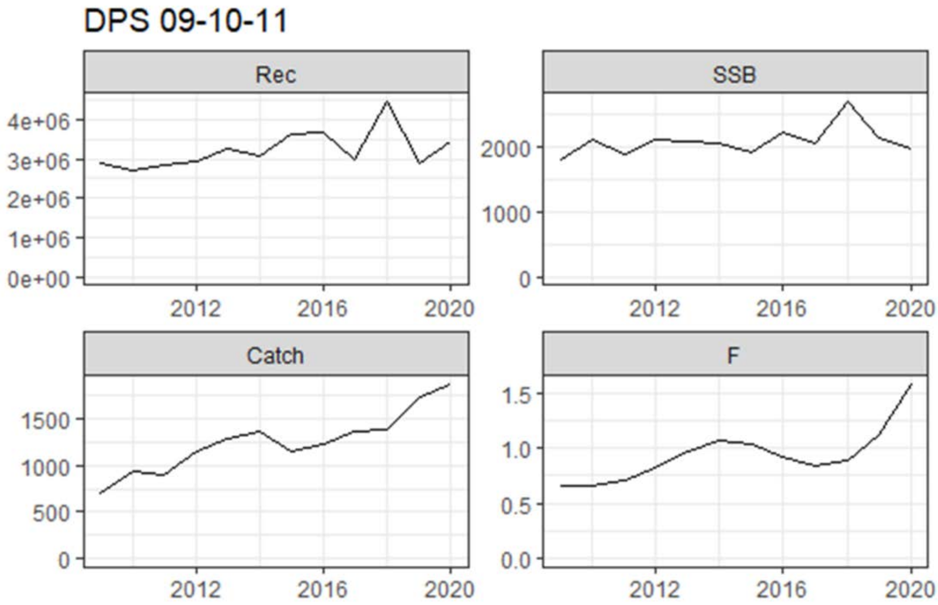

Figure 6.2.1.2: Deep water rose shrimp in GSAs 9, 10 and 11. Stock summary from the final a4a model.

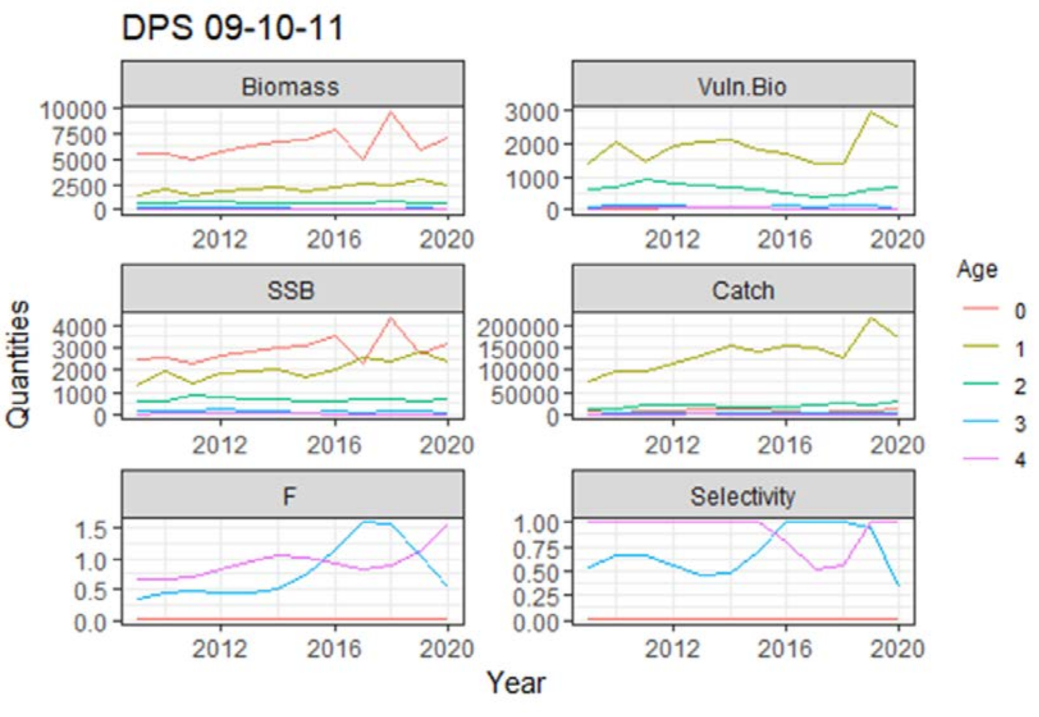

Figure 6.2.1.3: Deep water rose shrimp in GSAs 9, 10 and 11. Stock assessment trajectories at age.

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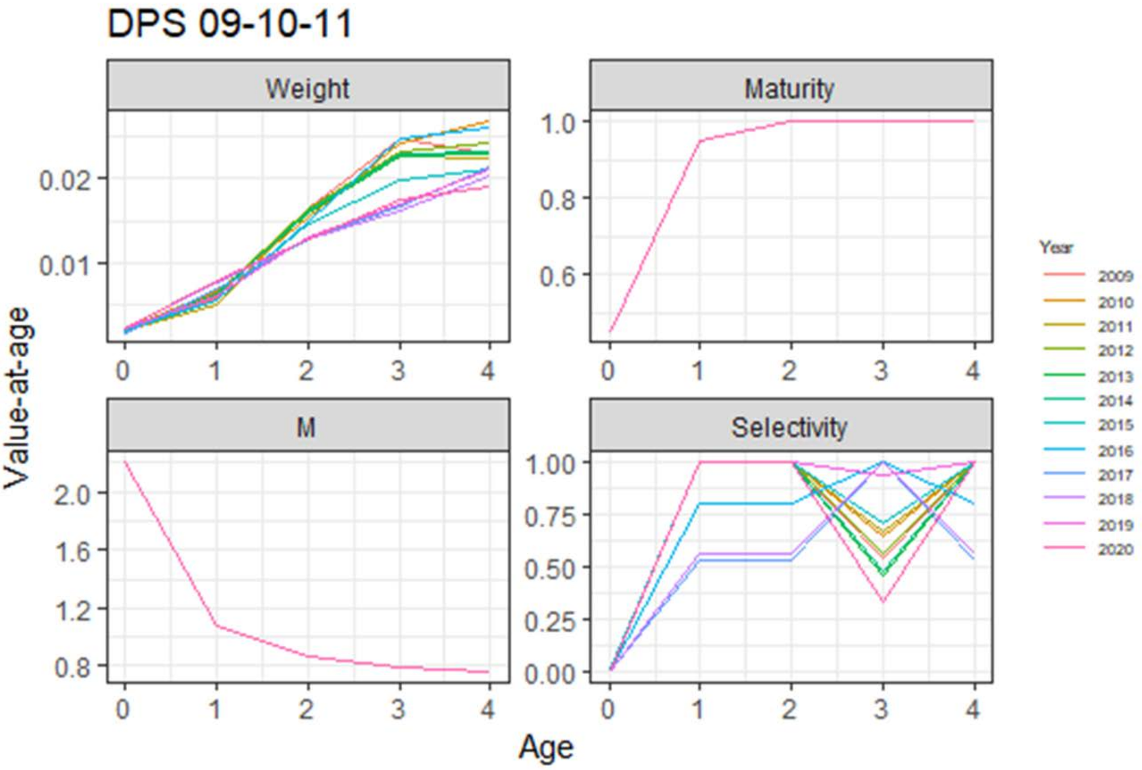


Figure 6.2.1.5: Deep water rose shrimp in GSAs 9, 10 and 11. Annual stock quantities at age: individual weights at age, fraction mature at age, natural mortality at age and selectivity at age in the fishery. The maturity at age 0 was modified from the value of 0.45 us

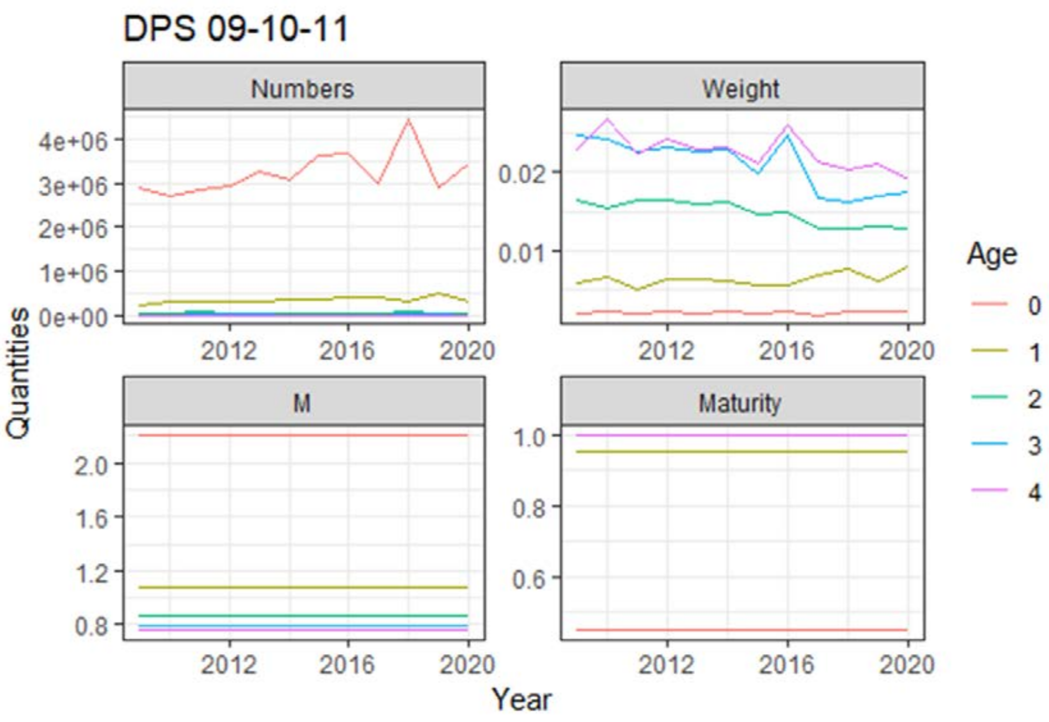


Figure 6.2.1.4: Deep water rose shrimp in GSAs 9, 10 and 11. Stock biology trajectories at age.

6.2.1.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.2.1.1 and Figure 6.2.1.1.

Table 6.2.1.1: Deep water rose shrimp in GSAs 9, 10 and 11. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
1.29	0.000281	0.000074	3.56	0.000475	0.001110

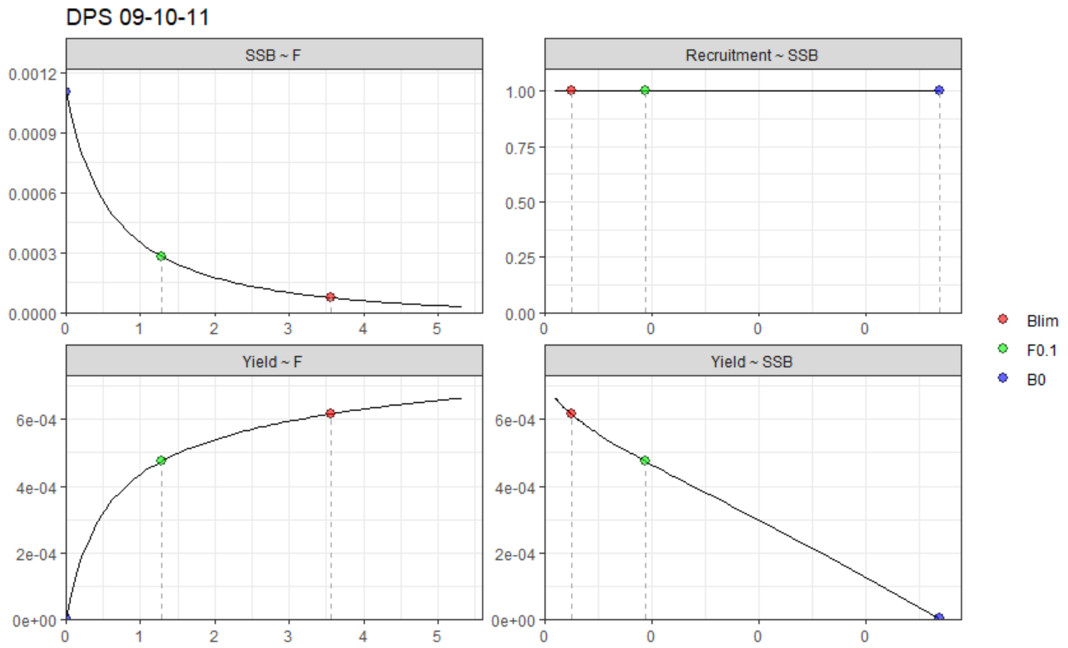


Figure 6.2.1.6: Deep water rose shrimp in GSAs 9, 10 and 11. Per-recruit analysis.

Figure 6.2.1.7 is showing the trajectories of the assessment outputs against the per-recruit reference points. SSB has been fluctuating slightly above the biomass at $F_{0.1}$ ($B_{F0.1}$) and well above B_{Lim}, with a value very close to $B_{F0.1}$ in the last year of the time series. At the same time, F has been always below $F_{0.1}$, with the only exception being the last year of the time series.

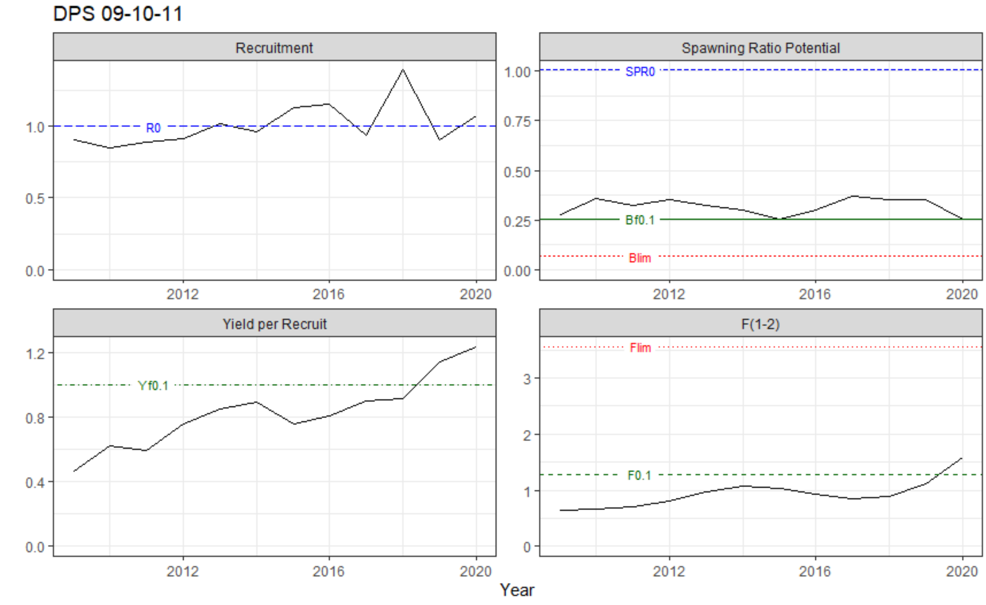


Figure 6.2.1.7: Deep water rose shrimp in GSAs 9, 10 and 11. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

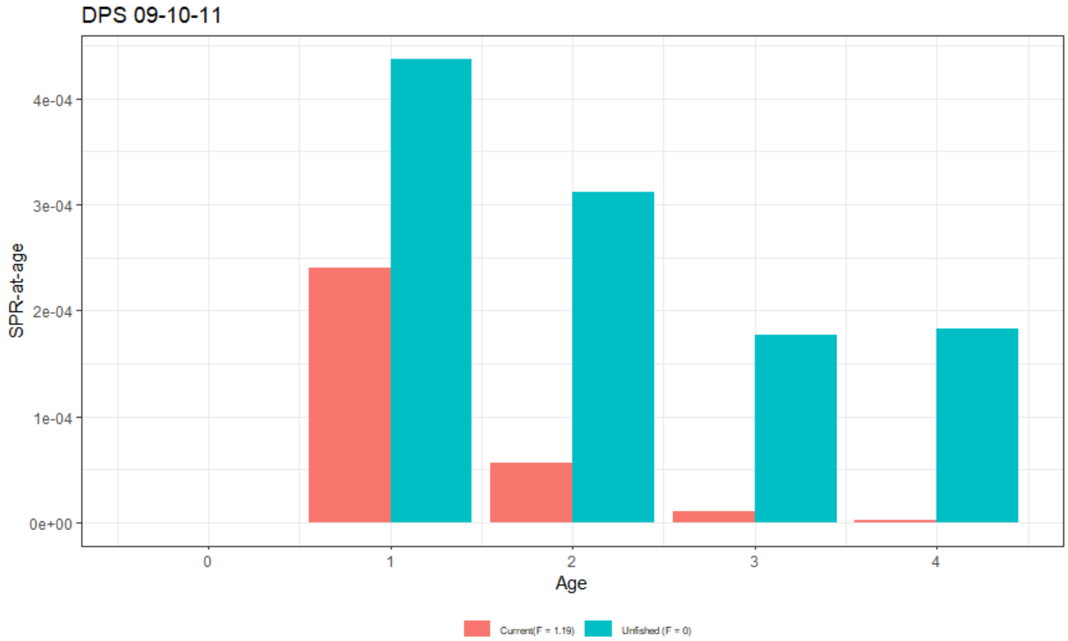


Figure 6.2.1.8: Deep water rose shrimp in GSAs 9, 10 and 11. Comparison of the spawning biomass per recruit SPRF at current F (average of last 3 years) and SPR0 with F = 0.

Figure 6.2.1.8 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario. This does not show evidence of overfishing.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean)

2. Hockey-Stick (model=segreg)

3. Beverton-Holt (model=bevholtSV)

4. Ricker (model=ricker)

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.2.1.2: Deep water rose shrimp in GSAs 9, 10 and 11. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.142389	3197123	-0.0693194	3549.693
Hockey-Stick	NA	0.1363269	3197123	-0.0693194	3549.693
Beverton-Holt	0.9905729	0.1364489	3215156	-0.0746591	3569.715
Ricker	0.8428332	0.1688646	2724072	0.1115038	3024.475

The observed SR data are sitting on the right part of the R-SSB plot, and the breakpoint from the HS model is well below the observed values, and comes from the limit parameters used in the fit.

The results show that the recruitment variation fairly low, e.g. σr = 0.25 for the Beverton-Holt model, associated with a steepness of s = 0.39. The predicted recruitment by Hockey-Stick, Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the three model differ largely in scale of their R_0 and B_0 estimates. Information on the slope to the origin is not found within the observed SSB Recruitment results from the assessment.

In order to obtain B_{Lim} assumptions on slope to the origin are required, as the Beverton-Holt models have considerable uncertainty with no data to estimate the slope, the default setting for the Hockey-Stick (at 0.25* $B_{F0.1}$) is applied. The break-point of the Hockey-Stick is estimated at b = 225 and the corresponding R_0 is equal to the geometric mean recruitment. The breakpoint from the Hockey-Stick comes from the control settings and is not informed by the data.

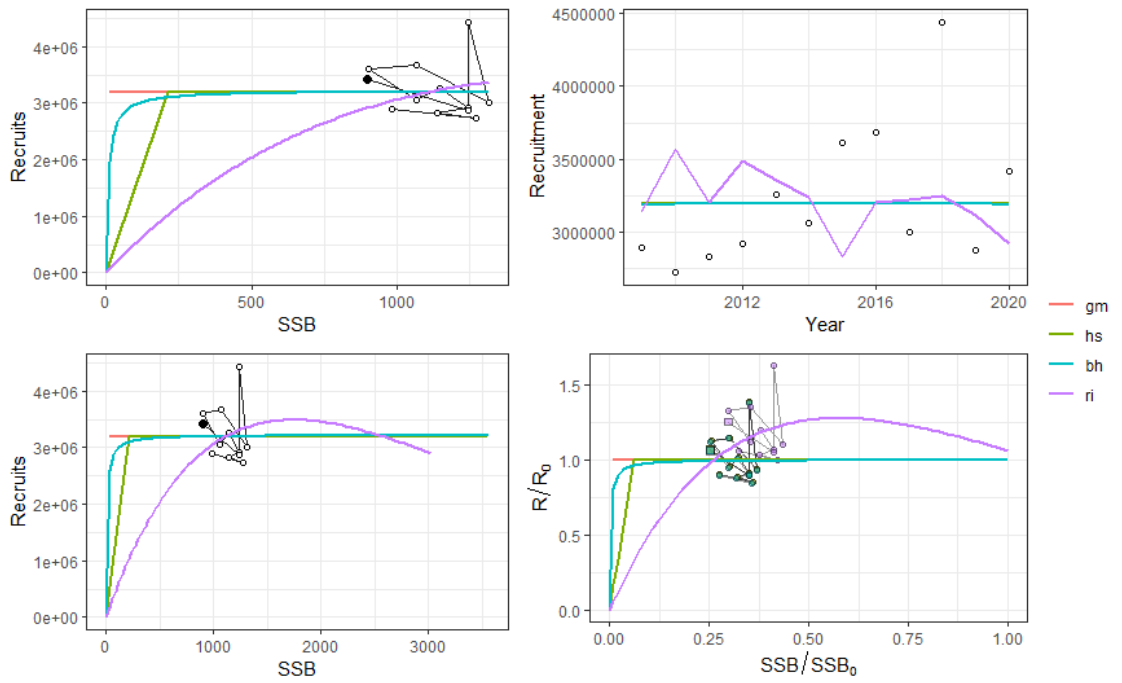


Figure 6.2.1.9: Deep water rose shrimp in GSAs 9, 10 and 11. Summary of the four SR models.

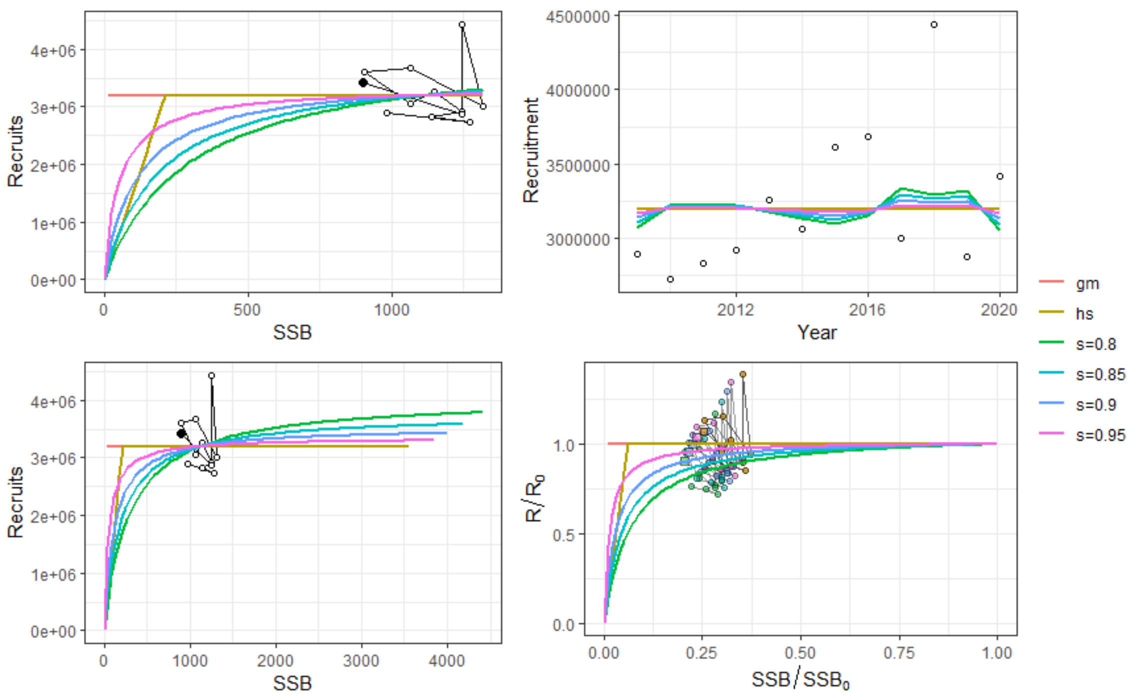


Figure 6.2.1.10: Deep water rose shrimp in GSAs 9, 10 and 11. Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Geometric Mean approach the most appropriate to estimate the biomass reference points for the stock of deep water rose shrimp in GSAs 9, 10 and 11. Table 6.2.1.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in Figure 6.2.1.11, and the historic assessment information is shown in this context in Figure 6.2.1.12 and Figure 6.2.1.13. In conclusion the stock is considered to be close to $B_{F0.1}$ in 2020.

Table 6.2.1.3 Deepwater rose shrimp in GSA 9, 10 and 11. Final reference points based on Geometric mean and a default value of B_{Lim} =25% $B_{F0.1}$.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
1.29	225	450	900	3550	2.37

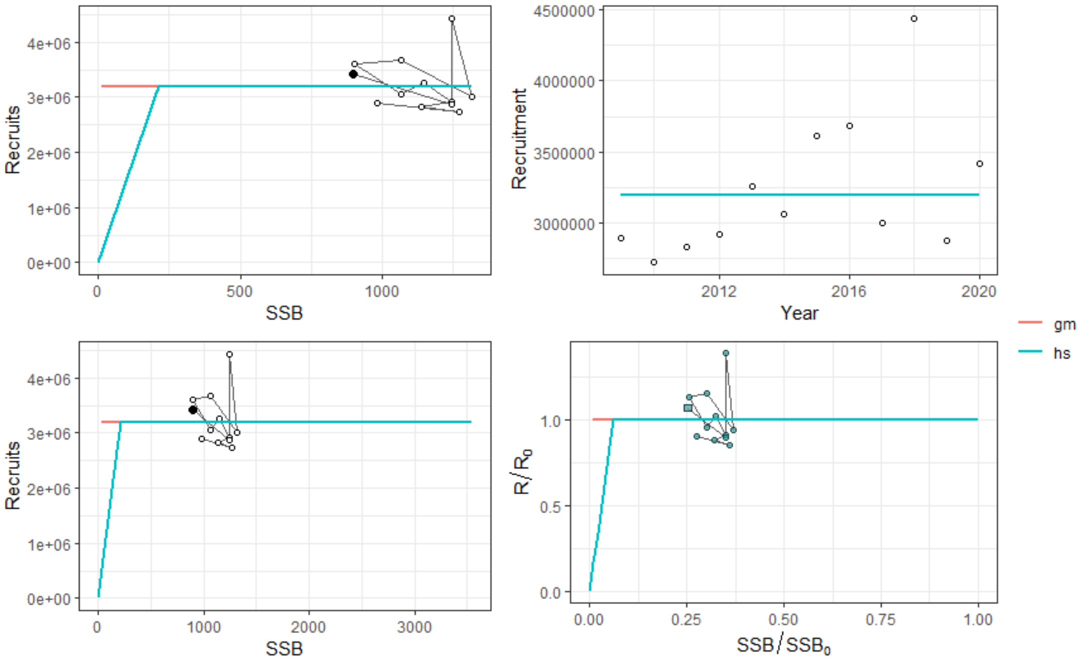
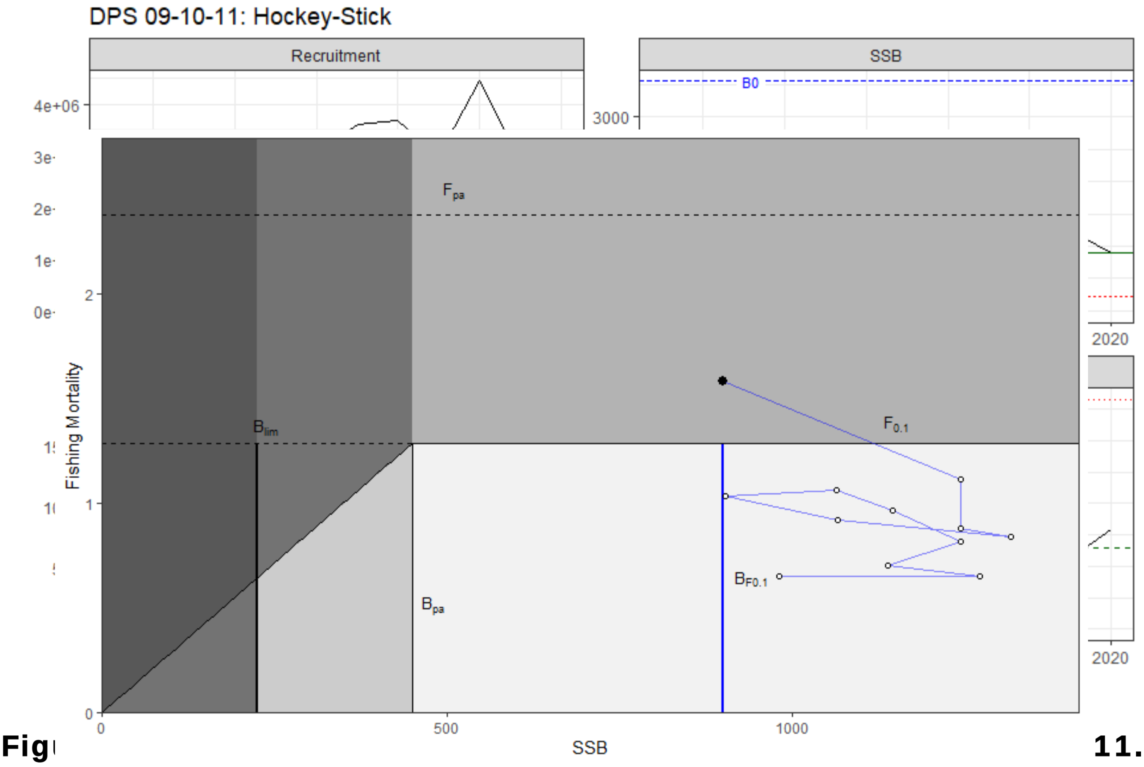


Figure 6.2.1.11: Deep water rose shrimp in GSAs 9, 10 and 11. Equilibrium yield with gm and HS models comparison.



Fig… 11. Sta… , F, Lan… nts, bas…

Figure 6.2.1.13: Deep water rose shrimp in GSAs 9, 10 and 11. Advice Rule plot, with B_{pa} = 2 B_{Lim}, based on Geometric mean R to give $B_{F0.1}$ with a default B_{Lim} = 0.25 $B_{F0.1}$.

6.2.1.3 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but may not be the most suitable for modelling stock dynamics. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above and illustrated in Figure 6.2.1.14, the steepness option that most closely mimics the HS chosen is thought to be steepness = 0.90.

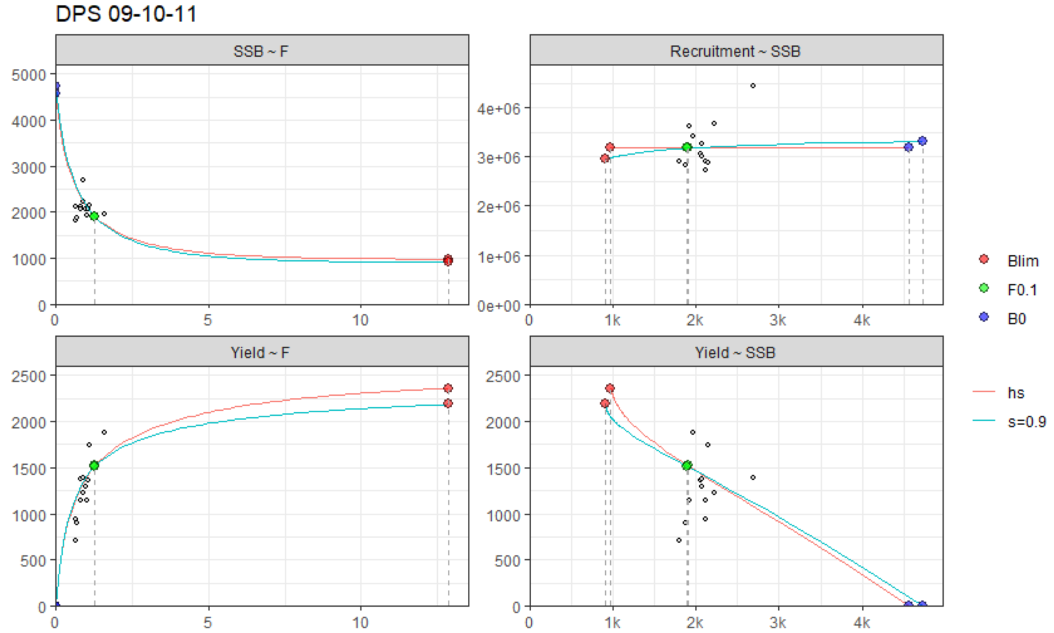


Figure 6.2.1.14: Deep water rose shrimp in GSAs 9, 10 and 11. Equilibrium yield with HS and BH (steepness 0.90) models comparison.

6.2.1.4 Stock assessment

An evaluation of deep-water rose shrimp stocks by GSA was carried out during STECF EWG 21-11. The assessments carried out on the four GSAs (Figure 6.2.2.1) were not accepted for advice and reference points were not calculated.

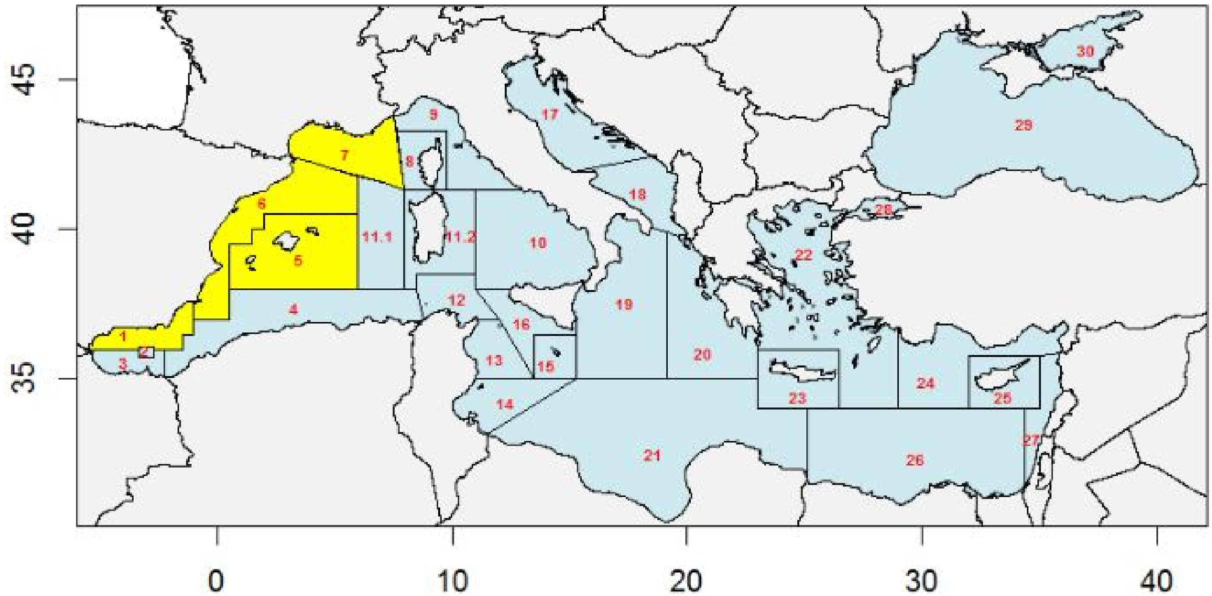


Figure 6.2.2.1: Deepwater Rose Shrimp GSAs 1, 5, 6 and 7. Limit of Geographical Sub-Areas (GSAs) 1, 5, 6, 7.

6.2.1.5 Exploratory analysis

In order to make a rough comparison between the current exploitation of stocks in GSAs 1-5-6-7 and that in GSAs 9-10-11, a ratio between commercial catches and MEDITS biomass indices was calculated as a “Harvest Rate Proxy”; biomass can be considered equivalent to SSB in MEDITS as catches are almost all mature

Such a harvest rate proxy could then be compared to similar havest rate proxies in other areas to assess relative exploitation levels in stocks where assessments are not available to derive reference points directly..

If we assume that the MEDITS data is comparable across all GSAs (1-5-6-7-9-10-11), then the Harvest Rate Proxy suggests that the exploitation of deep-water rose shrimp stocks is at a lower rate in the GSAs 1-5-6-7. However, this is a stong assumption, requiring:

Survey catchabilities are the same across the areas,

The selectivity and vulnerability in the fishery is the same in the fisheries across the areas.

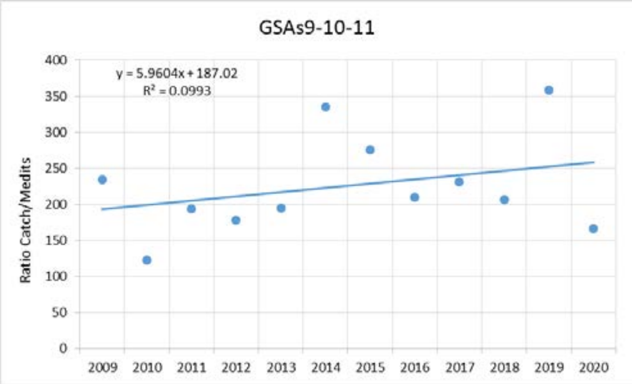
Biologically the natural mortalities are the same,

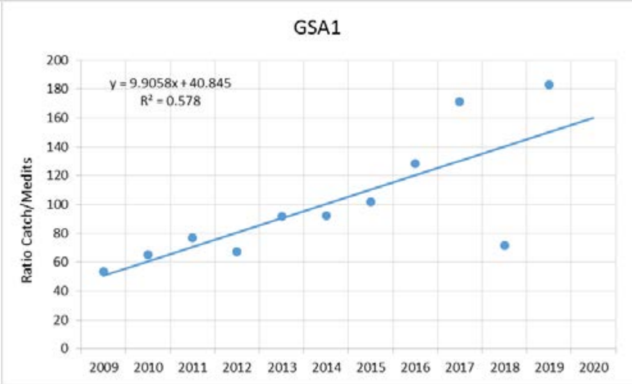
The range size is similar among the different depth strata

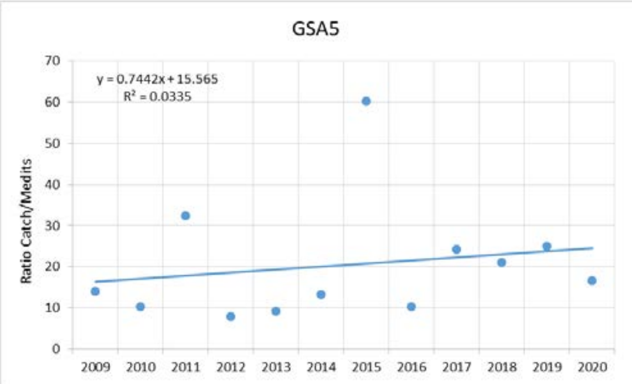
At Best all that can be said is that based on the analysis in Section 6.2.1 the F in GSAs 9-10-11 is generally at or below MSY (except in the last year), there is no evidence that F is above MSY for the deep-water rose shrimp stocks in the western GSAs.

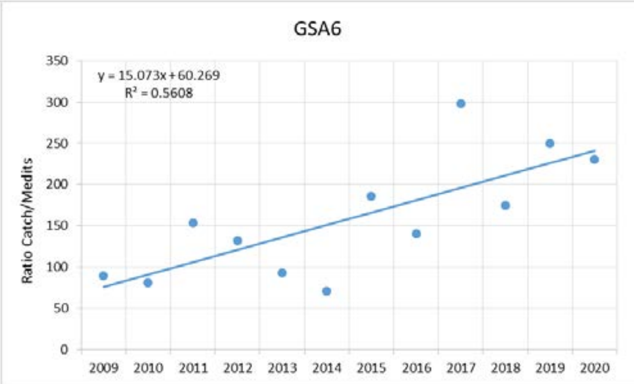
Another option would be to compare the slope of the catch curves for both the survey and the catch data. While this still ignores selectivity differences, this will check if the surveys are consistent with the catch data within and between stocks and give you some information regarding the similarity in biology between the stocks. However, the narrow range of ages available may hamper this approach.

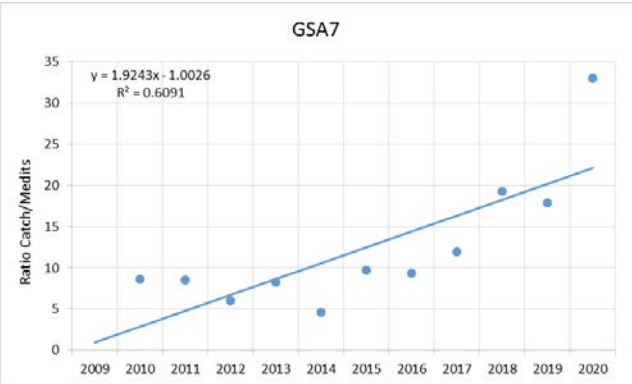
Overall it seems likely more work is required, see Section 3 and that currently no clear conclusions can be drawn.

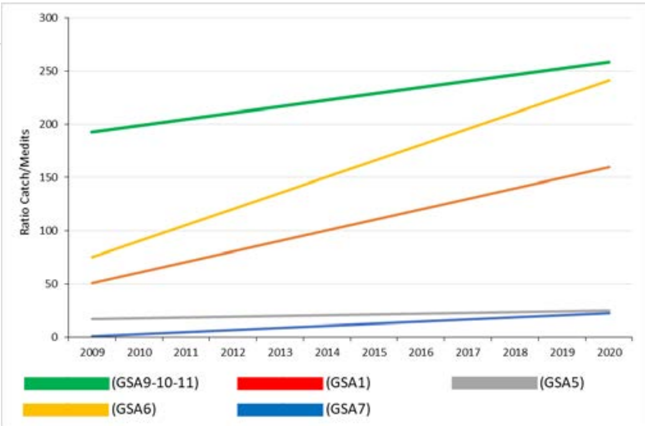












6.2.2 Deep-water rose shrimp (DPS) in GSAs 1, 5,6 and 7

6.2.2.1 Stock assessment

An evaluation of deep-water rose shrimp stocks by GSA was carried out during STECF EWG 21-11. The assessments carried out on the four GSAs (Figure 6.2.2.1) were not accepted for advice and reference points were not calculated.

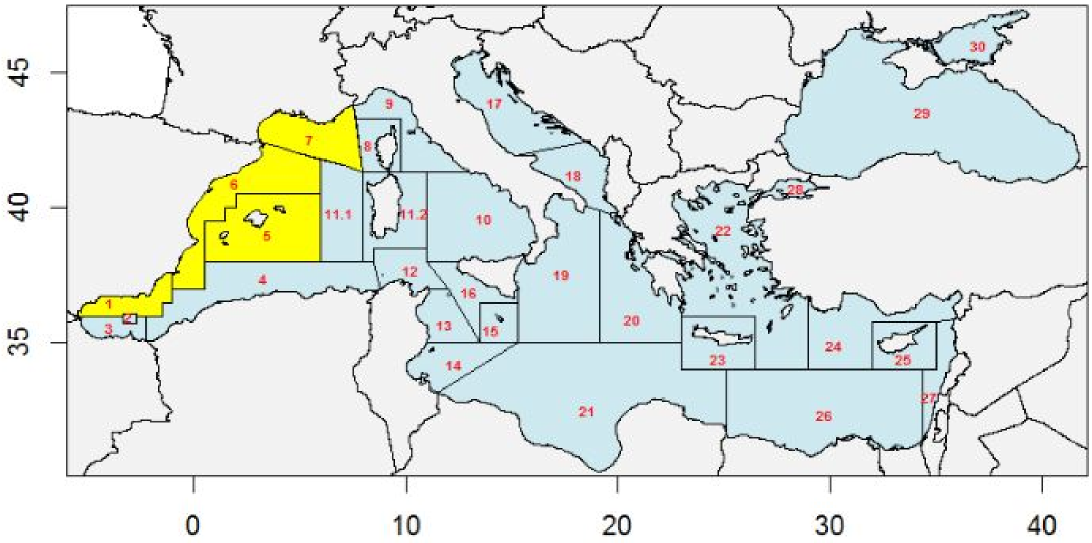


Figure 6.2.2.1: Deepwater Rose Shrimp GSAs 1, 5, 6 and 7. Limit of Geographical Sub-Areas.

6.2.2.2 Exploratory analysis

In order to make a rough comparison between the current exploitation of stocks in GSAs 1-5-6-7 and that in GSAs 9-10-11, a ratio between commercial catches and MEDITS biomass indices was calculated as a “Harvest Rate Proxy”; biomass can be considered equivalent to SSB in MEDITS as catches are almost all mature

Such a harvest rate proxy could then be compared to similar havest rate proxies in other areas to assess relative exploitation levels in stocks where assessments are not available to derive reference points directly..

If we assume that the MEDITS data is comparable across all GSAs (1-5-6-7-9-10-11), then the Harvest Rate Proxy suggests that the exploitation of deep-water rose shrimp stocks is at a lower rate in the GSAs 1-5-6-7. However, this is a stong assumption, requiring:

Survey catchabilities are the same across the areas,
The selectivity and vulnerability in the fishery is the same in the fisheries across the areas.
Biologically the natural mortalities are the same,
The range size is similar among the different depth strata

At best all that can be said is that based on the analysis in Section 6.2.1.1 the F in GSAs 9-10-11 is generally at or below MSY (except in the last year), there is no evidence that F is above MSY for the deep-water rose shrimp stocks in the western GSAs.

Another option would be to compare the slope of the catch curves for both the survey and the catch data. While this still ignores selectivity differences, this will check if the surveys are consistent with the catch data within and between stocks and give you some information regarding the similarity in biology between the stocks. However, the narrow range of ages available may hamper this approach.

Overall it seems likely more work is required, see Section 3 and that currently no clear conclusions can be drawn.

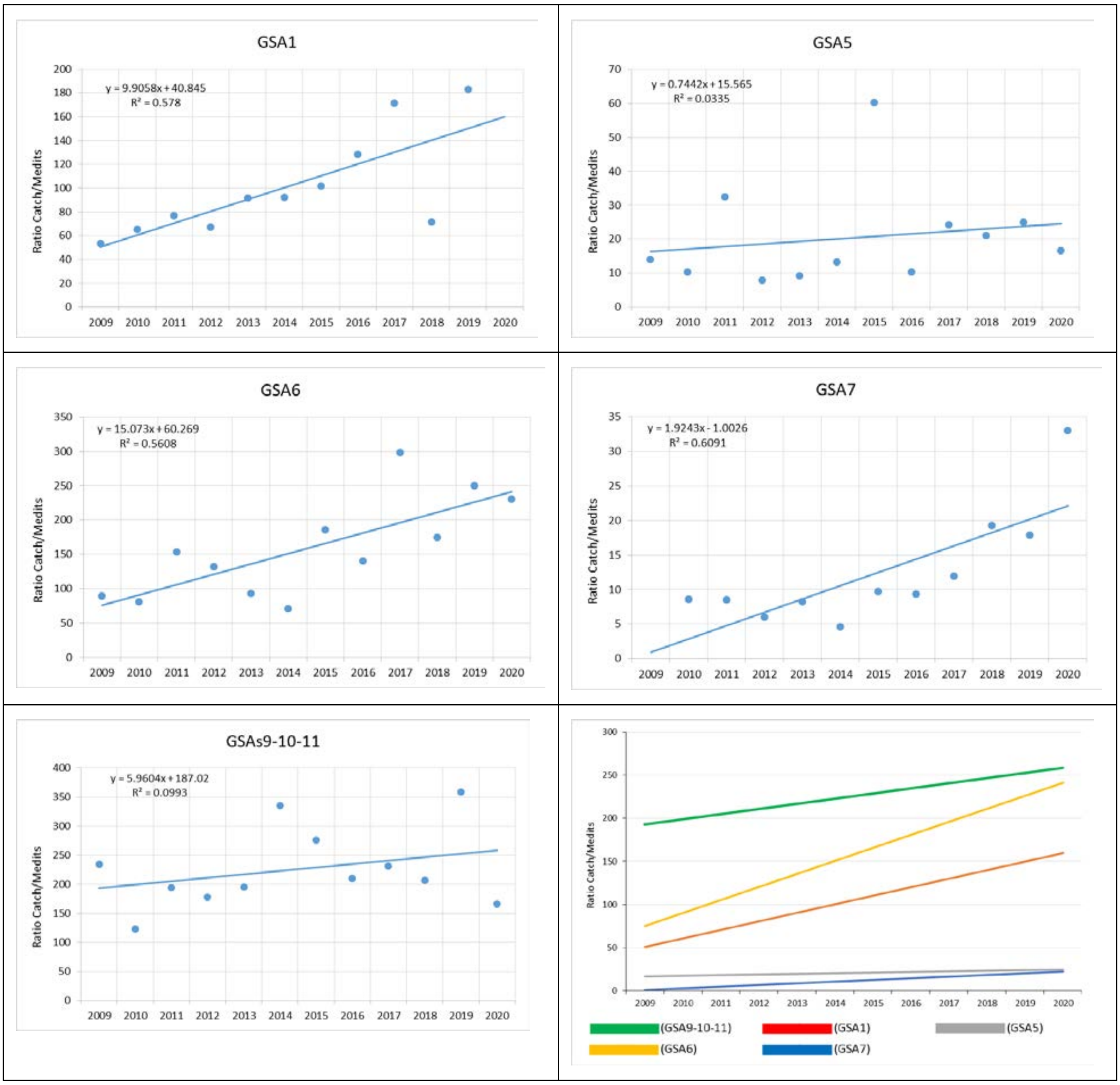


Figure 6.2.2.2: Deepwater Rose Shrimp GSAs 1, 5, 6 and 7 (top for plots) and GSA 9, 10 (bottom left) catch to absolute survey biomass estimates over time and the comparison of the trends over time (bottom right)

6.3 Red Mullet

6.3.1 Red mullet (MUT) in GSA 1

6.3.1.1 Stock assessment

The assessment of red mullet, *Mullus barbatus*, carried out during the STECF EWG 21-11 for GSA 1 was performed using catch-at-age data from commercial fisheries in the period 2002-2020, tuned with the index-at-age data from the MEDITS survey in GSA 1 (Figure 6.3.1.1). The assessments were performed with SCAA using a4a, and can be consulted at https://stecf.jrc.ec.europa.eu/ewg2111. The outputs of the assessment is summarized in Figure 6.3.1.2.

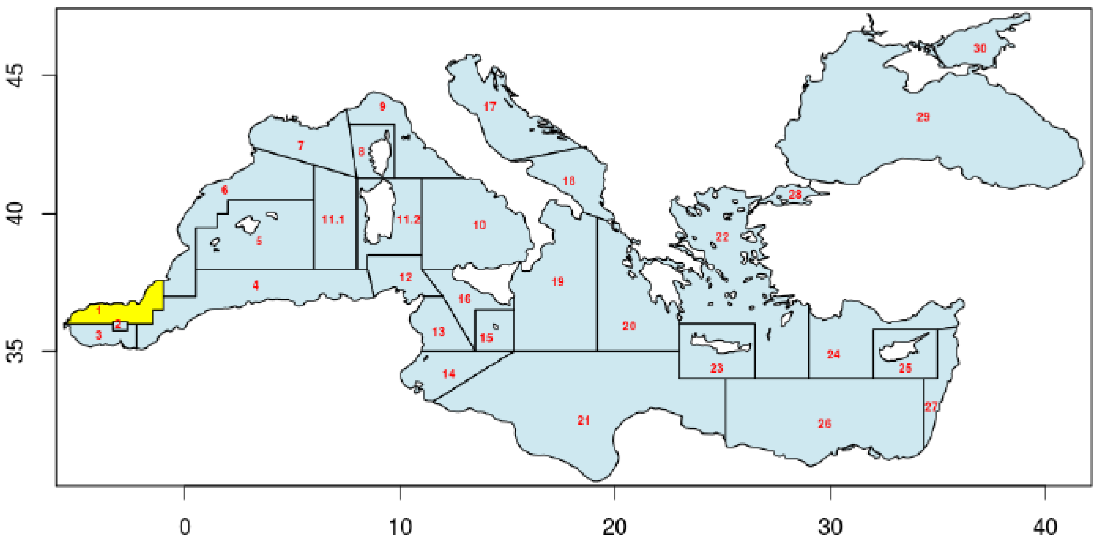


Figure 6.3.1.1: Red mullet in GSA 1: Location of GSA 1 in the Mediterranean Sea.

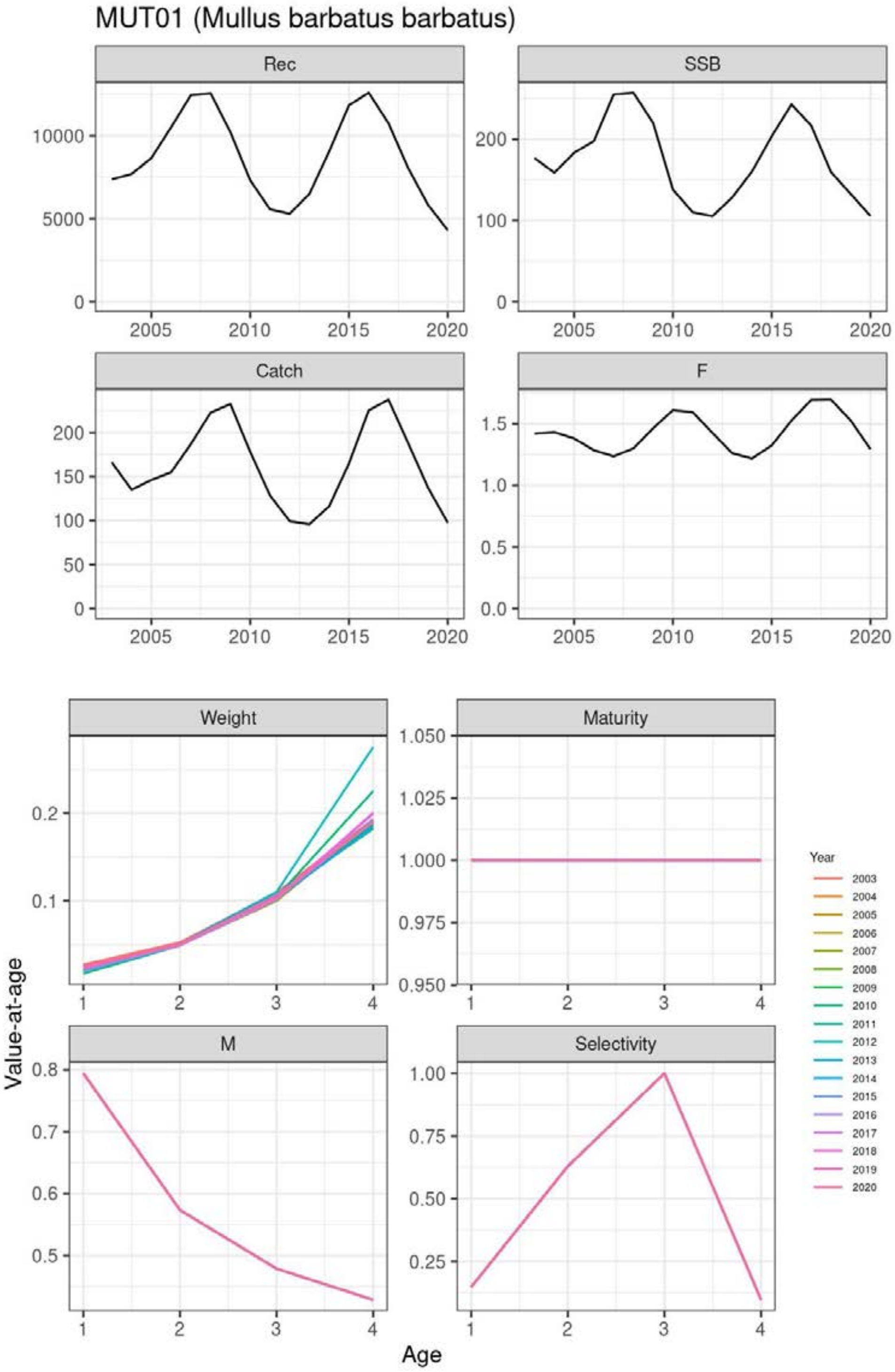


Figure 6.3.1.2: Red mullet in GSA 1. Stock summary from the final a4a model. Catch recruitment SSB and F are outputs from the model. Individual weights at age, fraction mature at age, natural mortality at age are input data and selectivity at age in the fishery is estimated in the model.

The model assumes maturity at age 1 and older, selectivity is low at age 0 and then strongly increases up to age 2. It then drops, which may reflect that some of the older individuals are located in areas either not targeted by or unavailable to the fishery. Recruitment has fluctuated

(GSA 1) over the year, most likely responding to environmental variability, though smooth fluctuation may be a property of the assessment model smoothing.

6.3.1.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessments. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.3.1.1 and Figure 6.3.1.3 .

Table 6.3.1.1: Red-Mullets in GSA 1. Per-recruit reference points GSA 1.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	**Flim**	**Yeq**	B_0
0.6074	0.0405	0.0127	3.0357	0.0168	0.125

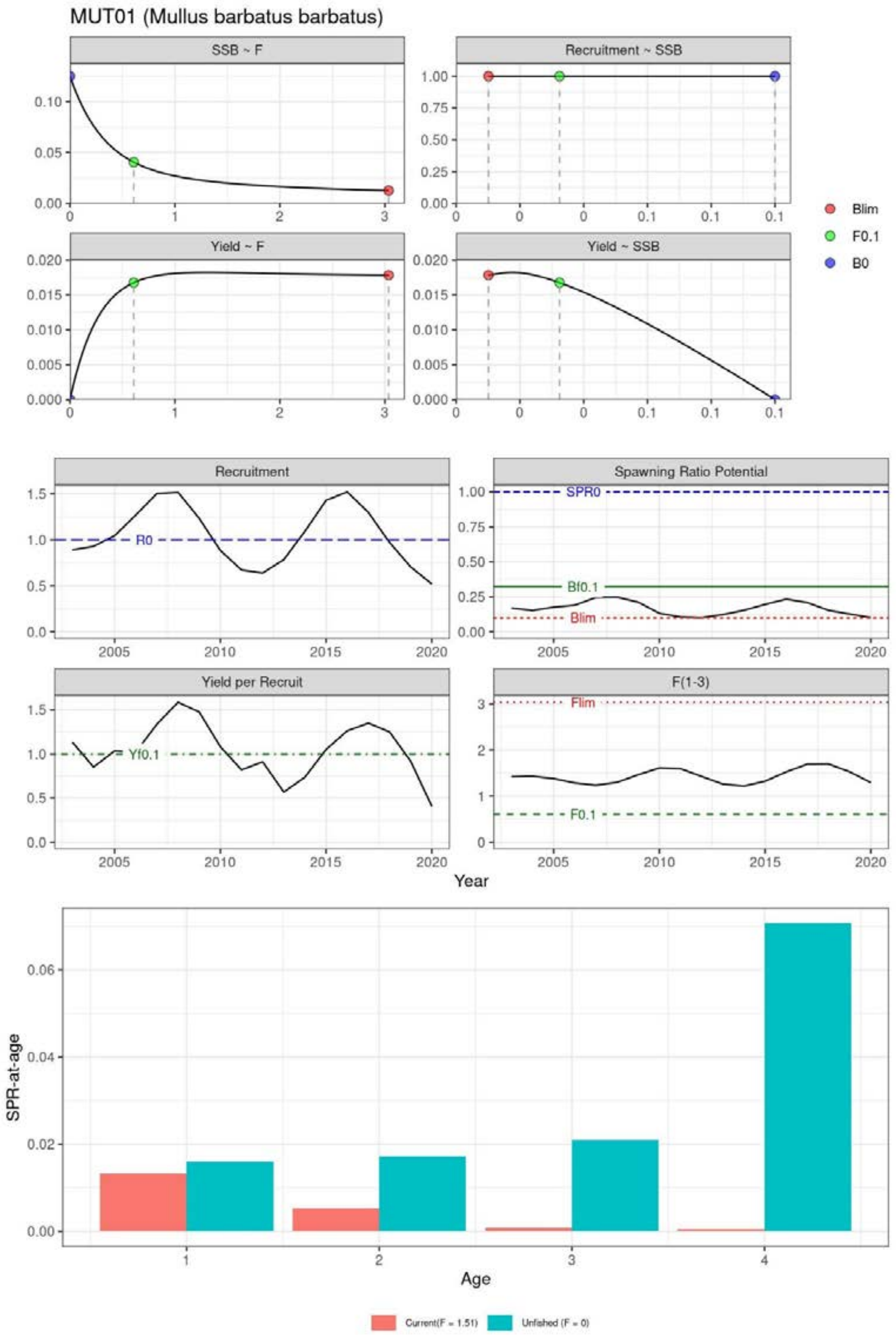


Figure 6.3.1.3: Red-Mullets in GSA 1. Upper-panel: per-recruit reference points of interest; middle panel: trajectories of the assessment outputs against the per-recruit reference points; lower panel: contribution in terms of spawning biomass per recruit (SPR) by age

Spawning ratio potential has been oscillating between B_{Lim} and $B_{F0.1}$, implying overfishing. Observed fishing mortality lies between F_{lim} and $F_{0.1}$. In an un-fished scenario, biomasses are expected to increase at all ages, but especially for older ages.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean), “GM”.

2. Hockey-Stick (model=segreg), “HS”.

3. Beverton-Holt (model=bevholtSV), “BH”.

4. Ricker (model=ricker), “Ri”.

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.3.1.2: Red mullet in GSA 1. Summary of the four SR models.

GSA	Model	s	sigmaR	R_0	rho	B_0
1	GM	NA	0.34	8,343.91	0.75	1,052.40
1	HS	NA	0.25	10,349.99	0.66	1,305.42
1	BH	0.68	0.25	25,998.19	0.71	3,279.09
1	RI	0.99	0.25	15,138.65	0.74	1,909.40

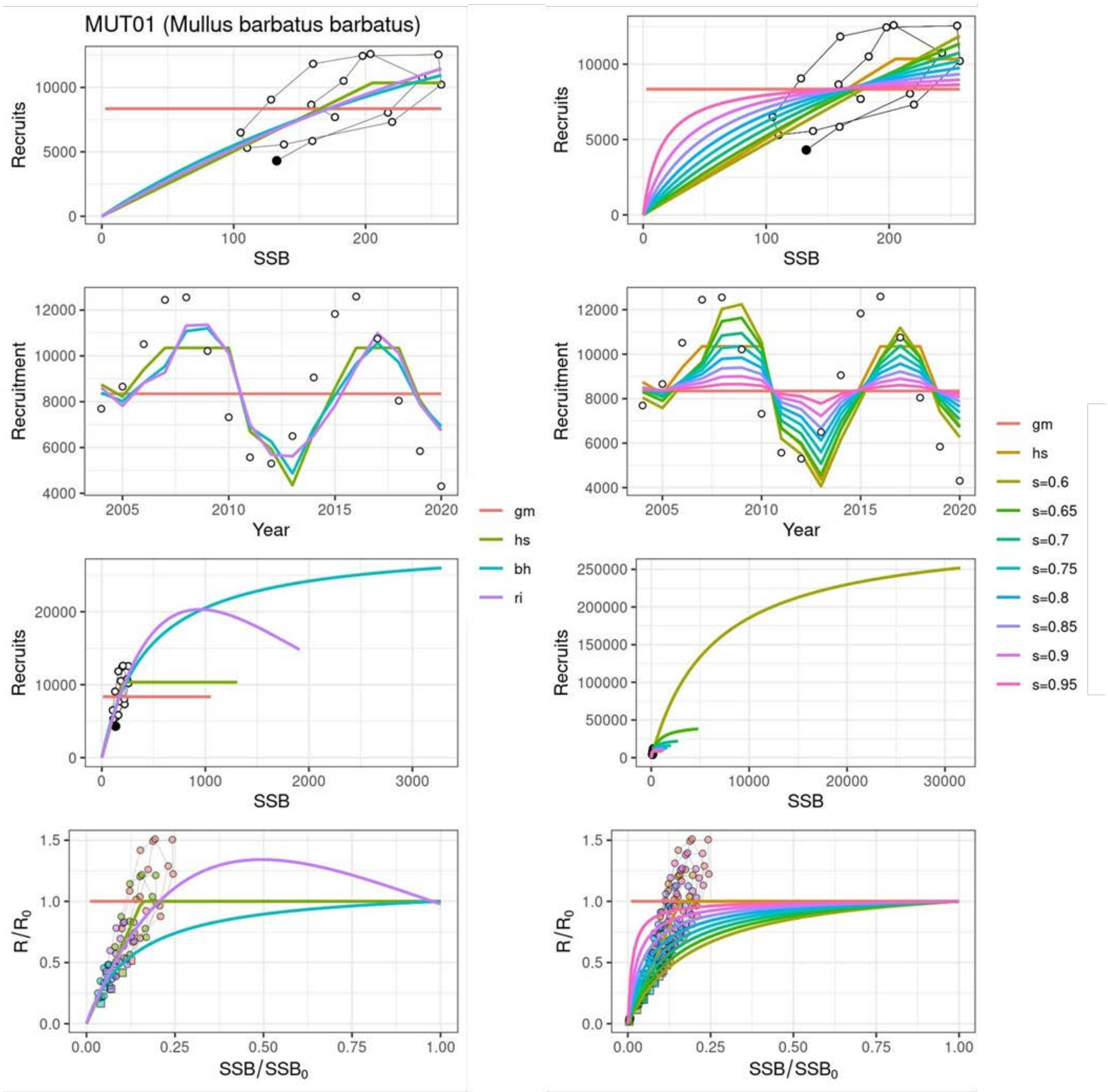


Figure 6.3.1.4: Red-Mullets in GSA 1. Left: Summary of the four SR models. Right: Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

The observed SR data are sitting on the right part of the R-SSB plot, (Figure 6.3.1.4) and the breakpoint estimated by the HS model is within the observed values. The results show that the recruitment variation fairly low, e.g. $\sigma r = 0.25$ for the Beverton-Holt model, which has a steepness = 0.7. The predicted recruitment by Hockey-Stick, Beverton-Holt and Ricker models follow the observed recruitment pattern over time. The models differ largely in scale of their R_0 and B_0 estimates, with Ricker and Beverton-Holt associated with higher values at SSBs that are well beyond the range of the data (Figure 6.3.1.4 3rd panel).

Because red-mullet recruitment is thought to be mostly controlled by the environment, at least in the short term, rather than though density-dependence, our opinion is that these data are not informative of the strength of the density-dependence and of the slope of stock-recruitment models to the origin for Beverton-Holt or Ricker models. For this reason, it was decided to consider the Hockey-Stick approach as the most appropriate to estimate the biomass reference points for the stocks of red mullet in GSA 1 and use the breakpoint that fits within the data cloud as an estimate of the lower bound on the region where density dependence on recruitment is not observed. This breakpoint lies at 48% of $B_{F0.1}$ which is a rather high value, the highest observed among the 14 stocks evaluated. This breakpoint is accepted because it lies within that accepted range (i.e. < 20% of B_0) however, it this upper limit of acceptance was to be reduced, the geometric mean recruitment and B_{Lim} at 25% of $B_{F0.1}$ would give a B_{Lim} at 84.5 tonnes (See Section 4.3 on sensitivity to model choices).

6.3.1.3 Results

Following the exploratory analysis, it was decided to consider the Hockey-Stick approach the most appropriate to estimate the biomass reference points for red mullet in GSA 1. Table 6.3.1.3 summaries the reference point values based on the fitted value of Hockey-Stick model for B_{Lim} and R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics and the historic assessment information are shown in this context in Figure 6.3.1.5. In conclusion the stock is considered to be below to B_{Lim} in 2020.

Table 6.3.1.3: Red mullet in GSA 1. Final reference points based on Hockey-Stick stock recruit model fitted to the data.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.607	205	410	419	1294	0.624

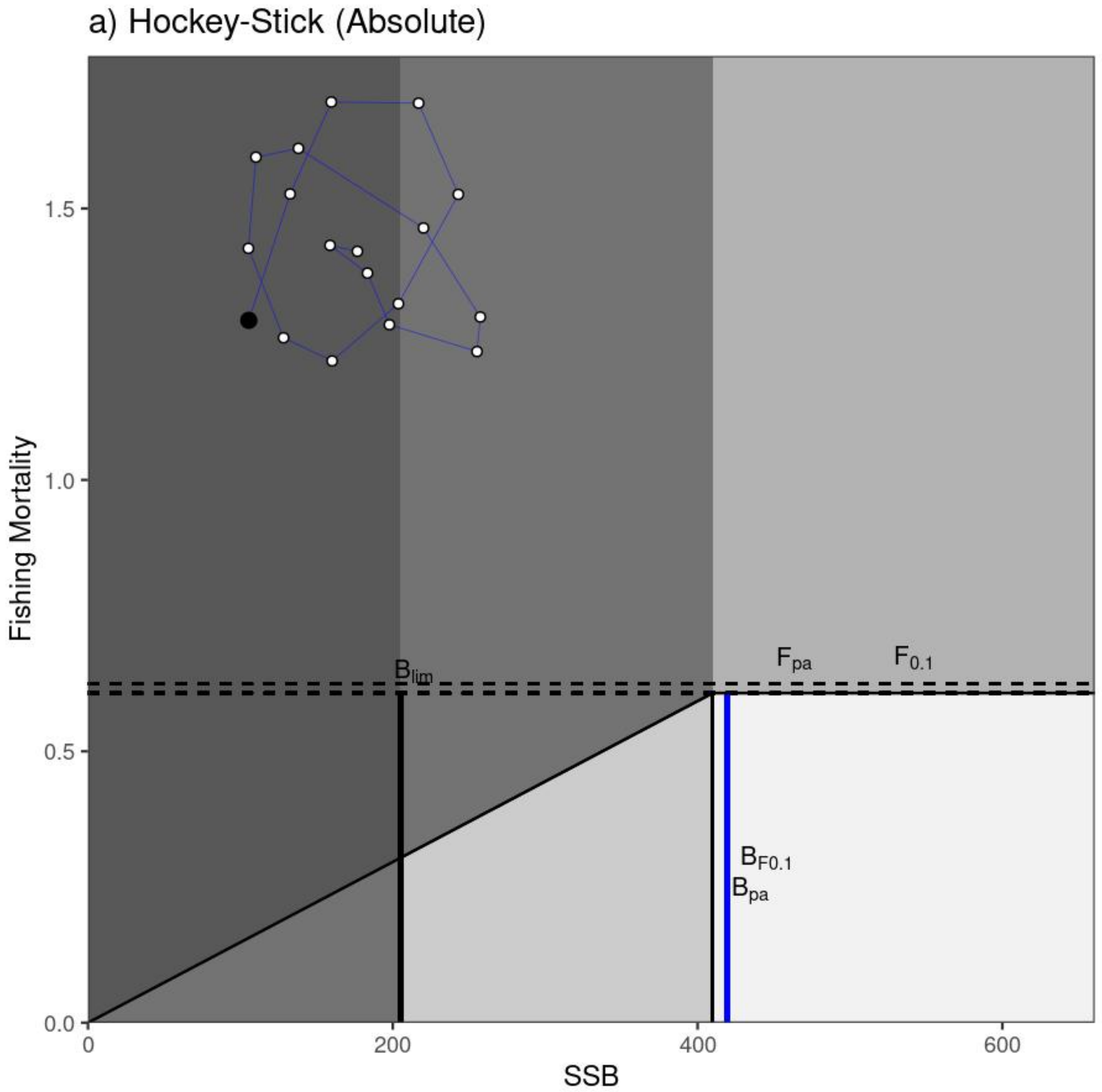


Figure 6.3.1.5: Red Mullet in GSA 1. Advice Rule plots, with Bpa = 2 BLim, showing the results of the Hockey-Stick model with BLim of 205 tonnes based on the fit to the data.

6.3.1.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. For this purpose, we advise the use of steepness = 0.80 which mimics the HS chosen (see Figure 6.3.1.6).

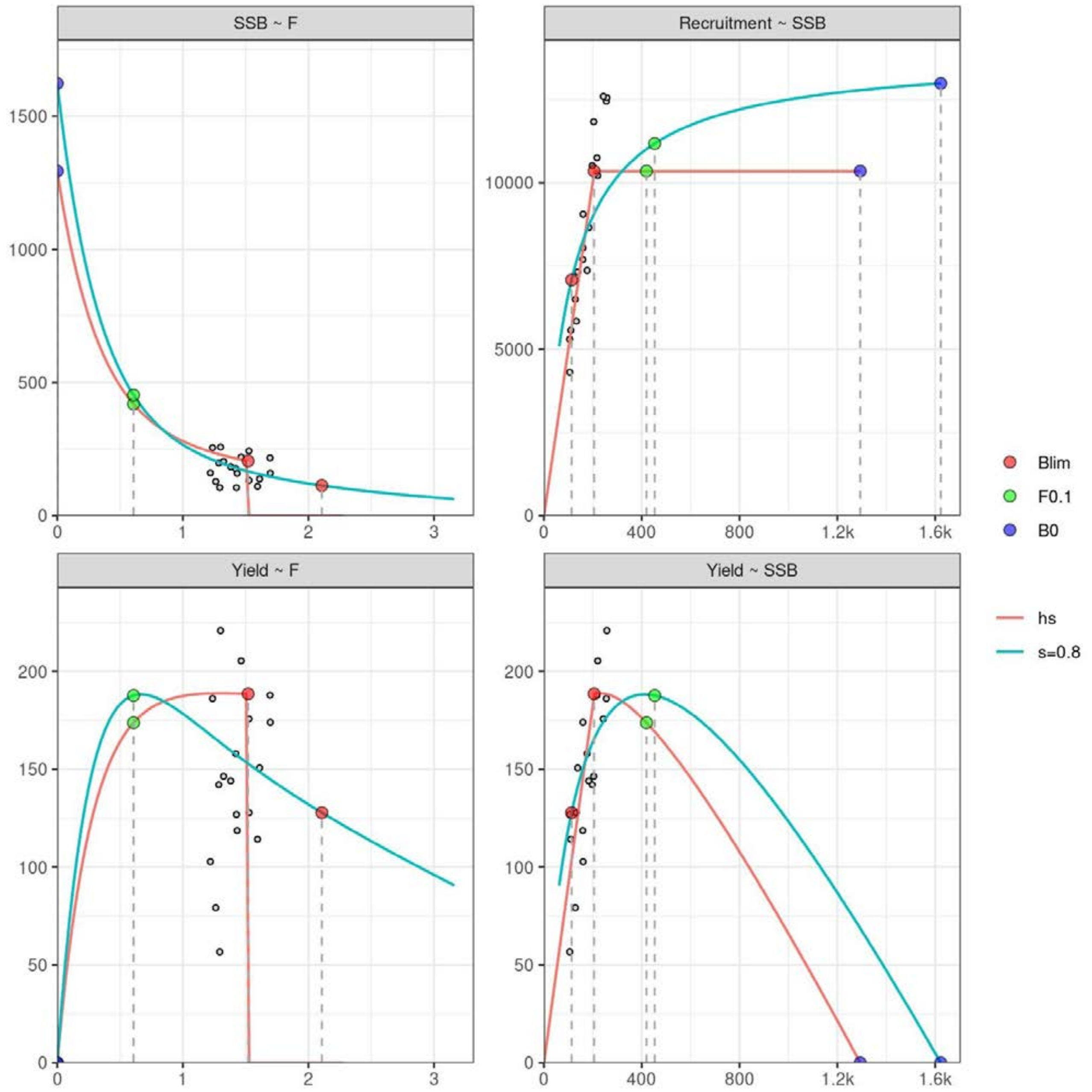


Figure 6.3.1.6: Red mullet in GSA 1 Equilibrium yield with HS and BH (steepness 0.80) models comparison.

6.3.2 Red mullet (MUT) in GSA 6.

6.3.2.1 Stock assessment

The assessments of red mullet, *Mullus barbatus*, carried out during the STECF EWG 21-11 for GSA 6 was performed using catch-at-age data from commercial fisheries in the period 2002-2020, tuned with the index-at-age data from the MEDITS survey in GSA 6 (Figure 6.3.2.1). The assessments were performed with SCAA using a4a, and can be consulted at https://stecf.jrc.ec.europa.eu/ewg2111. The outputs of these assessment are summarized in Figure 6.3.2.2.

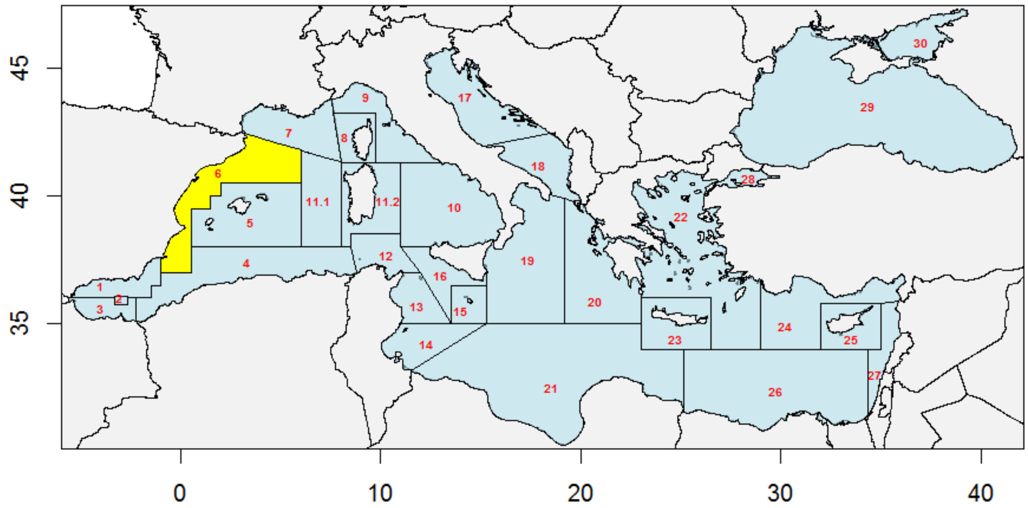


Figure 6.3.2.1: Red mullet in GSA 6: Location of GSA 6 in the Mediterranean Sea

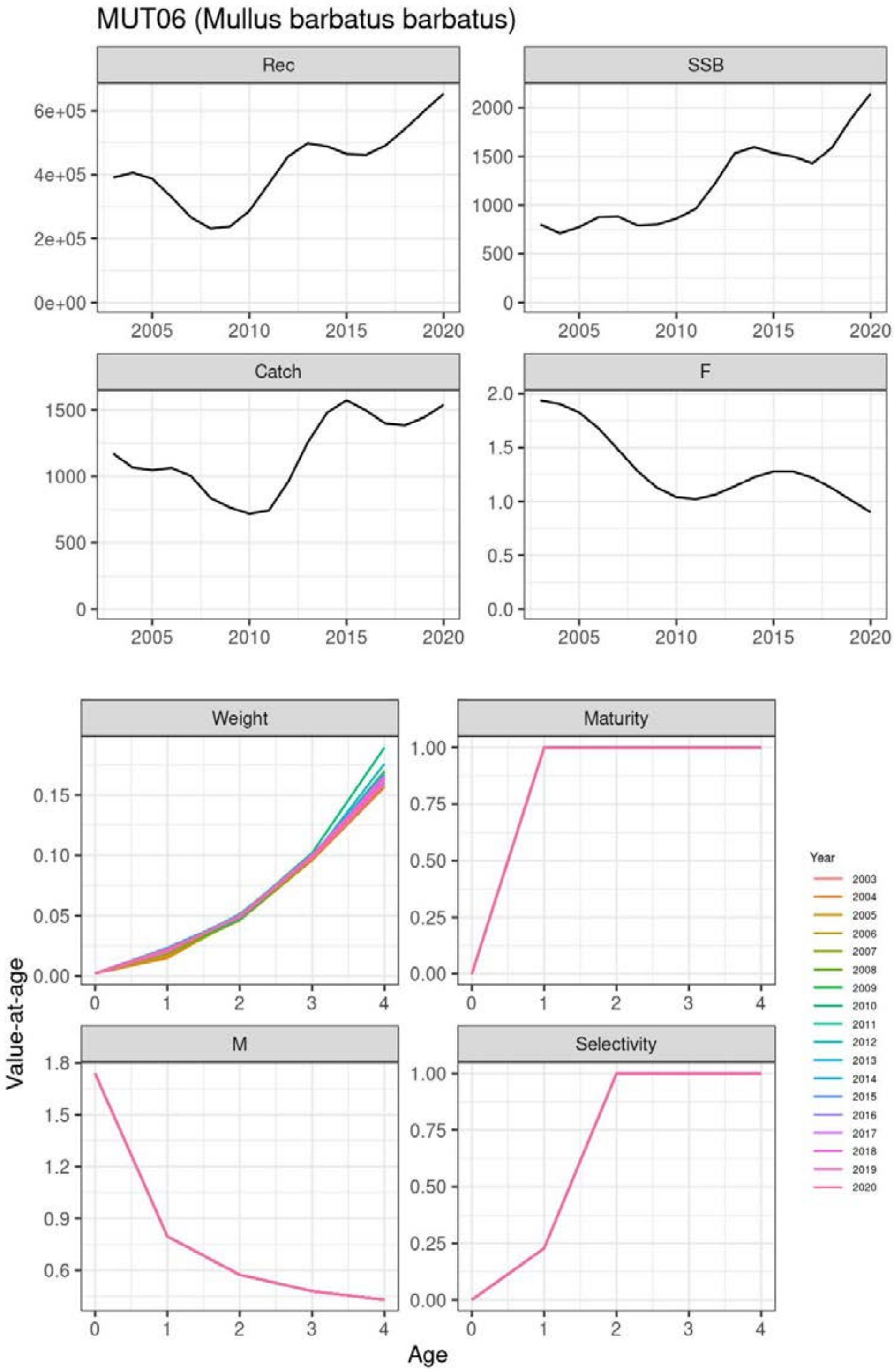


Figure 6.3.2.2: Red mullet in GSA 6. Stock summary from the final a4a model. Catch, recruitment, SSB, and F are outputs from the model. Individual weights at age, fraction mature at age, natural mortality at age are input data and selectivity at age in the fishery is estimated in the model.

The model assume maturity at age 1 and onward, selectivity is low at age 0 and then strongly increases up to age 2 and reach a plateau. Recruitment has improved over the year, most likely responding to environmental variability and leading to increased catch and SSB.

6.3.2.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessments. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.3.2.1 and Figure 6.3.2.3.

Table 6.3.2.1: Red-Mullets in GSA 6. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	**Flim**	**Yeq**	B_0
0.3169	0.0082	0.0027	1.5822	0.0028	0.0194

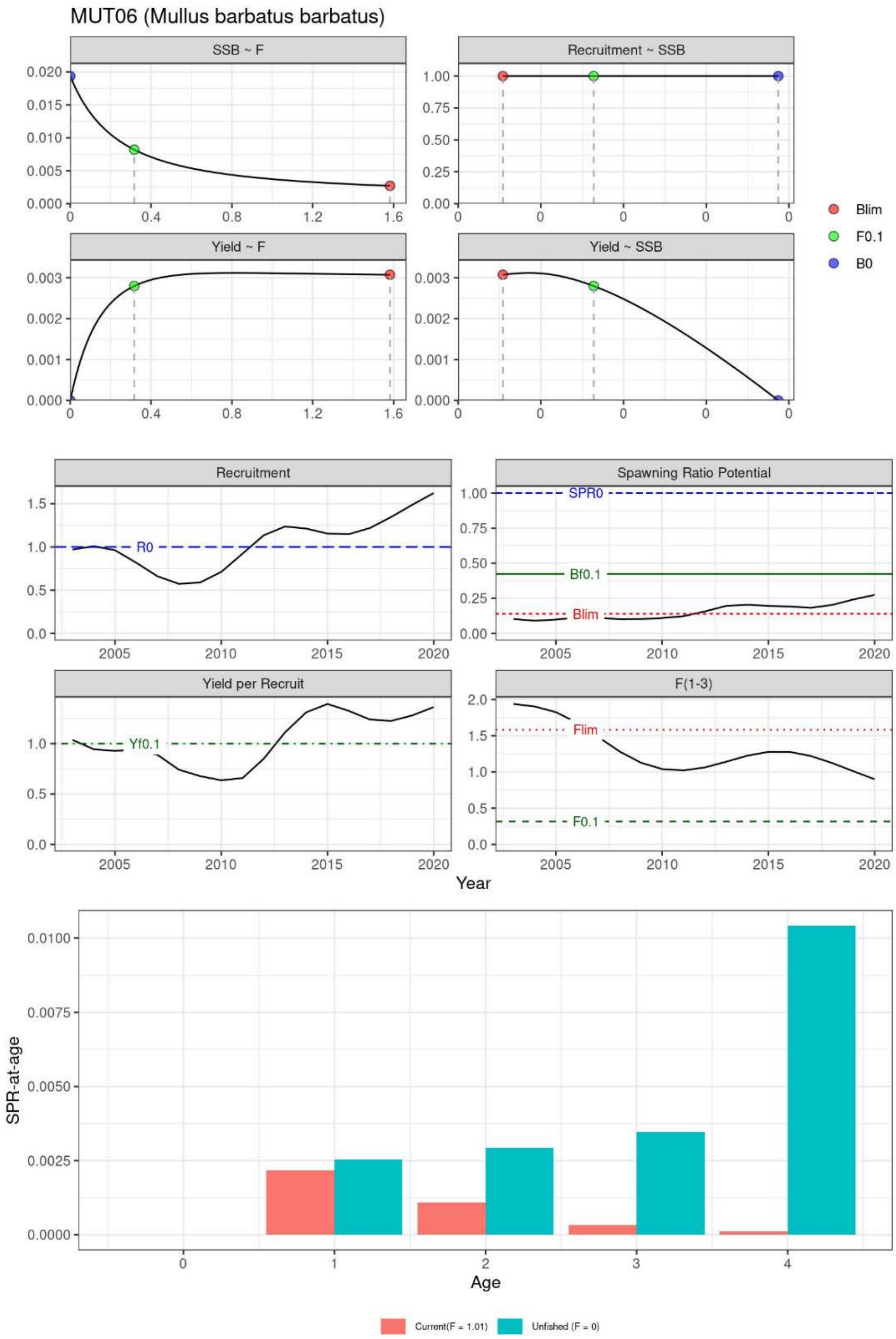


Figure 6.3.2.3: Red-Mullets in GSA 6. Upper-panel: per-recruit reference points of interest; middle panel: trajectories of the assessment outputs against the per-recruit reference points; lower panel: contribution in terms of spawning biomass per recruit (SPR) by age

Spawning ratio potential has been oscillating between B_{Lim} and $B_{F0.1}$, indicating overfishing. The stock trajectory tends to approach $B_{F0.1}$, an improvement of the situation thought to be predominantly due to environmentally-driven increased recruitment. Observed fishing mortality liens between F_{lim} and $F_{0.1}$. In a un-fished scenario, biomasses are expected to increase at all ages, but especially for older ages.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean), "GM".
2. Hockey-Stick (model=segreg), "HS".
3. Beverton-Holt (model=bevholtSV), "BH".
4. Ricker (model=ricker), "Ri".

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.3.2.2: Red mullet in GSA 6. Summary of the four SR models

GSA	Model	s	sigmaR	R_0	rho	B_0
6	GM	NA	0.31	403,443.50	0.91	7,811.33
6	HS	NA	0.30	403,443.50	0.91	7,811.33
6	BH	0.70	0.16	1,466,632.80	0.75	28,396.43
6	RI	1.14	0.17	525,260.20	0.77	10,169.90

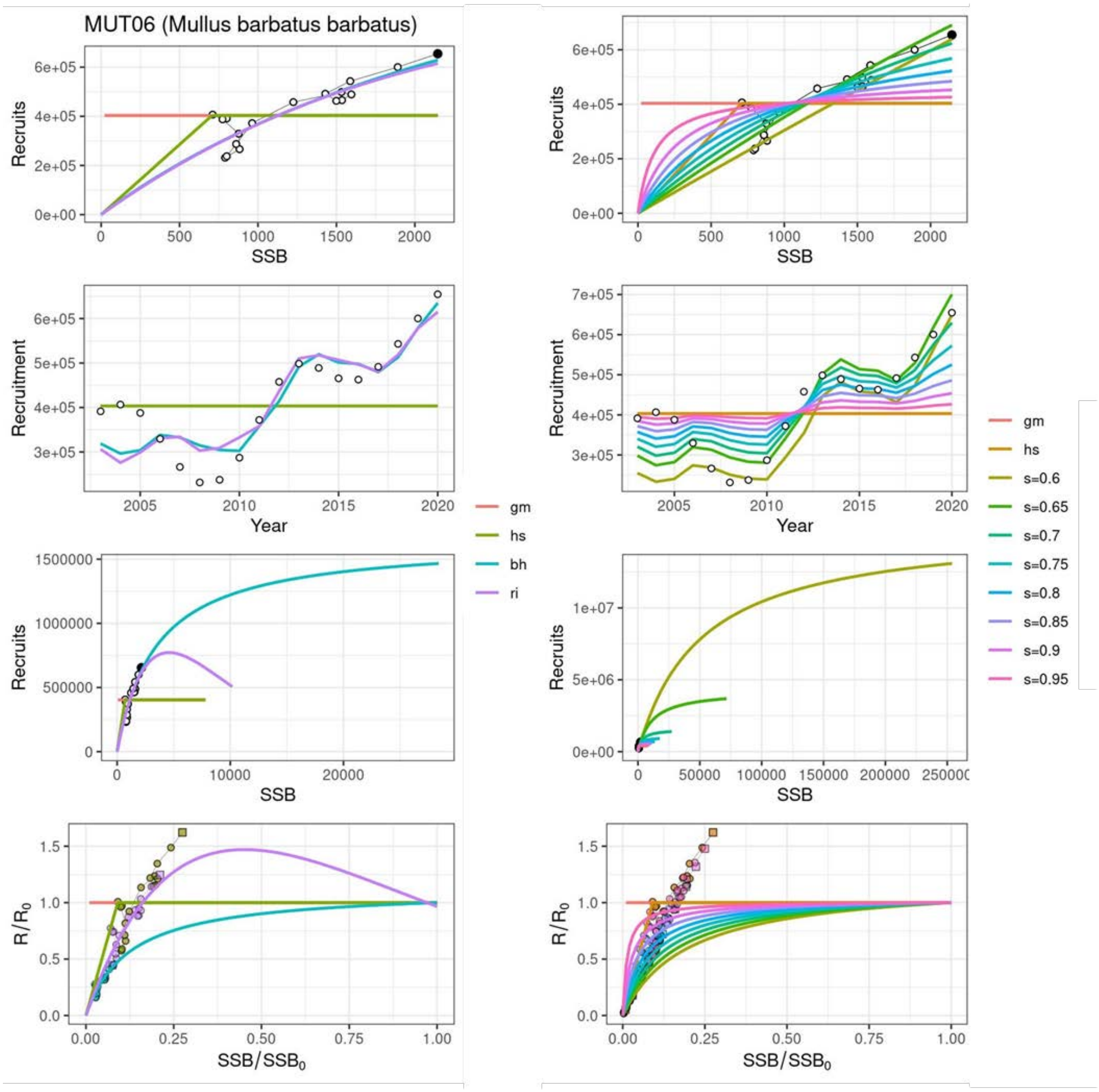


Figure 6.3.2.4: Red-Mullets in GSA 6. Left: Summary of the four SR models. Right: Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

The observed SR data distributed over two thirds of the R-SSB plot, (Figure 6.3.2.4) and the breakpoint estimated by the HS model is not found within the data but at the lower end of the observed values, so is not considered as an acceptable fitted value. The results show that the recruitment variation fairly low, e.g. σr = 0.16 for the Beverton-Holt model, associated with a steepness = 0.7. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, while HS and GM models are equivalents. The models differ largely in scale of their R_0 and B_0 estimates, with Ricker and Beverton-Holt associated to higher values (Figure 6.3.2.4).

Because much of the positive relationships observed between SSB and recruitment is thought to be the result of favourable environmental forcing, and more generally short term variation in red-mullet recruitment is thought to be mostly controlled by the environment rather than through density-dependence, our opinion is that these data are not informative of the strength of the density-dependence and of the slope of stock-recruitment models to the origin. Moreover, no recruitment saturation is observable in the data, hence no information is available to model the asymptotic behaviour of the BH and RI models. For these reasons, it was decided to consider the Geometric mean approach as the most appropriate to estimate the biomass reference points for the stocks of red mullet in GSA 6.

6.3.2.3 Results

Following the exploratory analysis above, it was decided to consider the Geometric mean recruitment approach the most appropriate to estimate the biomass reference points for the stock of red mullet in GSA 6. Table 6.3.2.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics are illustrated in Figure 6.3.2.5, and the historic assessment information is shown in this context in Figure 6.3.2.6. In conclusion the stock is considered to be between B_{pa} and $B_{F0.1}$ in 2020.

Table 6.3.2.3: Red Mullet in GSA 6. Final reference points based on Geometric mean and a default value of B_{Lim} =25% $B_{F0.1}$.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.317	827	1653	3307	7811	0.874

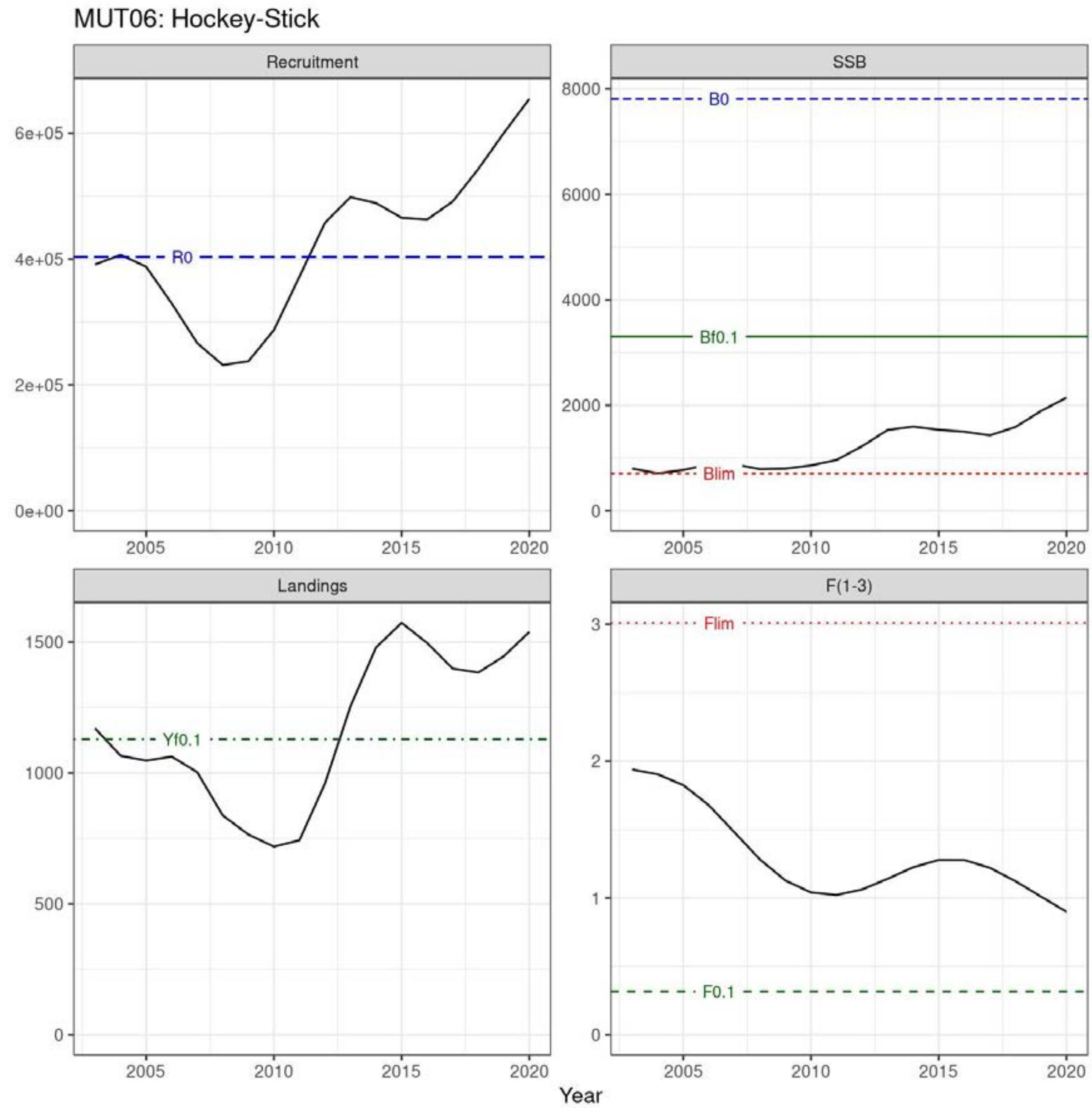


Figure 6.3.2.5: Red Mullet in GSA 6. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a GM stock-recruitment relationship.

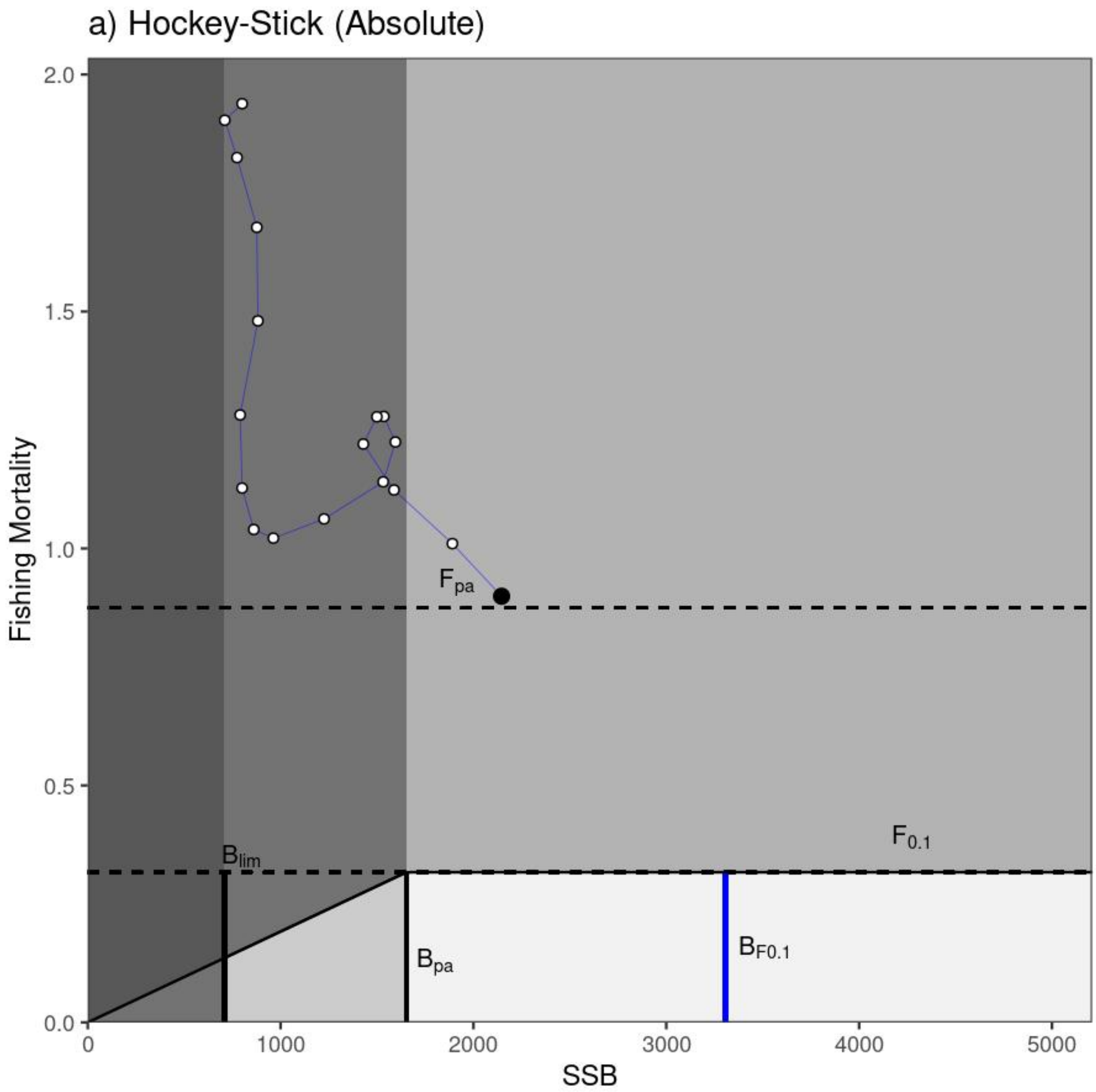


Figure 6.3.2.6: Red Mullet in GSA 6. Advice Rule plots, with B_{pa} = 2* B_{Lim}, and GM recruitment model to give $B_{F0.1}$ with default B_{Lim} = 0.25 $B_{F0.1}$.

6.3.2.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. For this purpose it is suggested the use of steepness = 0.80 which mimics the HS chosen (see Figure 6.3.2.7).

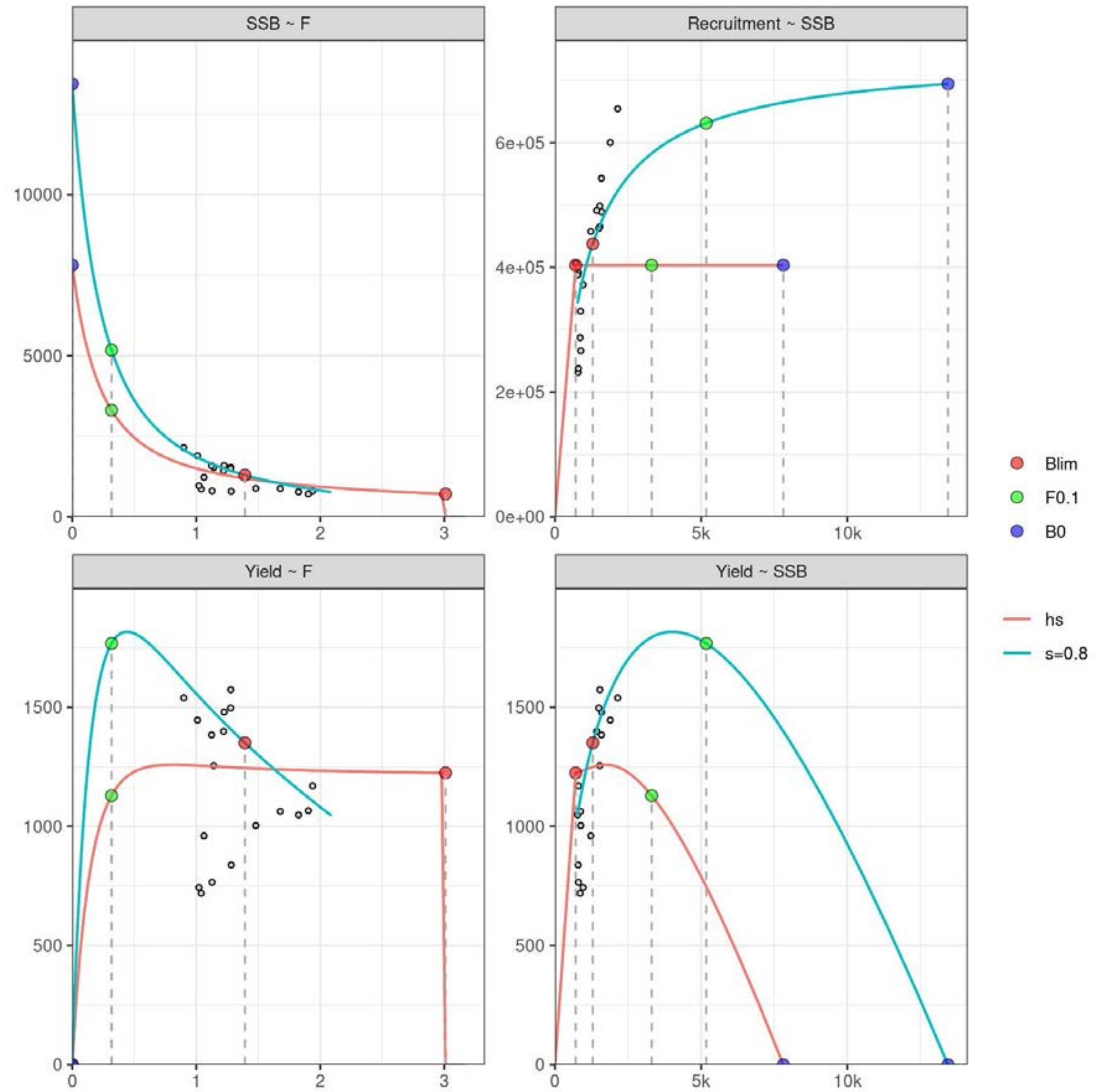


Figure 6.3.2.7: Red mullet in GSA 6. Equilibrium yield with HS and BH (steepness 0.80) models comparison.

6.3.3 Red mullet (MUT) in GSA 7.

6.3.3.1 Stock assessment

The assessments of red mullet, *Mullus barbatus*, carried out during the STECF EWG 21-11 for GSA 7 was performed using catch-at-age data from commercial fisheries in the period 2002-2020, tuned with the index-at-age data from the MEDITS survey in GSA 7 (Figure 6.3.3.1). The assessments were performed with SCAA using a4a, and can be consulted at https://stecf.jrc.ec.europa.eu/ewg2111. The outputs of these assessment are summarized in Figure 6.3.3.2

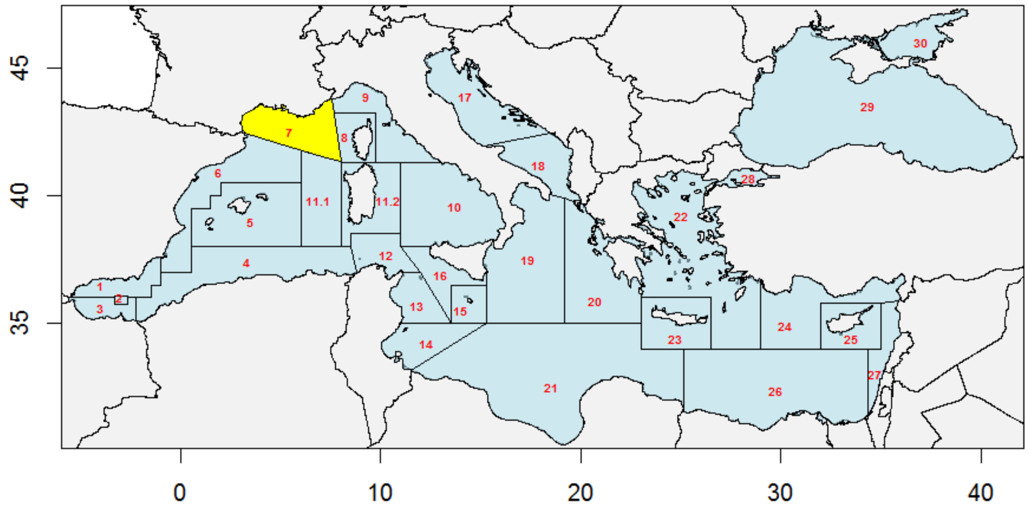


Figure 6.3.3.1: Localisation of GSA 7 (in Yellow) in the Mediterranean Sea

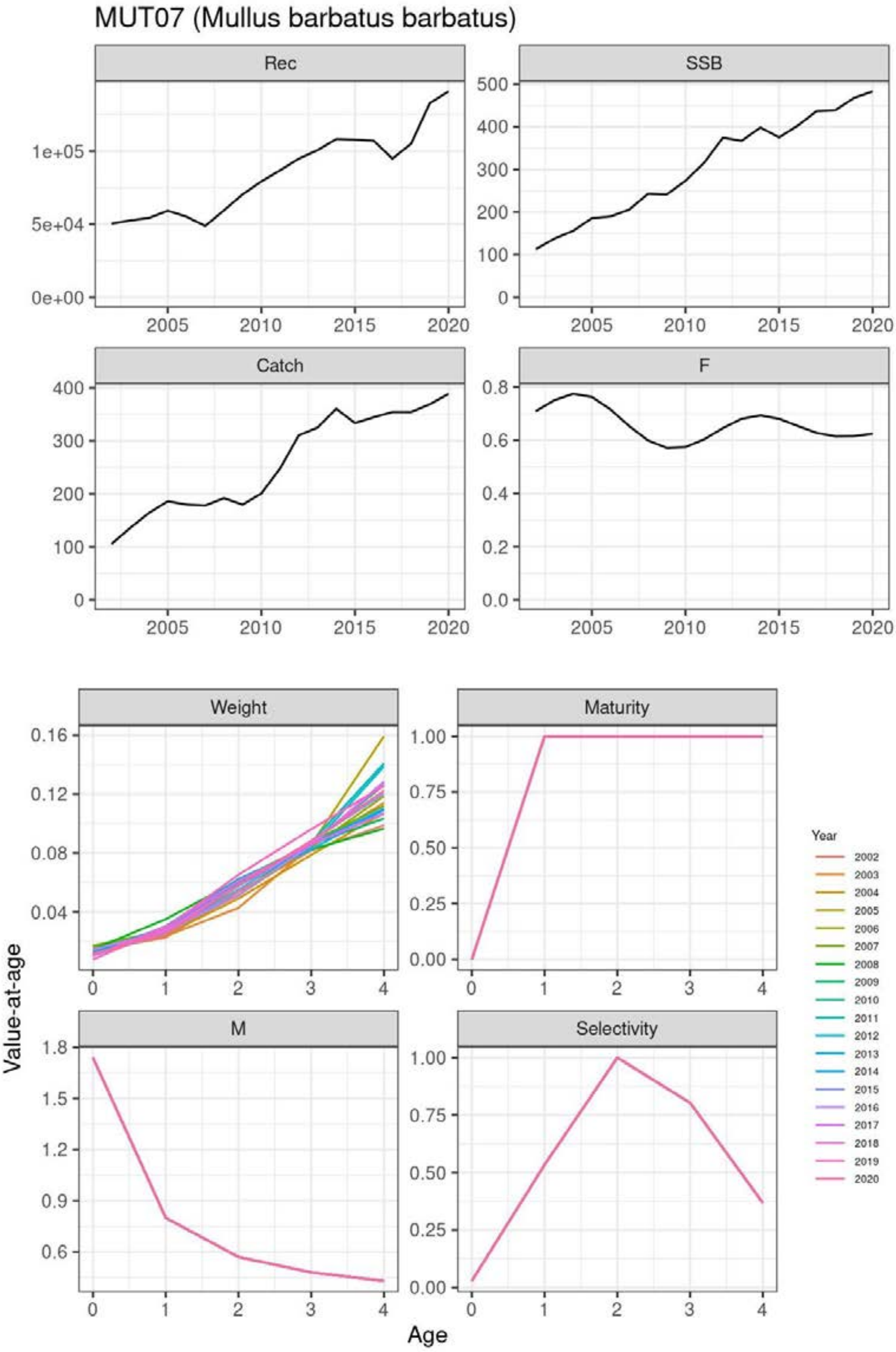


Figure 6.3.3.2: Red mullet in GSA 7. Stock summary from the final a4a model. Catch, recruitment, SSB, and F are outputs from the model. Individual weights at age, fraction mature at age, natural mortality at age are input data and selectivity at age in the fishery is estimated in the model.

The model assume maturity at age 1 and onward, selectivity is low at age 0 and then strongly increases up to age 2. It then drops, which may reflect that some of the older individuals are located in areas either untargeted by or unavailable to the fishery. Recruitment has strongly improved over the year, most likely responding to environmental variability and leading to increased catch and SSB.

6.3.3.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessments. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.3.3.1 and Figure 6.3.3.2.

Table 6.3.3.1: Red-Mullets in GSA 7. Per-recruit reference points GSA 7.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.456	0.0057	0.0014	1.8909	0.0031	0.0177

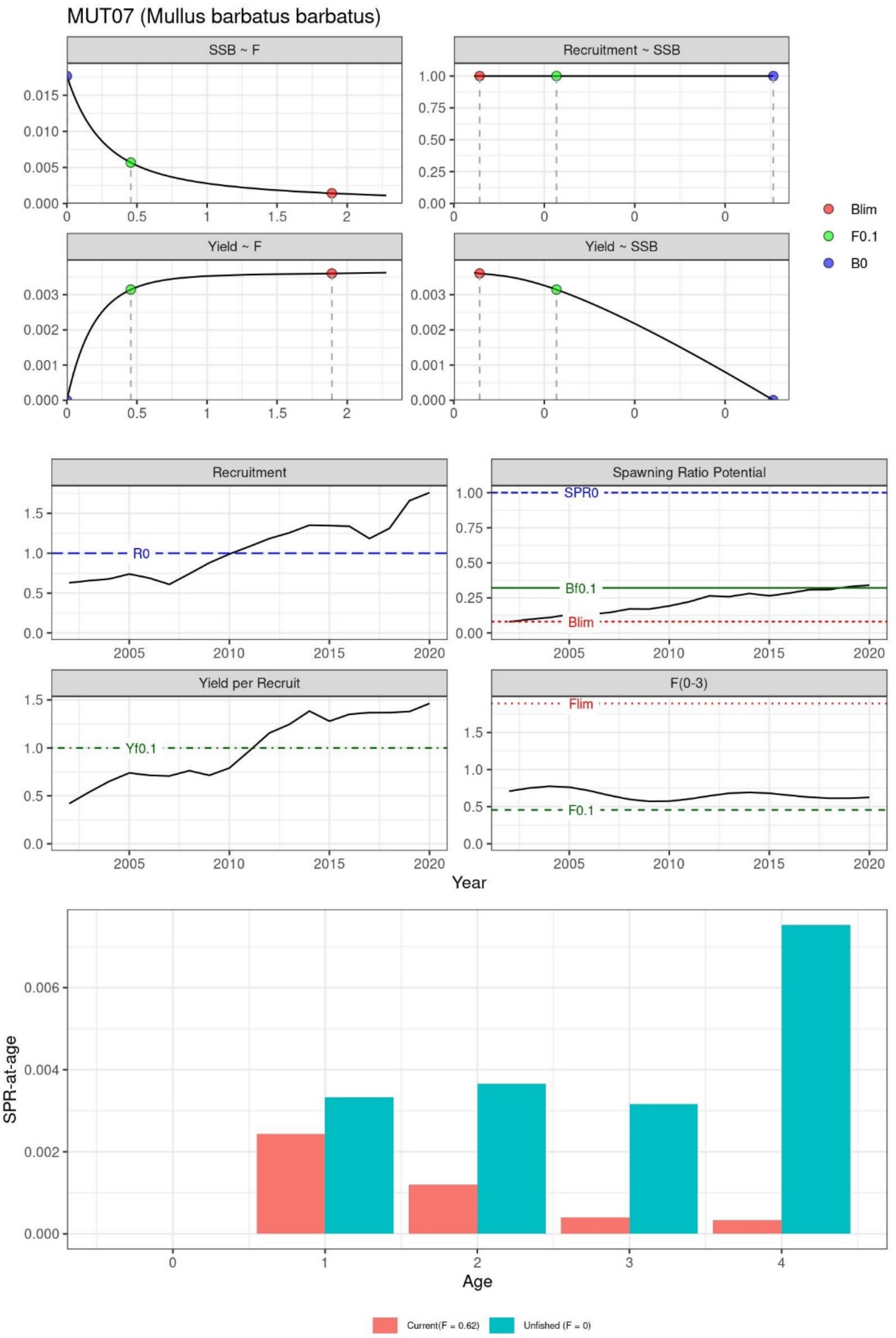


Figure 6.3.3.3: Red-Mullets in GSA 7. Upper-panel: per-recruit reference points of interest; middle panel: trajectories of the assessment outputs against the per-recruit reference points; lower panel: contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario.

Spawning ratio potential has been increasing from B_{Lim} to $B_{F0.1}$, traducing a progressive evolution from strong overfishing towards a more sustainable situation, most likely due to environmentally-driven increased recruitment. Observed fishing mortality lies between F_{lim} and $F_{0.1}$. In un-fished scenario, biomasses are expected to increase at all ages, but especially for older ages.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean), "GM".
2. Hockey-Stick (model=segreg), "HS".
3. Beverton-Holt (model=bevholtSV), "BH".
4. Ricker (model=ricker), "Ri".

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.3.3.2: Red mullet in GSA 7. Summary of the four SR models for each GSA.

GSA	Model	S	sigmaR	R_0	rho	B_0
7	GM	NA	0.35	80,124.97	0.96	1,415.54
7	HS	NA	0.34	80,124.97	0.96	1,415.54
7	BH	0.61	0.12	335,714.31	0.47	5,930.94
7	RI	0.92	0.13	118,184.88	0.61	2,087.93

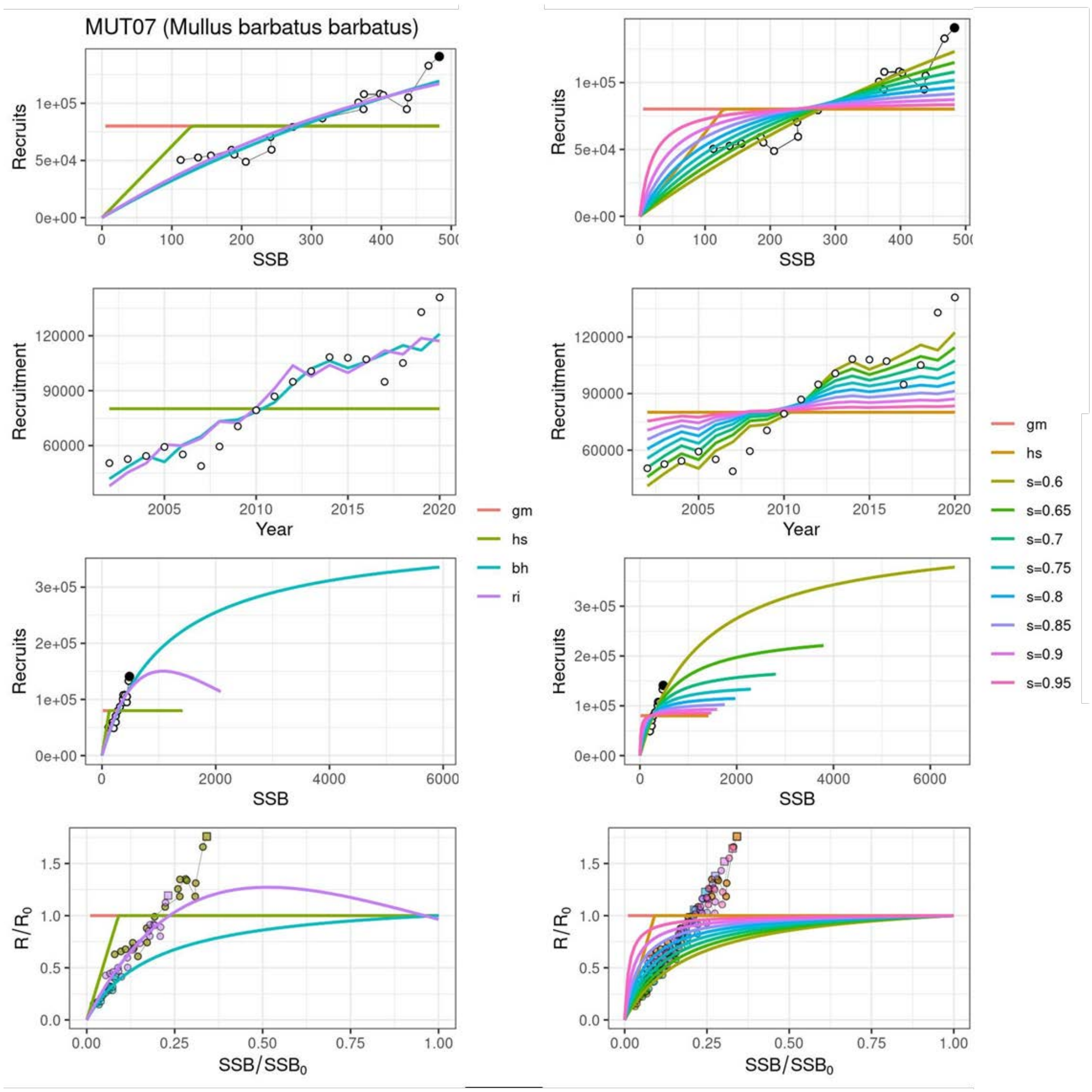


Figure 6.3.3.4: Red-Mullets in GSA 7. Left: Summary of the four SR models. Right: Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

The observed SR data are spread across the R-SSB plot, and the breakpoint estimated by the HS model is inside the observed values, just above the lowest point. The results show that the recruitment variation fairly low, e.g. σr = 0.12 for the Beverton-Holt model, associated with a steepness = 0.6. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, while HS and GM models are unvarying and equivalents. The models differ largely in scale of their R_0 and B_0 estimates, with Ricker and Beverton-Holt associated to higher values. In particular the Beverton-Holt model implies very recruitment and biomass (Figure 6.3.3.4 3rd panel). The Riker model has no data to inform on the falling slope of the model.

Because the positive relationships observed between SSB and recruitment is thought to be the result of favourable environmental forcing, and more generally red-mullet recruitment is thought to be mostly controlled by the environment rather than through density-dependence, it is considered that these data are not informative of the strength of the density-dependence and of the slope of stock-recruitment models to the origin. Moreover, no recruitment saturation is observable in the data, hence no information is available to model the asymptotic behaviour of the BH and RI models. HS model does give a breakpoint within the data and very close to the default value of B_{Lim} =0.25 $B_{F0.1}$. (128 and 113 respectively) For these reasons, it was decided to consider the Hockey-Stick approach as the most appropriate to estimate the biomass reference points for the stocks of red mullet in GSA 7.

6.3.3.3 Results

Following the exploratory analysis, it was decided to consider the Hockey-Stick approach the most appropriate to estimate the biomass reference points for red mullet in GSA 7. Table 6.3.3.3 summaries the reference point values based on the fitted value of Hockey-Stick model for B_{Lim} and R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics and the historic assessment information are shown in the context of the reference points in Figure 6.3.3.4 and Figure 6.3.3.6. In conclusion the stock is considered to be above $B_{F0.1}$ in 2020.

Table 6.3.3.3: Red mullet in GSA 7. Final reference points based on Hockey-Stick stock recruit model fitted to the data.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.456	128	256	455	1415	0.868

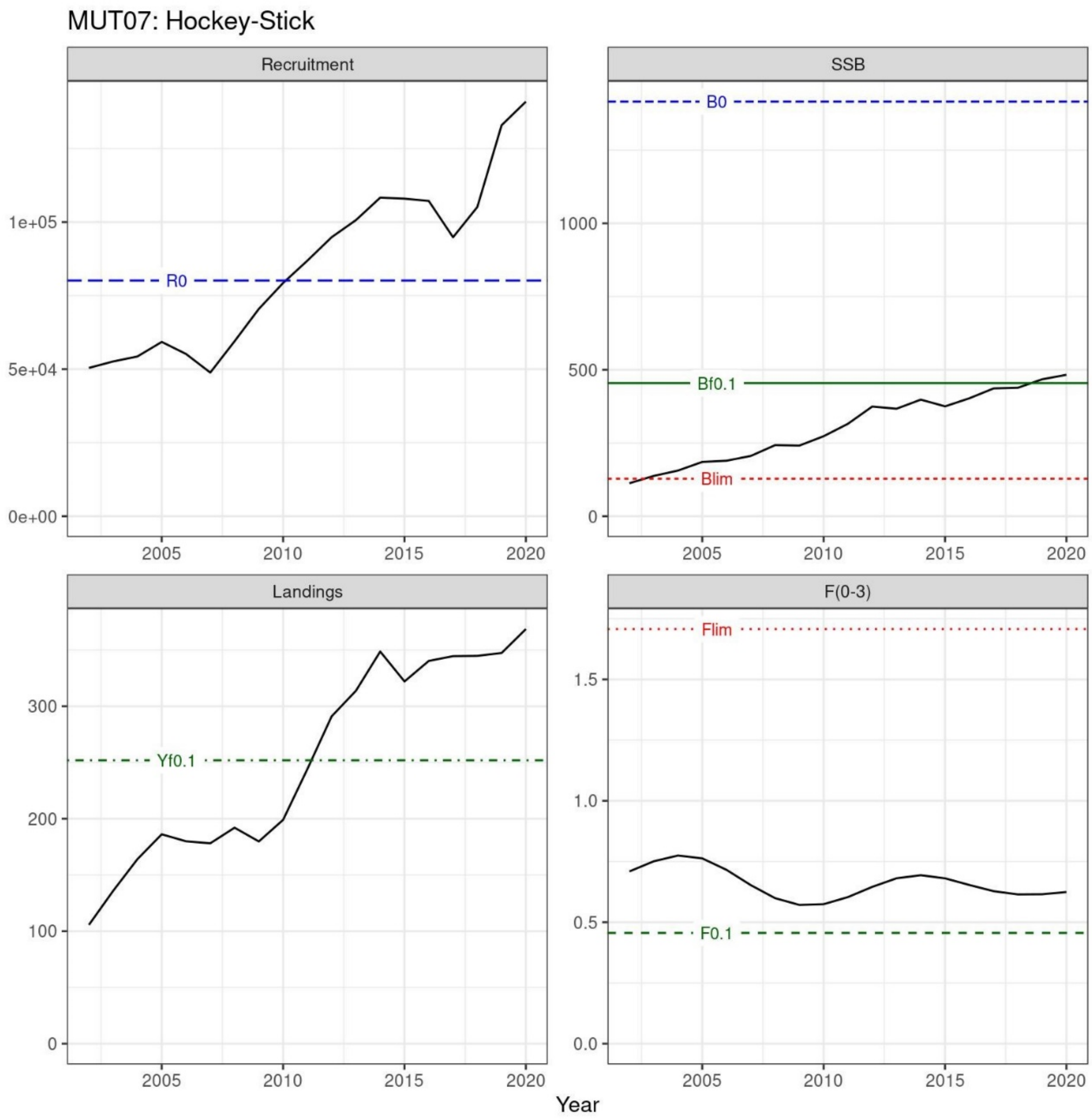


Figure 6.3.3.5: Red Mullet in GSA 7. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

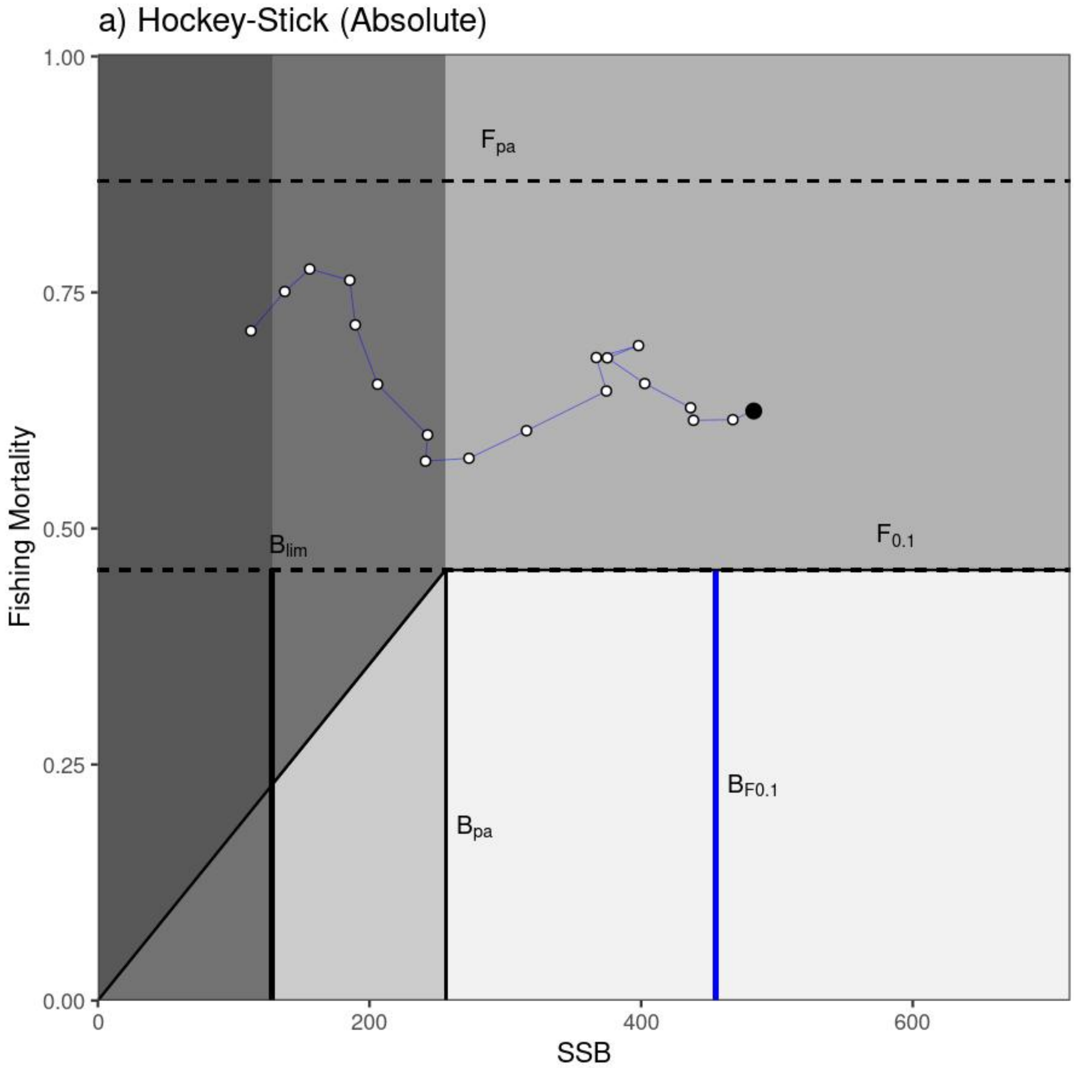


Figure 6.3.3.6: Red Mullet in GSA 7. Advice Rule plots, with Bpa = 2*BLim, Hockey-Stick model with an BLim = 128 tonnes fitted to the observation.

6.3.3.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. For this purpose, we advise the use of steepness = 0.90 which mimics the HS chosen (see Figure 6.3.3.7).

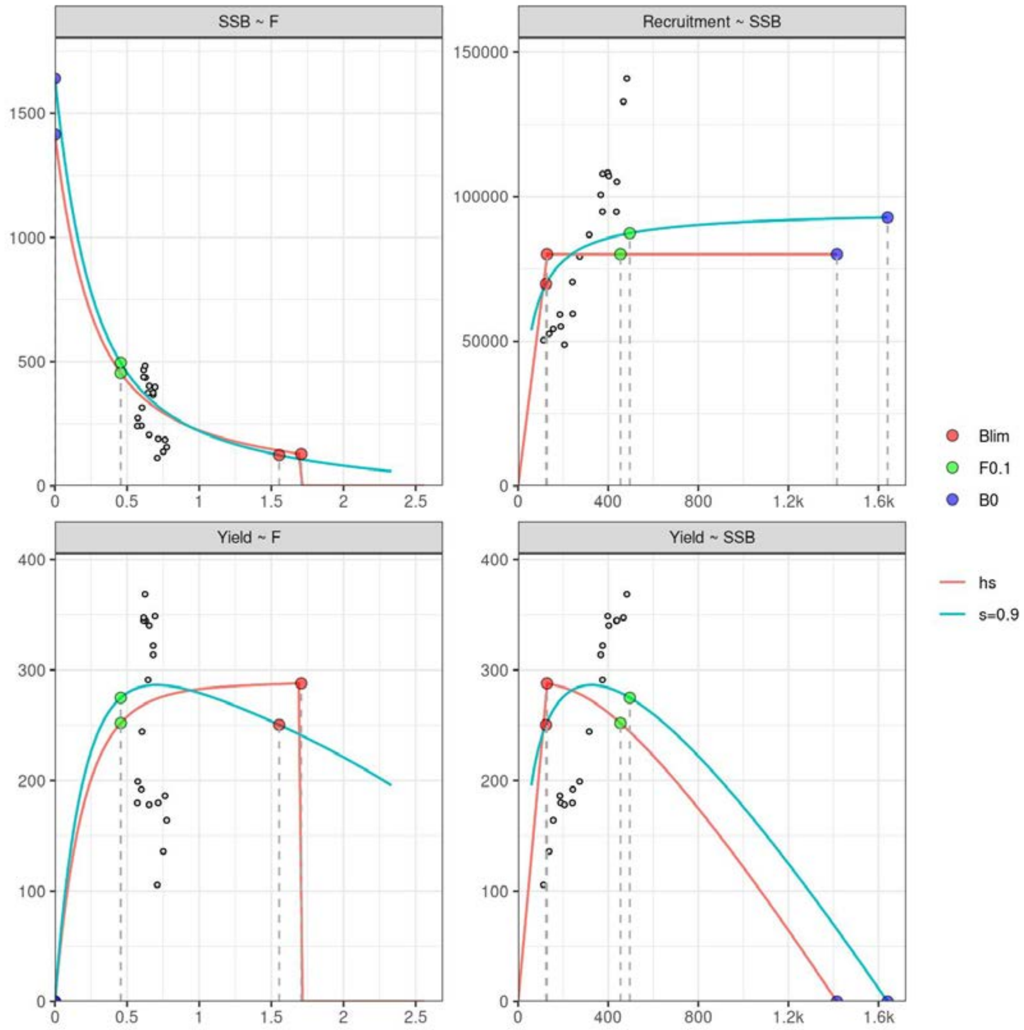


Figure 6.3.3.7: Red mullet in GSA 7. Equilibrium yield with HS and BH (steepness 0.90) models comparison.

6.3.4 Red mullet (MUT) in GSA 9

6.3.4.1 Stock assessment

The assessment of red mullet in GSA 9 was carried out in STECF EWG 21-11, considering the stock boundaries represented by the only GSA 9 (Figure 6.3.4.1).

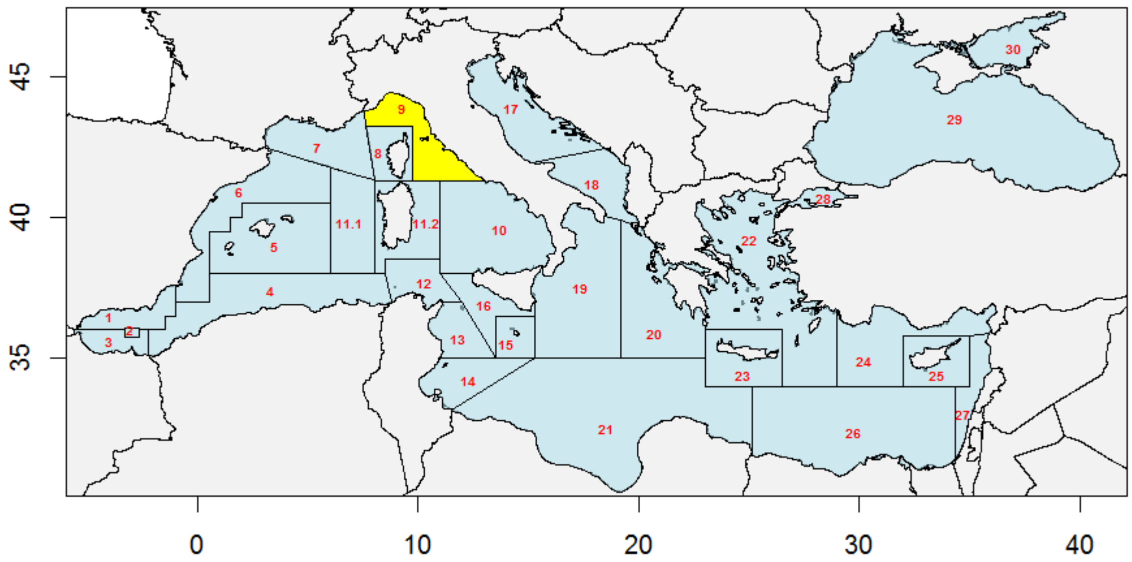


Figure 6.3.4.1: Red mullet in GSA 9. Limit of Geographical Sub-Area.

A statistical catch-at-age assessment was performed for this stock, using data from the period 2003-2020. The catch-at-age data from commercial fisheries were tuned with the index-at-age data from the MEDITS survey in GSA 9. The assessment was performed using the Assessment for All Initiative (a4a) method (Jardim et al., 2015). The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.3.4.2.

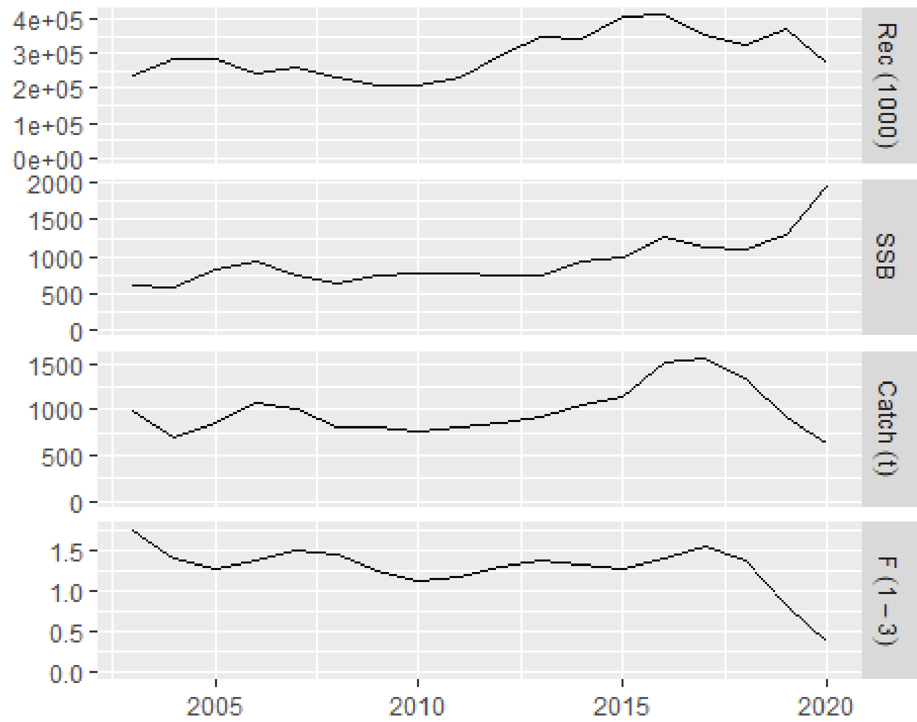


Figure 6.3.4.2: Red mullet in GSA 9. Stock summary from the final a4a model.-

An overview of the input data used in the assessment and outcome is provided in Figure 6.3.4.3 - Figure 6.3.4.5.

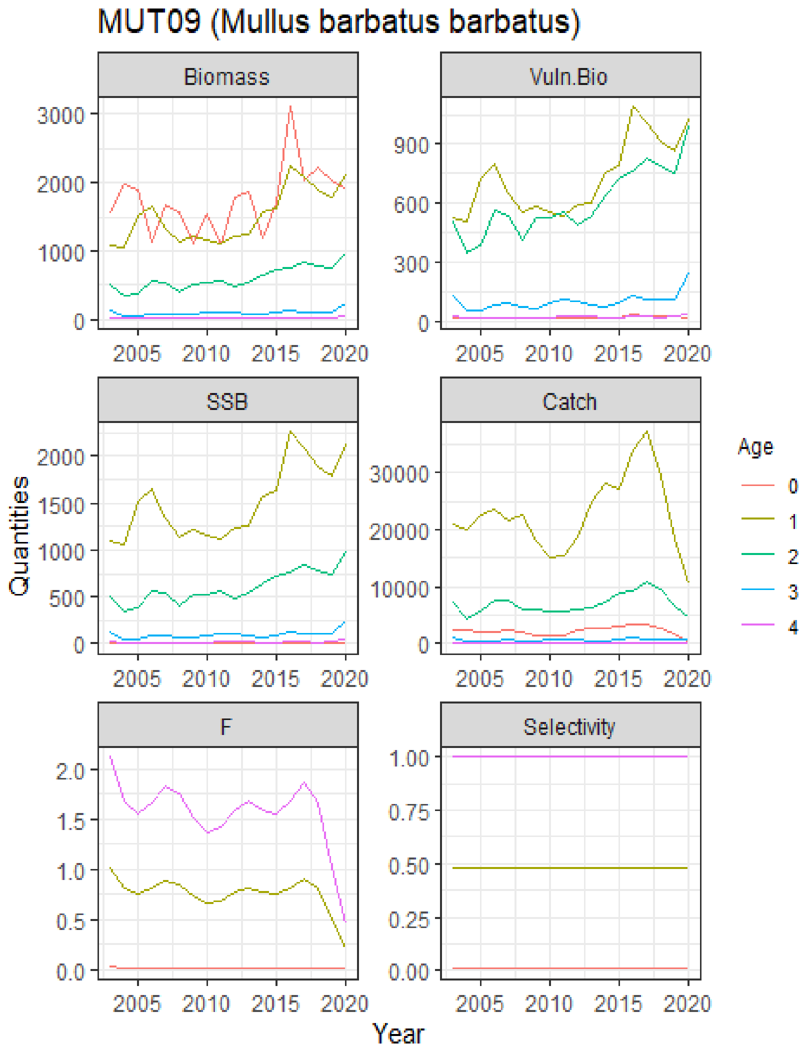


Figure 6.3.4.3: Red mullet in GSA 9. Stock assessment trajectories at age from the assessment output.

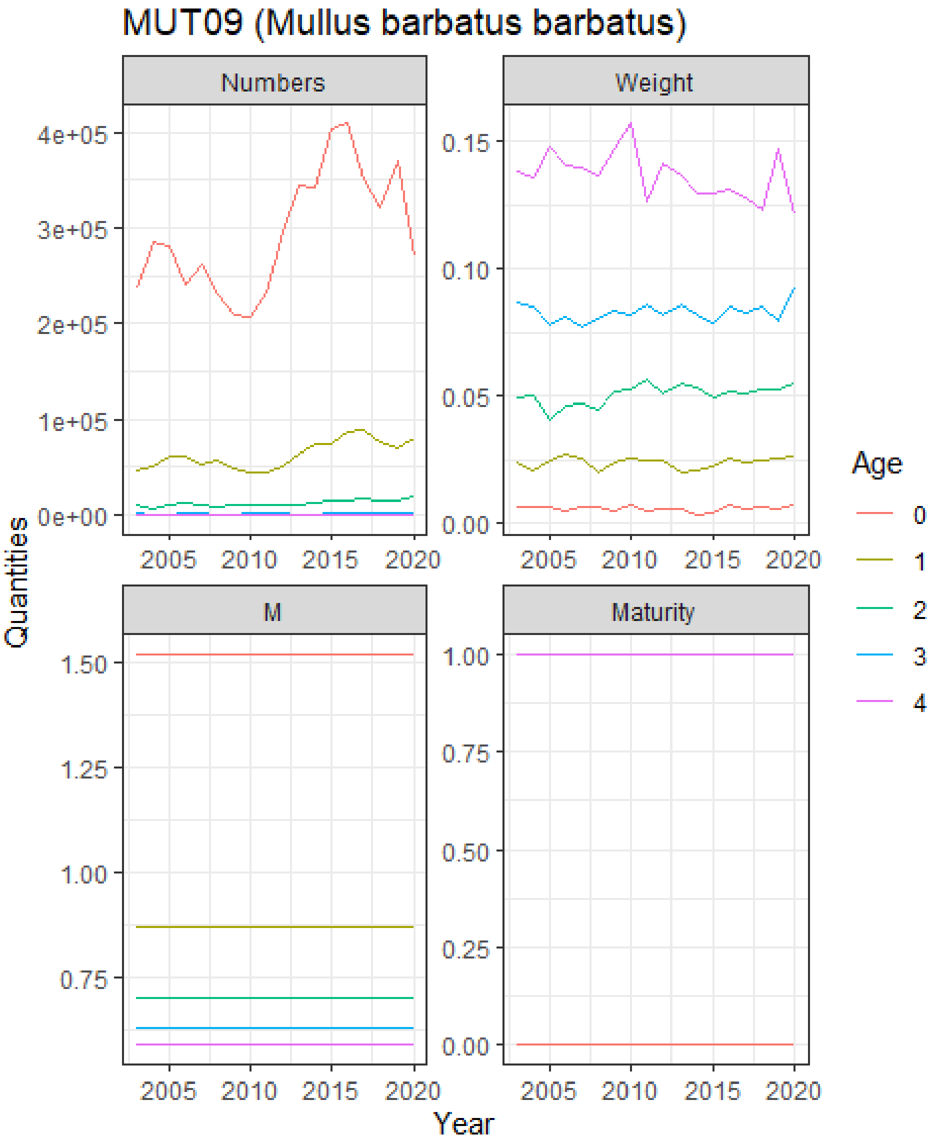


Figure 6.3.4.4: Red mullet in GSA 9. Stock biology trajectories at age Numbers from the fitted assessment the other values from input data to the assessments.

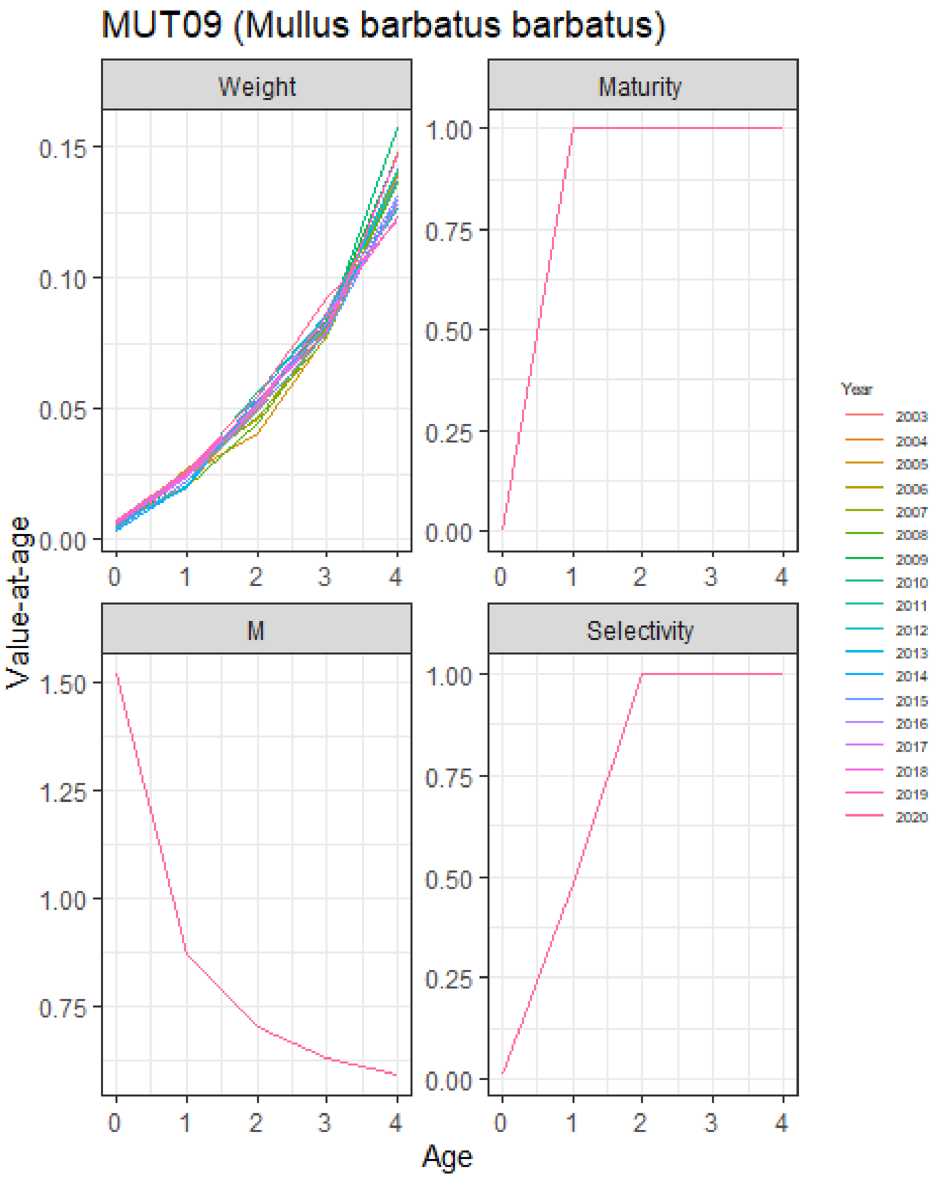


Figure 6.3.4.5: Red mullet in GSA 9. Annual stock quantities at age, weights, maturity and M are input data by age in the assessment, Selectivity in the fishery is fitted in the model.

6.3.4.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.3.4.1 and Figure 6.3.4.6.

Table 6.3.4.1: Red mullet in GSA 9. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.52	0.0063	0.00183	2.597	0.00295	0.0153

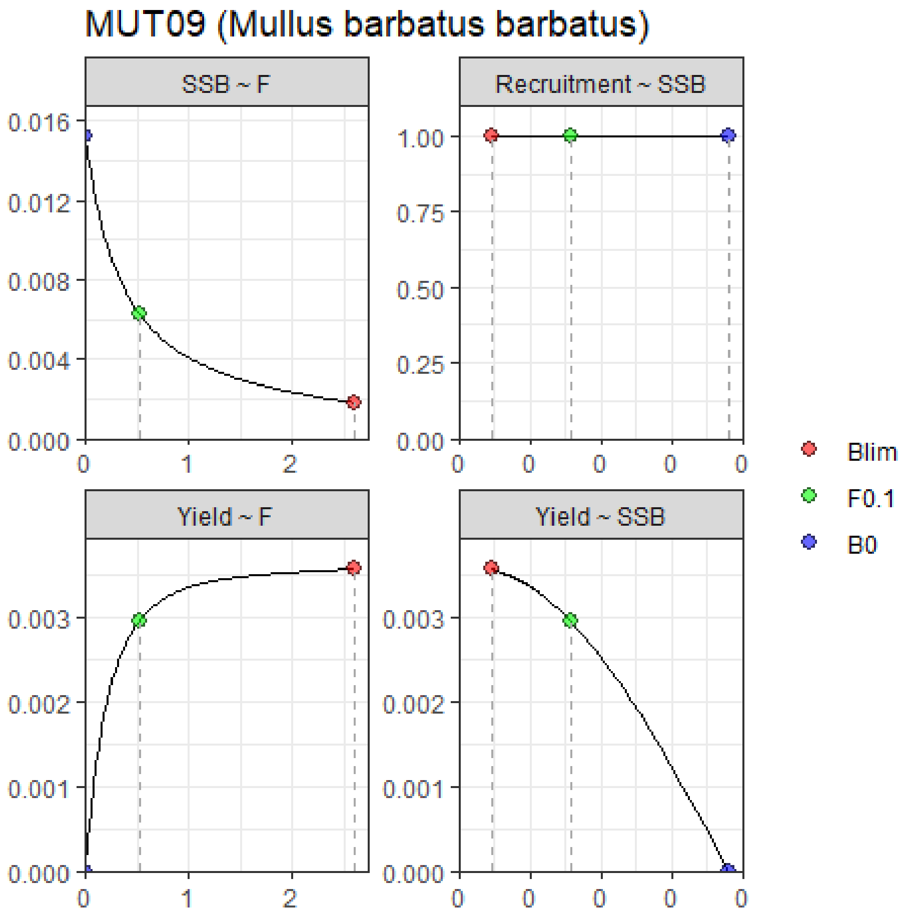


Figure 6.3.4.6: Red mullet in GSA 9. Per-recruit analysis.

Figure 6.3.4.6 shows the trajectories of the assessment outputs against the per-recruit reference points. SSB is below the biomass at $F_{0.1}$ ($B_{F0.1}$) except for 2020 and above the B_{Lim} for the whole time series. At the same time, F is well above $F_{0.1}$ except for 2020 and below Flim for the whole series, with a sharp decrease in the last year.

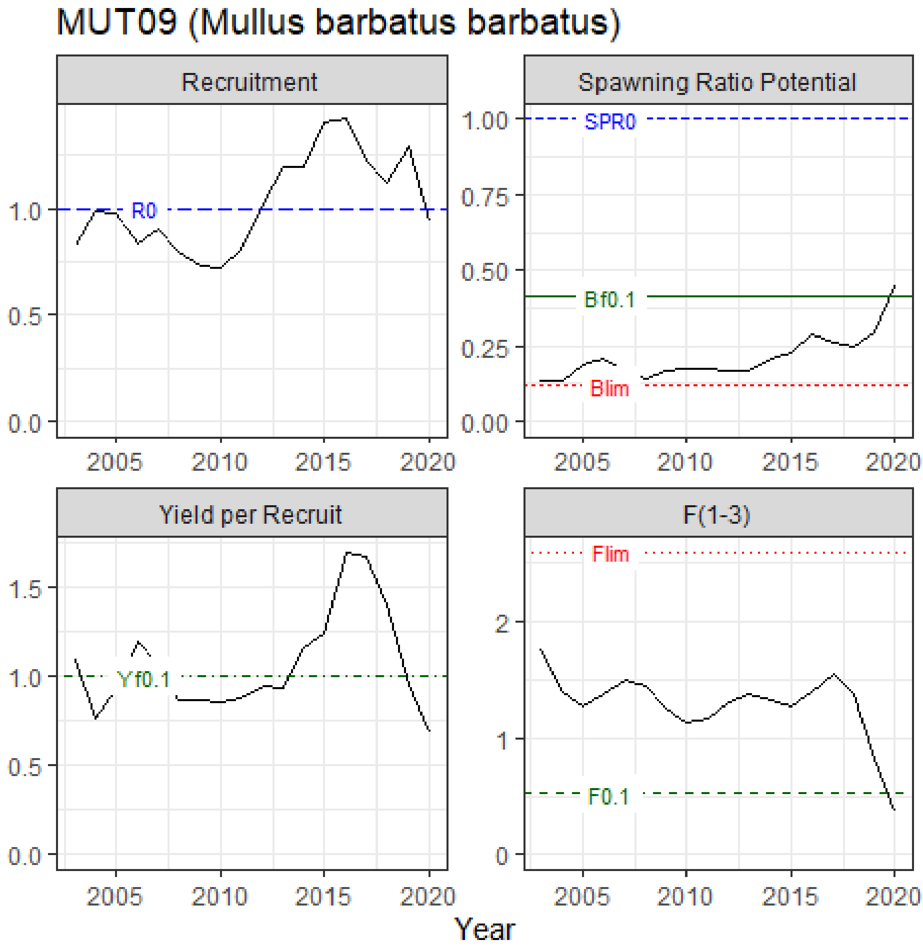


Figure 6.3.4.7: Red mullet in GSA 9. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

Figure 6.3.4.7 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario.

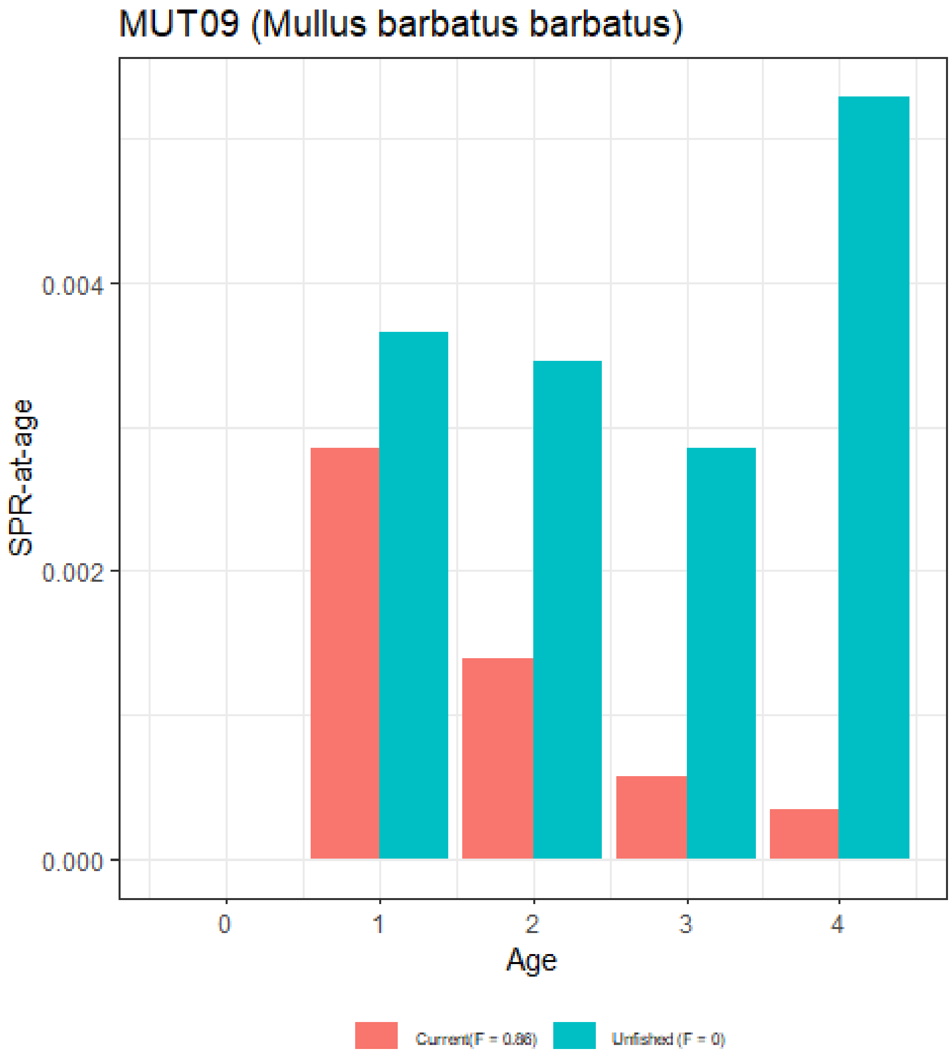


Figure 6.3.4.8: Red mullet in GSA 9. Comparison of the spawning biomass per recruit SPR_F at current F (average of last 3 years) and SPR_0 with $F = 0$.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean);
2. Hockey-Stick (model=segreg);
3. Beverton-Holt (model=bevholtSV);
4. Ricker (model=ricker).

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.3.4.2: Red mullet in GSA 9. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.2184805	287566	0.7723117	4384.813
Hockey-stick	NA	0.2123249	287566	0.7723117	4384.813
Beverton-Holt	0.744806	0.1738606	460008.3	0.5009415	7014.218
Ricker	1.160248	0.1827003	228935.2	0.5751842	3490.809

The observed SR data are in the centre and right part of the R-SSB plot, and the breakpoint estimated by the HS model does not fit within the data (Figure 6.3.4.9) due to the restrictive upper bound of 20% of B_0 noted above. The HS point of infection is on the left of the observed values located at the default position of 25% $B_{F0.1}$.

The results show that the recruitment variation fairly low, e.g. σ_r = 0.17 for the Beverton-Holt model, associated with a steepness of s = 0.74. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the two models differ largely in scale of their R_0 and B_0 estimates. The break-point of the hockey-stick is estimated at b = 439 corresponding to an SRP_{lim} = 0.0104 and the corresponding R_0 is the geometric mean recruitment. The default breakpoint of 25% of $B_{F0.1}$ is used as the value for B_{Lim}

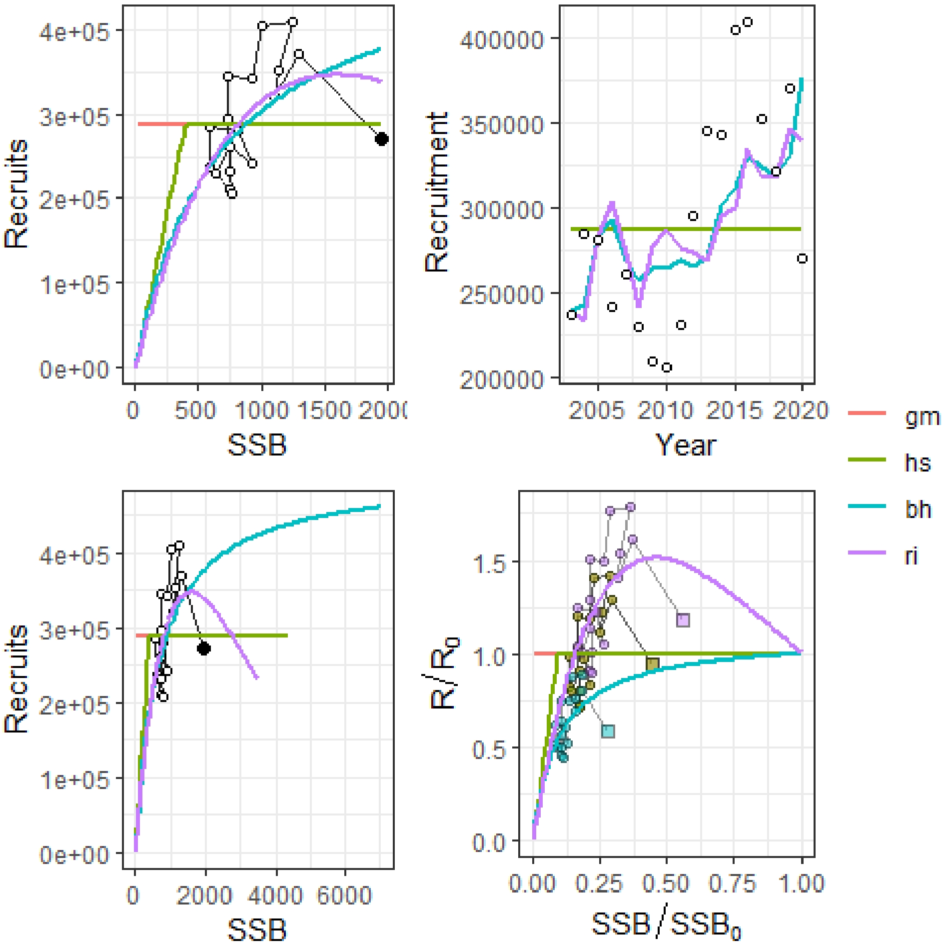


Figure 6.3.4.9: Red mullet in GSA 9. Summary of the four SR models.

Figure 6.3.4.10 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.8-0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates.

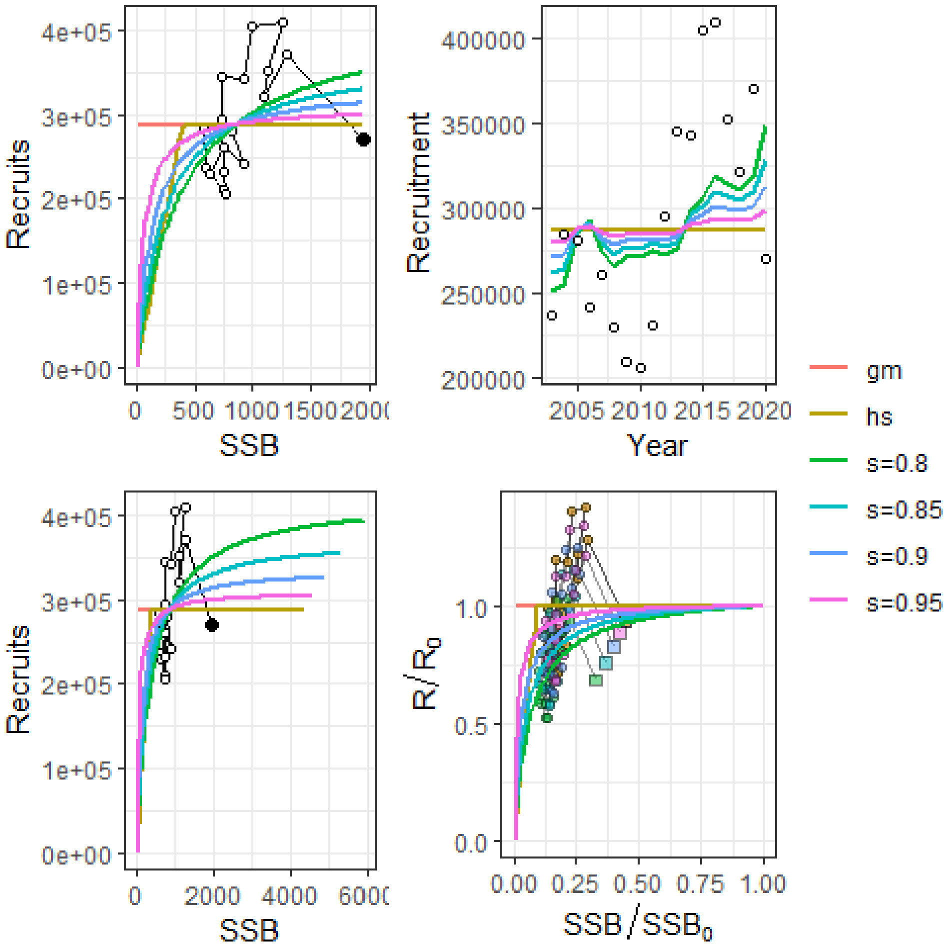


Figure 6.3.4.10: Red mullet in GSA 9. Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

Historical landings were gathered from the Italian national official statistics (ISTAT) as collected and stored in the RECFISH project (Ligas, 2019). Landings for red mullet were available from 1972 to 2001 and they are summarized in Figure 6.3.4.11 together with the EU DCF time series (2002-2020). Some historic landings are reported higher than recent landings, the higher landings could be due to some overexploitation before 2002 giving the low biomass we see at the beginning of the assessed time period. Or recruitment may have been higher in the past. The landing of the species in the recent period is in line with the results of the SR analysis using the Geometric Mean. Given uncertainty in the basis of the earlier higher landings, excess exploitation or increased recruitment, it seems appropriate to use the observed recruitment of the last 20 years as the basis for reference points for now.

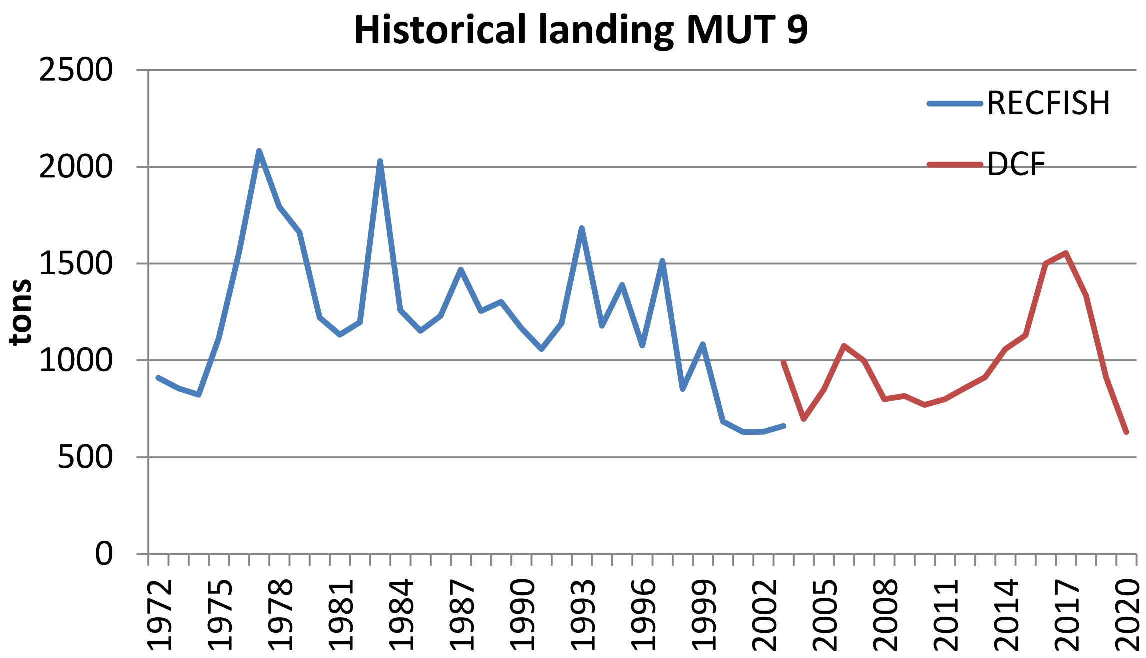


Figure 6.3.4.11: Red mullet in GSA 9. Historical landings (tonnes) from RECFISH and EU DCF landings.

6.3.4.3 Results

In the light of the outcomes of the exploratory analysis, because the point of inflection on the HS was outside the data it was decided to consider the Geometric Mean approach as the most suitable to estimate the biomass reference points for the stock of red mullet in GSA 9, This being also equivalent to the asymptote of the HS. Table 6.3.4.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in Figure 6.3.4.12 and the historic assessment information is shown in this context in Figure 6.3.4.13 and Figure 6.3.4.14. In conclusion the stock is considered to be between B_{pa} and $B_{F0.1}$ in 2020.

Table 6.3.4.3: Red Mullet in GSA 9. Final reference points based on Geometric mean and a default value of B_{Lim} =25% $B_{F0.1}$.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.52	453	906	1811	4385	1.402

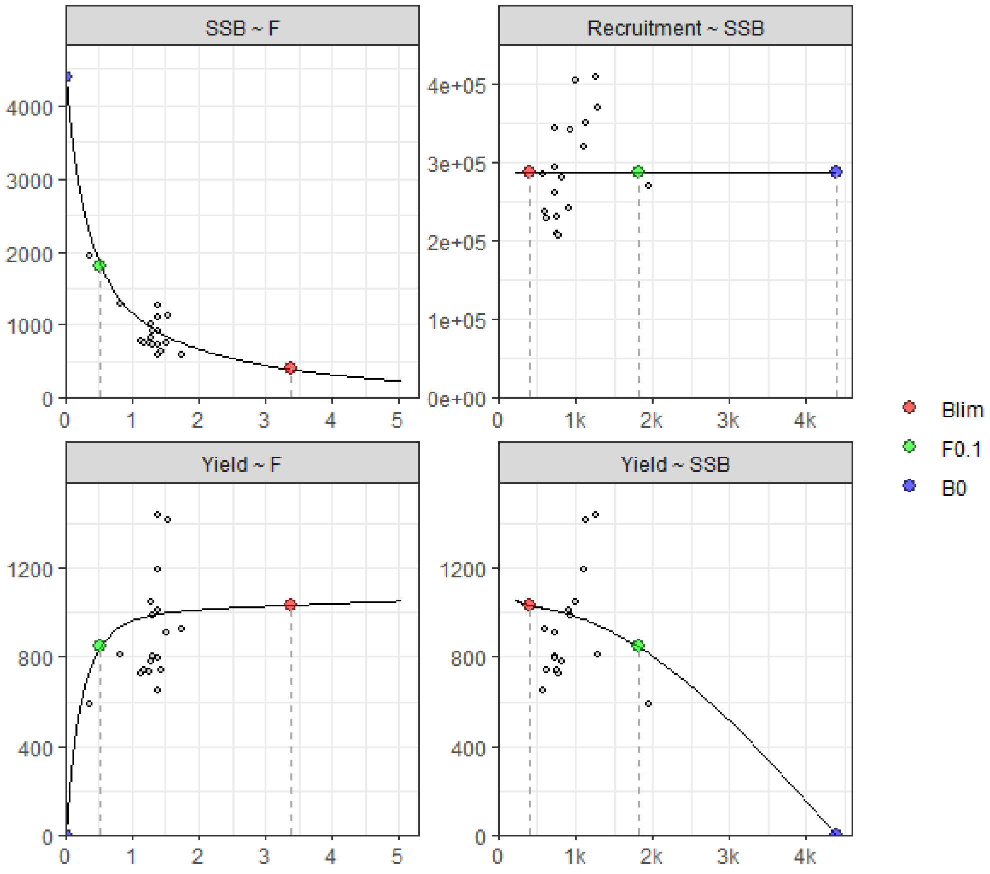


Figure 6.3.4.12: Red mullet in GSA 9. Reference point estimates of F_{01}, B_{lim} and B_0 shown as functions of SSB, F, Yield and Recruitment. Grey dots show the corresponding observations.

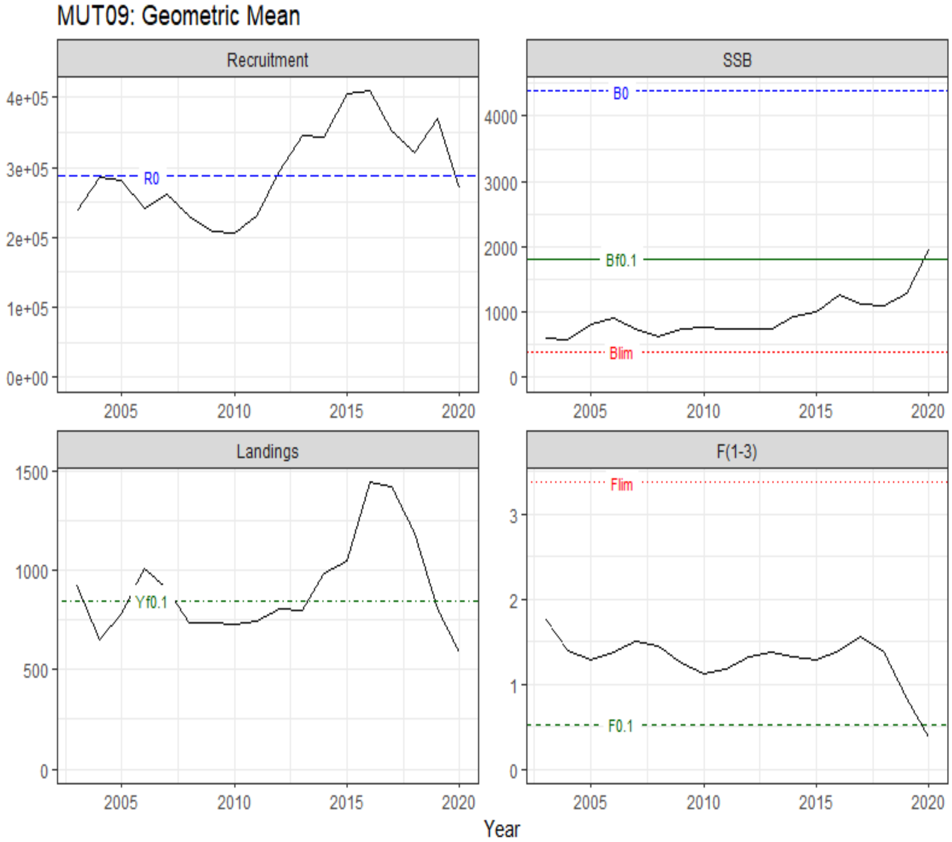


Figure 6.3.4.13: Red mullet in GSA 9. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a R_0 from Geometric Mean stock-recruitment relationship with default breakpoint at 25%$B_{F0.1}$, used for B_{Lim}.

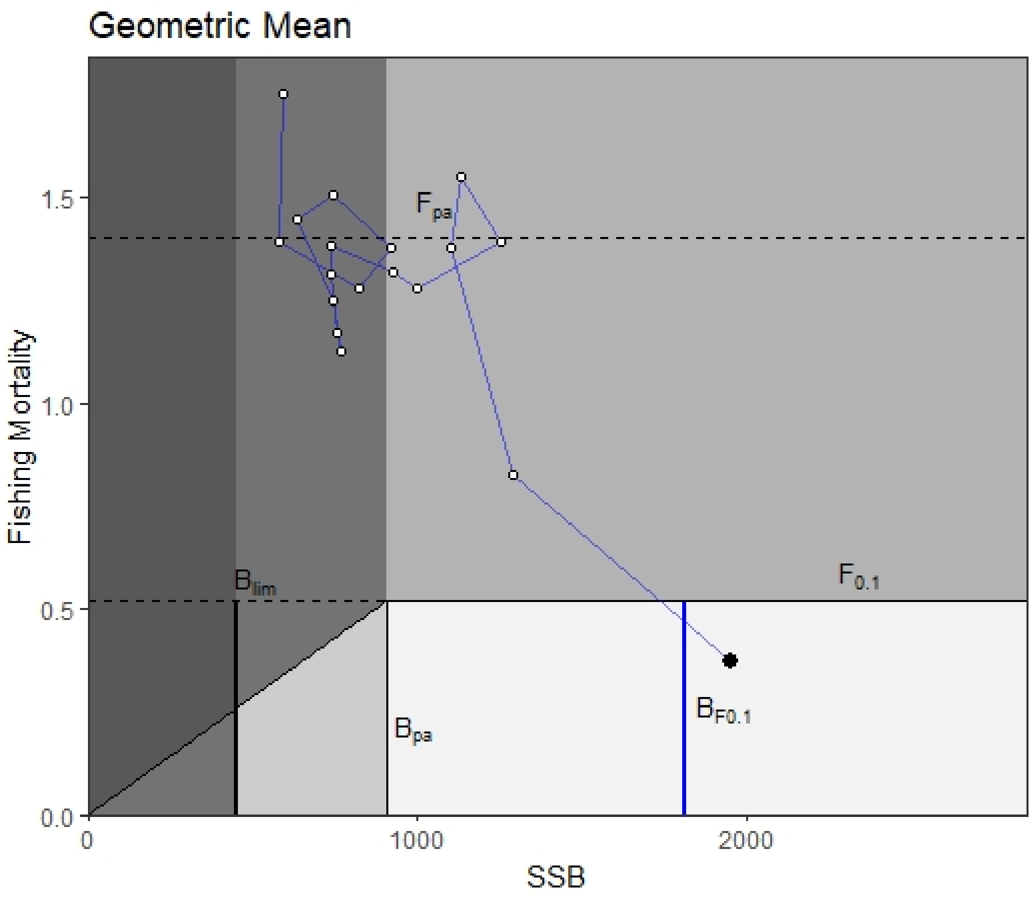


Figure 6.3.4.14: Red mullet in GSA 9. Advice Rule plots, with B_{pa} = 2*B_{Lim},, $B_{F0.1}$ from R_0 based on Geometric mean with a default $B_{lim} = 0.25B_{F0.1}$.

6.3.4.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modeling. A Beverton-Holt model may be helpful to as a modeling option. The steepness options considered above are illustrated inFigure 6.3.4.10. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.95 (Figure 6.3.4.15).

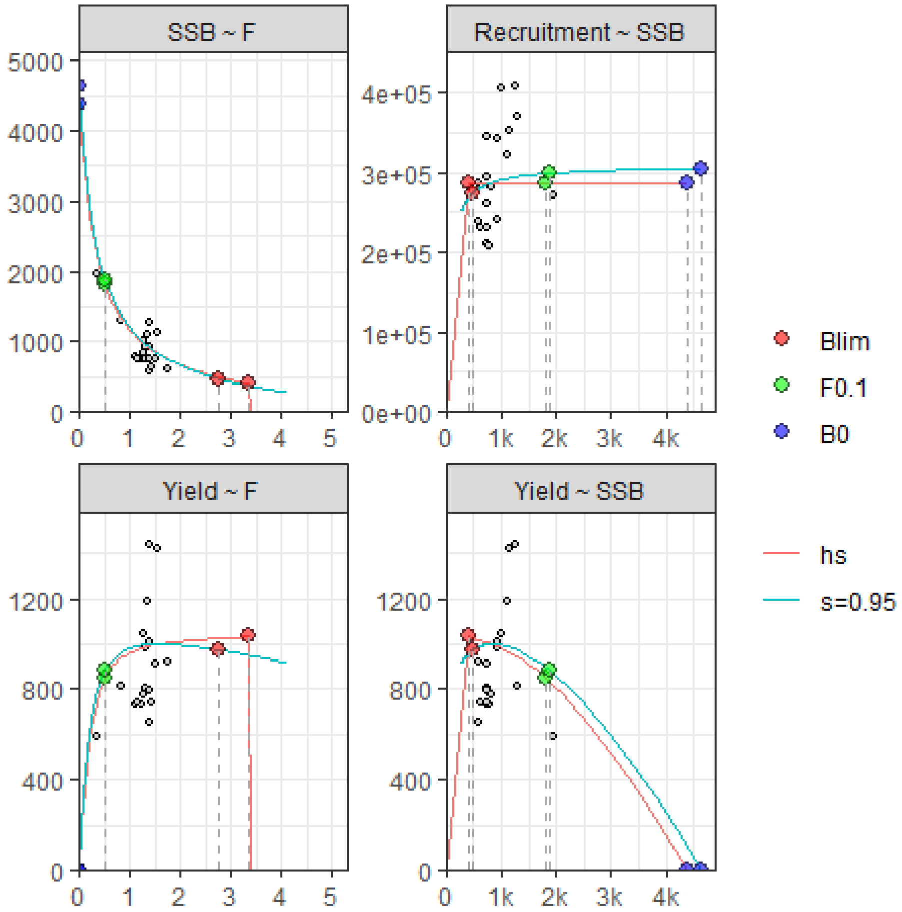


Figure 6.3.4.15: Red mullet in GSA 9. Equilibrium yield: relative reference points for HS and BH (steepness 0.95) models.

6.3.5 Red mullet (MUT) in GSA 10

6.3.5.1 Stock assessment

The assessment of red mullet in GSA 10 was carried out in STECF EWG 21-11, considering the stock boundaries represented by the only GSA 10 (Figure 6.3.5.1).

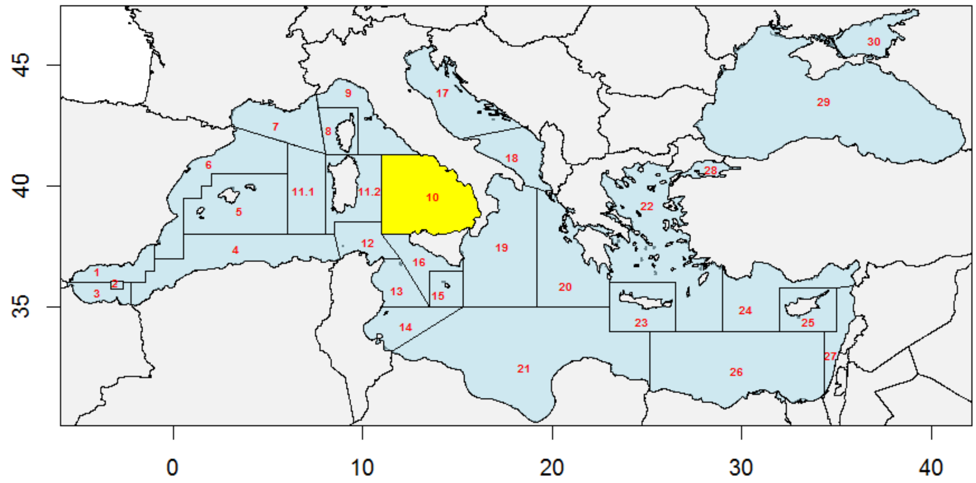


Figure 6.3.5.1: Red mullet in GSA 10. Limit of Geographical Sub-Area (GSA) 10.

A statistical catch-at-age assessment was performed for this stock, using data from the period 2002-2020. The catch-at-age data from commercial fisheries were tuned with the index-at-age data from the MEDITS survey in GSA 10. The catch at age data for 2020 was not utilized (due to inconsistencies with the previous years) allowing the model to estimate the catch at age in the last year. The assessment was performed using the Assessment for All Initiative (a4a) method (Jardim et al., 2015). The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.3.5.2.

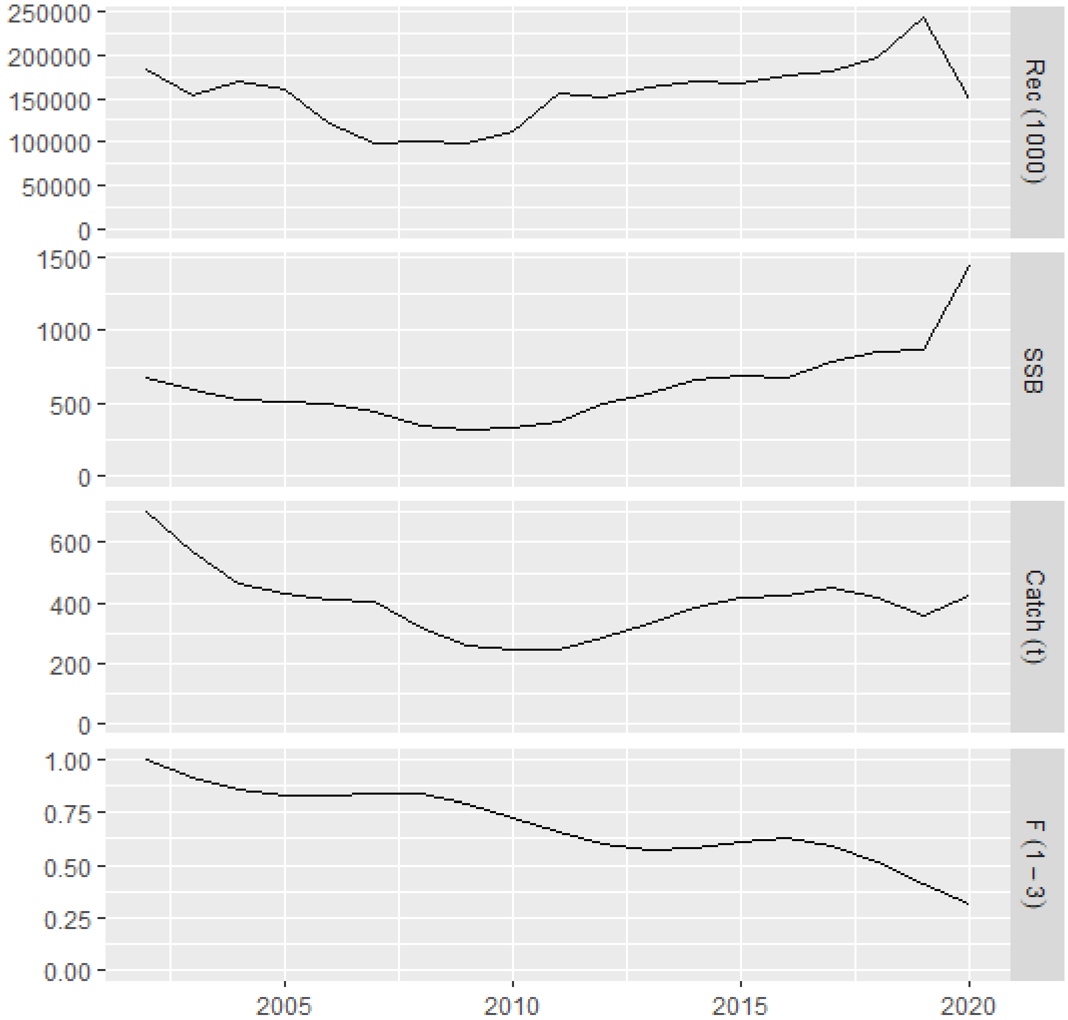


Figure 6.3.5.2: Red mullet in GSA 10. Stock summary from the final a4a model.

An overview of the input data used in the assessment and outcomes is provided in Figure 6.3.5.3-Figure 6.3.5.5

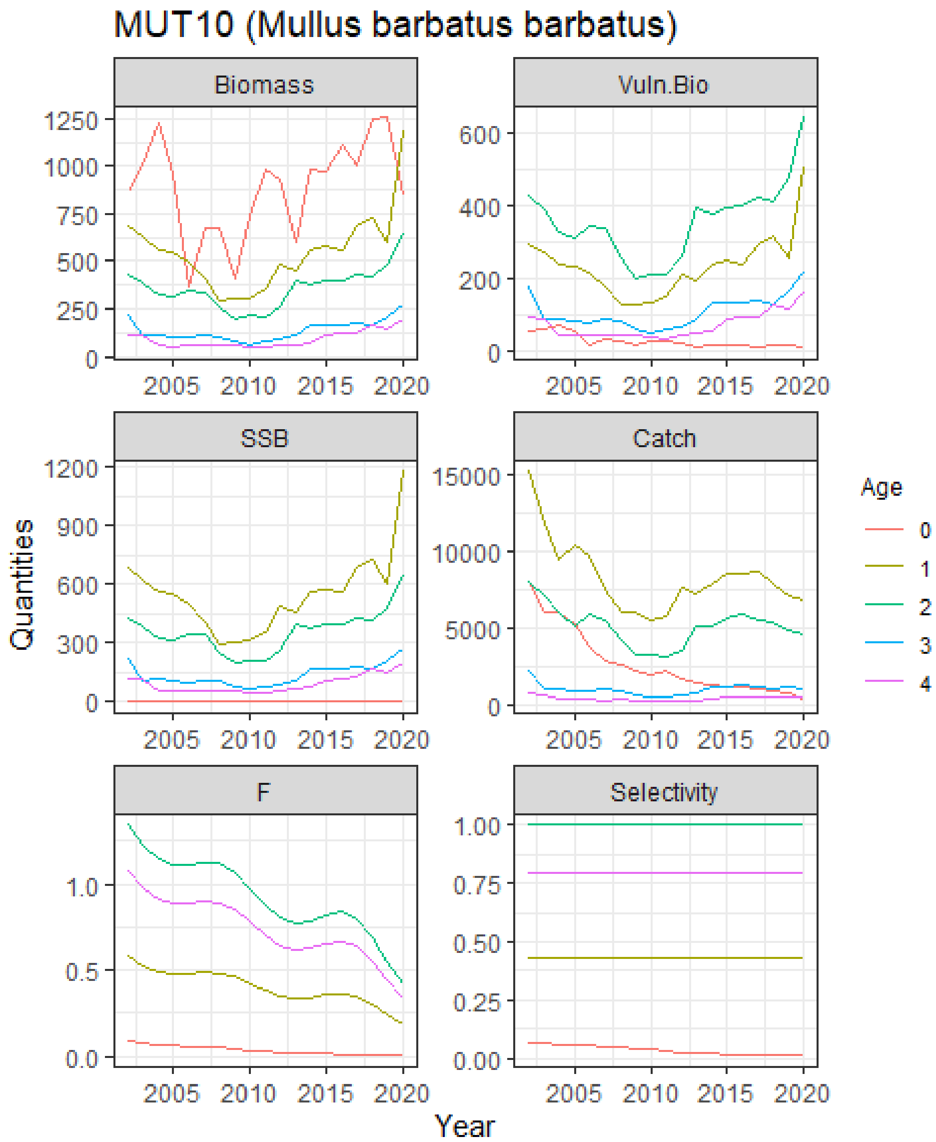


Figure 6.3.5.3: Red mullet in GSA 10. Stock assessment trajectories at age from the assessment output.

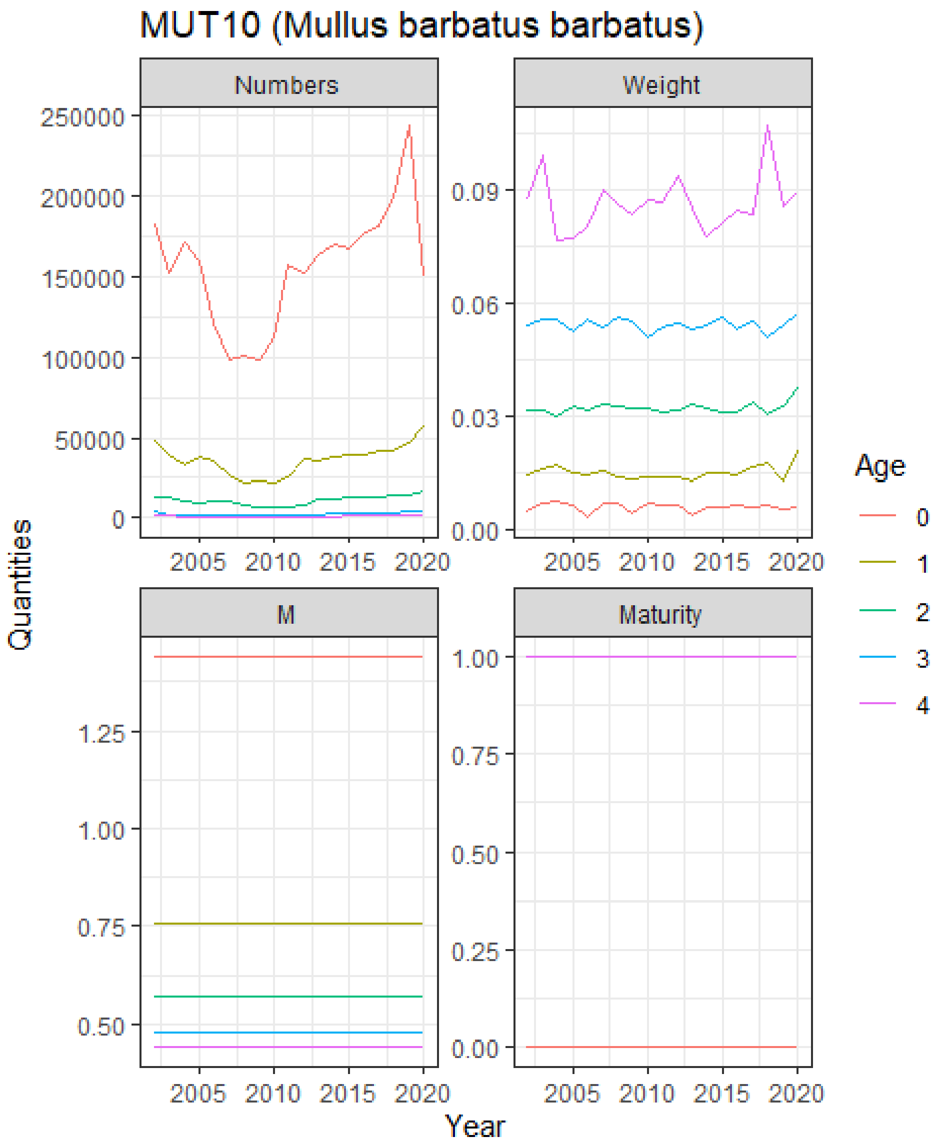


Figure 6.3.5.4: Red mullet in GSA 10. Stock biology trajectories at age. Numbers from the fitted assessment the other values from input data to the assessments.

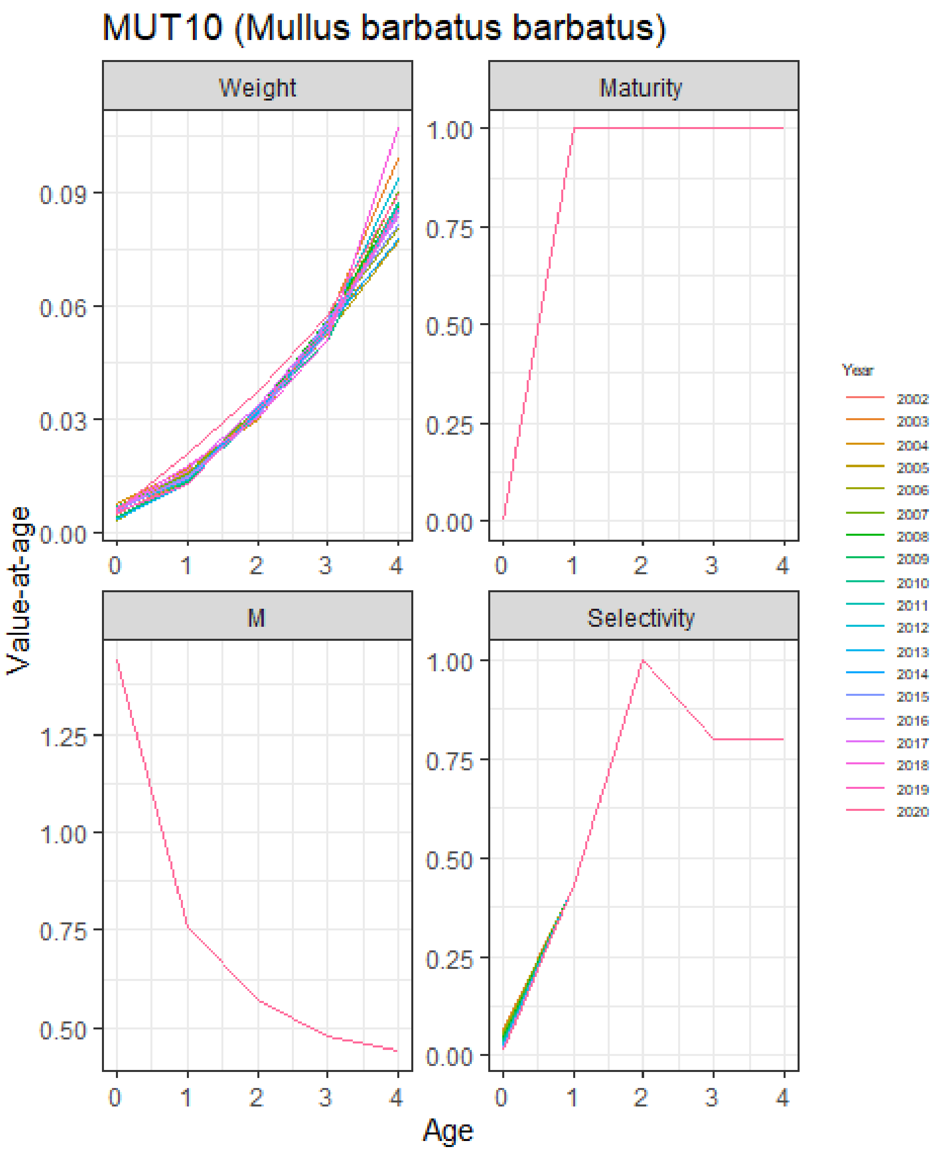


Figure 6.3.5.5: Red mullet in GSA 10. Annual stock quantities at age, weights, maturity and M are input data by age in the assessment, Selectivity in the fishery is fitted in the model.

6.3.5.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.3.5.1 and Figure 6.3.5.6.

Table 6.3.5.1: Red mullet in GSA 10. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.40	0.0063	0.00173	2.00339	0.00255	0.01649

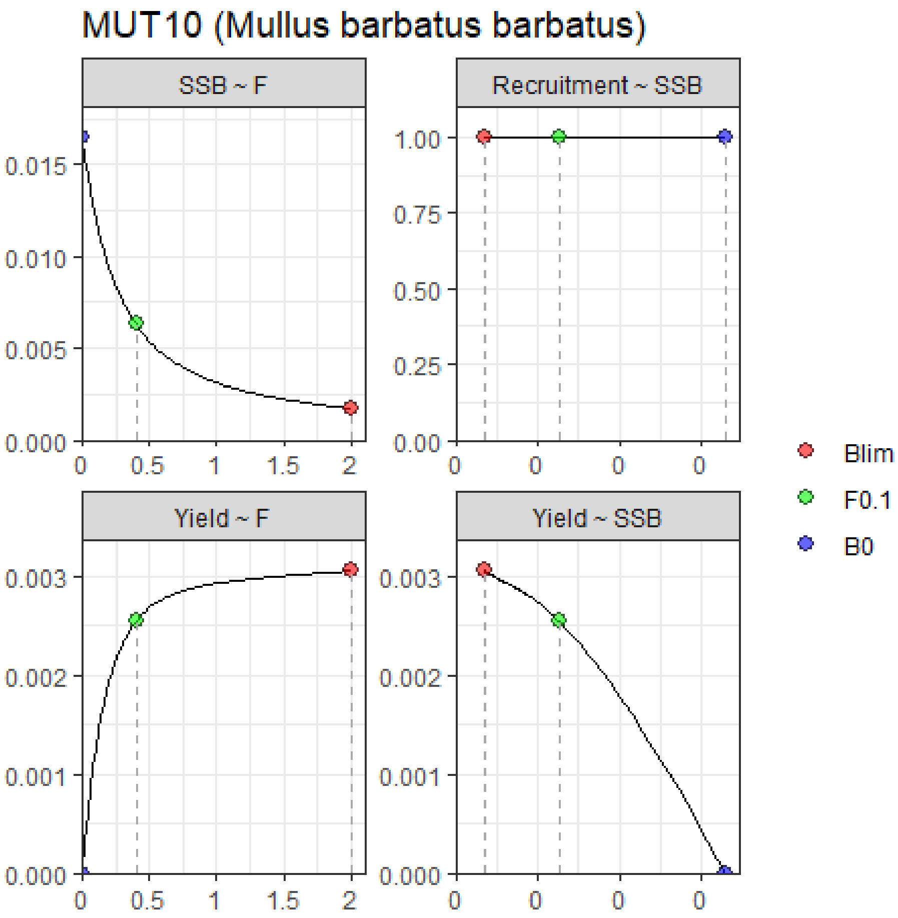


Figure 6.3.5.6: Red mullet in GSA 10. Per-recruit analysis.

Figure 6.3.5.7 shows the trajectories of the assessment outputs against the per-recruit reference points. SSB is below the biomass at $F_{0.1}$ ($B_{F0.1}$) except for 2020 and above the B_{Lim} for the whole time series. At the same time, F is well above $F_{0.1}$ except for 2020 and below Flim for the whole series, with a sharp decrease in the last year.

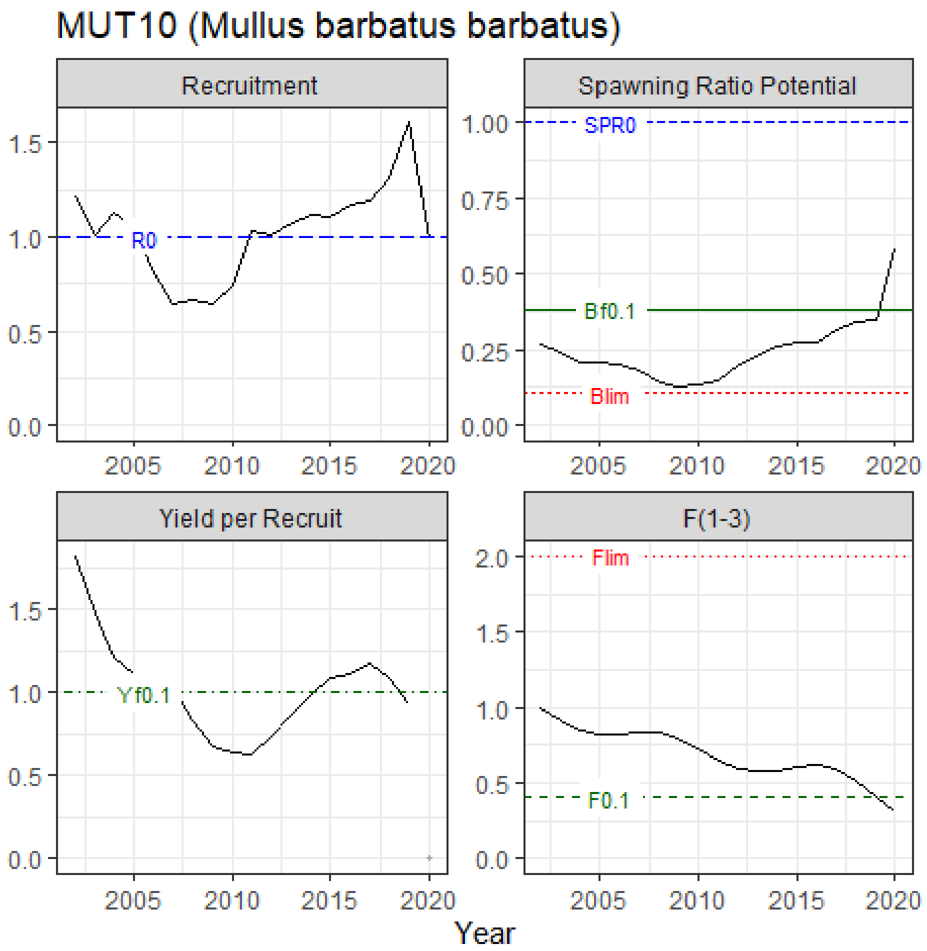


Figure 6.3.5.7: Red mullet in GSA 10. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

Figure 6.3.5.8 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario.

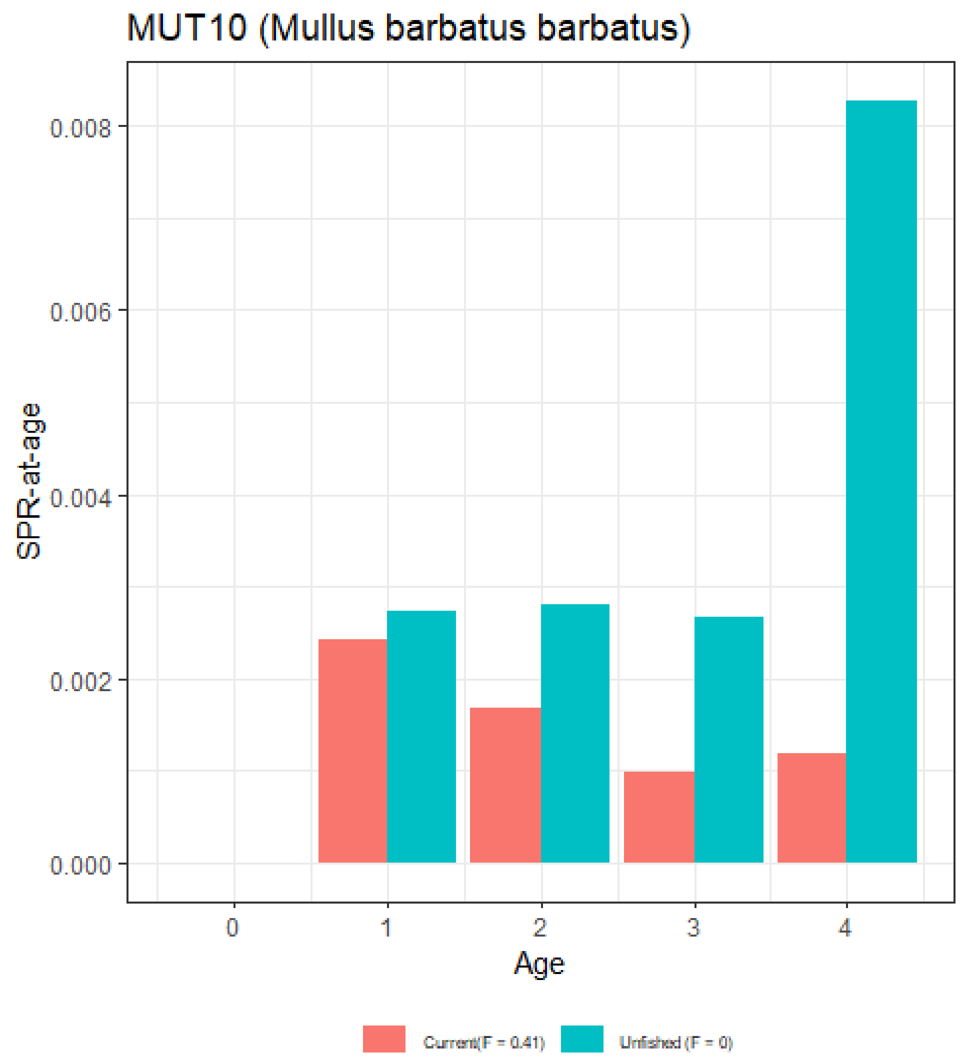


Figure 6.3.5.8: Red mullet in GSA 10. Comparison of the spawning biomass per recruit SPR_F at current F (average of last 3 years) and SPR_0 with $F = 0$.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean);

2. Hockey-Stick (model=segreg);

3. Beverton-Holt (model=bevholtSV);

4. Ricker (model=ricker).

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y.

Table 6.3.5.2: Red mullet in GSA 10. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.2491233	151186.1	0.7277321	2493.335
Hockey-stick	NA	0.2424788	151186.1	0.7277321	2493.335
Beverton-Holt	0.6673906	0.1602355	276392.4	0.2091715	4558.216
Ricker	1.034488	0.1636943	139721.1	0.09804088	2304.256

The observed SR data are across most of the R-SSB plot (Figure 6.3.5.9), but due to the constraint of an upper limit of 20% of B_0 the breakpoint lies outside the range of the data and is set at the default value of 25% $B_{F0.1}$ which is to left of the observed values.

The results show that the recruitment variation fairly low, e.g. σ_r = 0.16 for the Beverton-Holt model, associated with a steepness of s = 0.67. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the two models differ largely in scale of their R_0 and B_0 estimates (Figure 6.3.5.9). The parameters for these models are particularly sensitive to the final point in the series, making it difficult to use these models. In contrast the Geometric Mean is influenced only slightly by the final point, or indeed any other single point.

The break-point of the hockey-stick based on 25% of $B_{F0.1}$ is estimated at b = 239 corresponding to an SRP_{lim} = 0.096 and the corresponding R_0 comes from the geometric mean recruitment. If the Hockey-stick is fitted without the upper constraint of 20% B_0, a fit is found at 666 tonnes, which lies at about 70% of $B_{F0.1}$, which is considered unrealistically high, and not used for the B_{Lim} evaluation.

Figure 6.3.5.10 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.8-0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates.

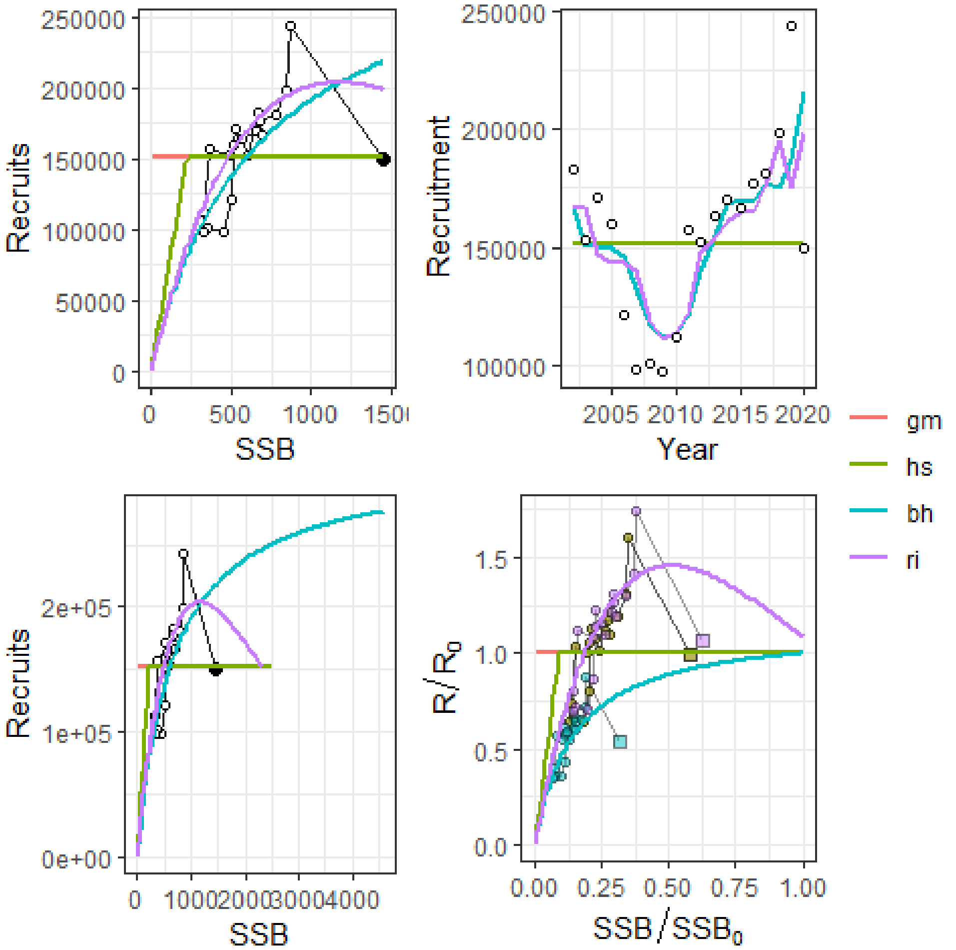


Figure 6.3.5.9: Red mullet in GSA 10. Summary of the four SR models.

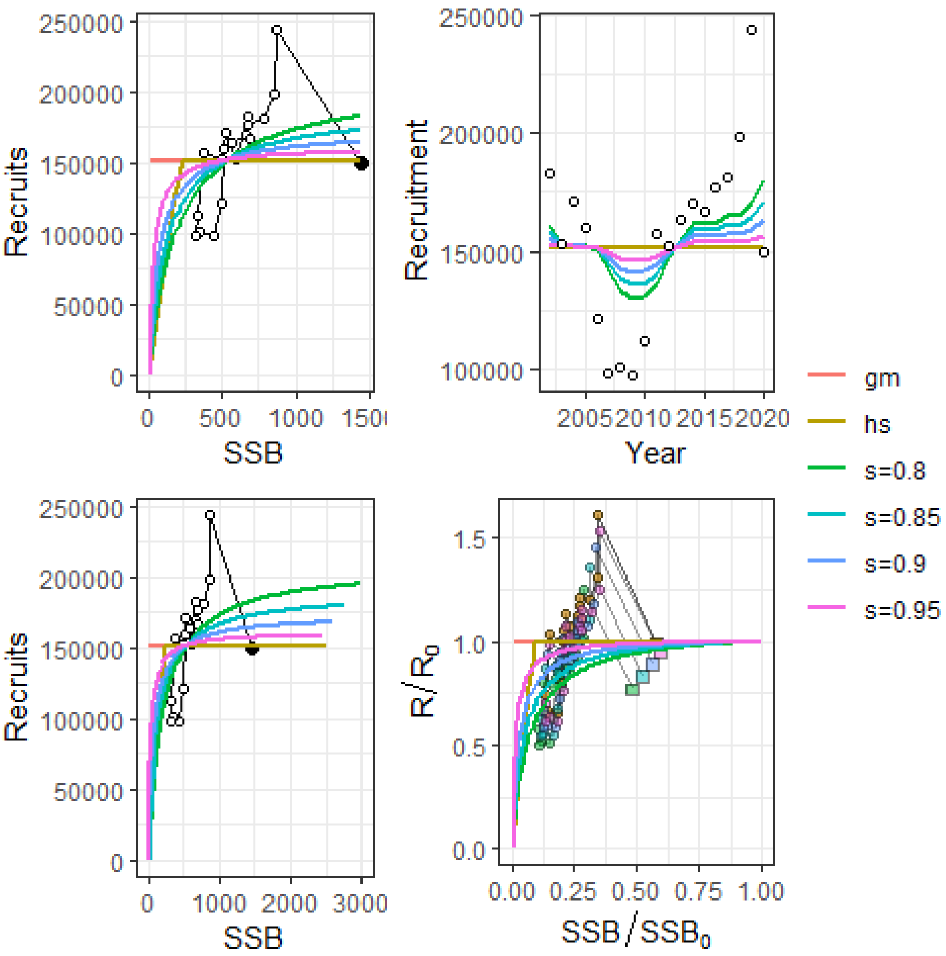


Figure 6.3.5.10: Red mullet in GSA 10. Equilibrium yield with different slope (s, steepness) scenarios for the Beverton-Holt model.

Historical landings were gathered from the Italian national official statistics (ISTAT) as collected and stored in the RECFISH project (Ligas, 2019). Landings for red mullet were available from 1972 to 2001 and they are summarized in Figure 6.3.5.11, together with the EU DCF time series (2002-2020). The landing of the species is in line with the results of the SR analysis.

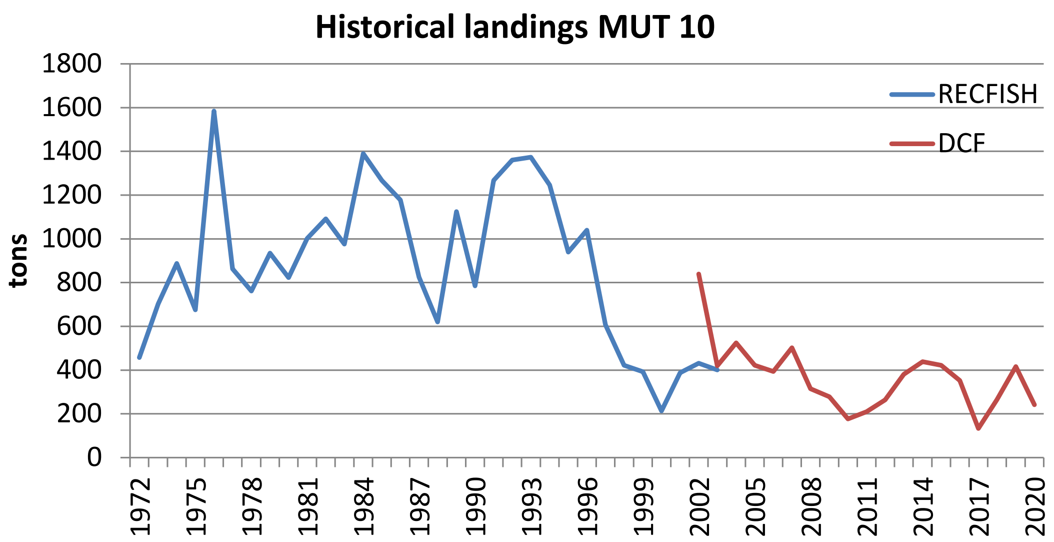


Figure 6.3.5.11: Red mullet in GSA 10. Historical landings (tonnes) from RECFISH and EU DCF landings.

6.3.5.3 Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Geometric mean approach as the most appropriate to estimate the biomass reference points for the stock of red mullet in GSA 10, being also equivalent to the HS asymptotic recruitment.Table 6.3.5.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in Figure 6.3.4.12, and the historic assessment information is shown in this context in Figure 6.3.5.13 and Figure 6.3.5.14. In conclusion the stock is considered to be above $B_{F0.1}$ in 2020.

Table 6.3.5.3 Red Mullet in GSA 10. Final reference points based on Geometric mean and a default value of BLim =25% BF0.1.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.401	239	477	954	2493	0.993

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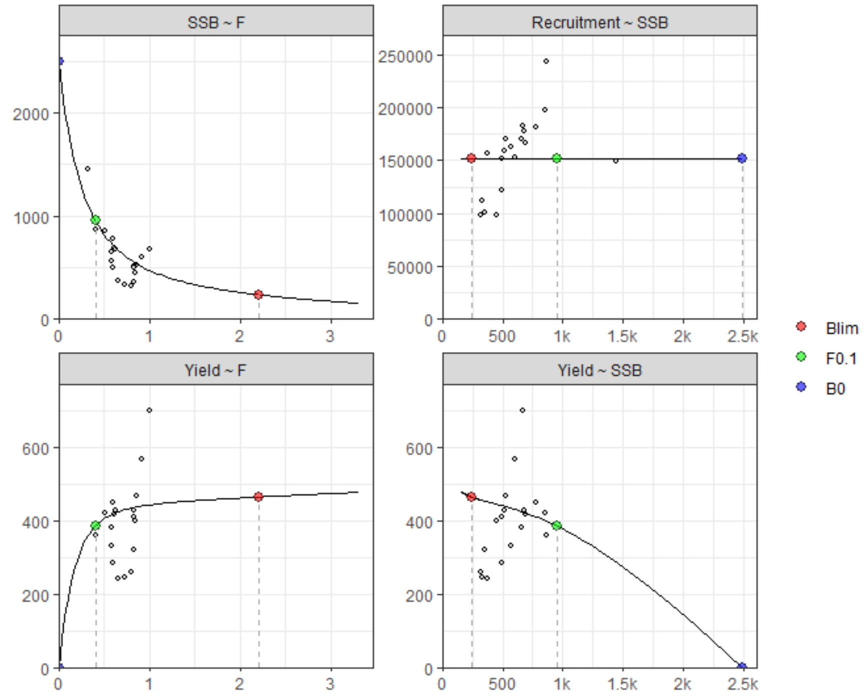

Figure 6.3.5.12: Red mullet in GSA 10. Reference point estimates of F_{01}, B_{lim} and B_0 shown as functions of SSB, F, Yield and Recruitment. Grey dots show the corresponding observations.

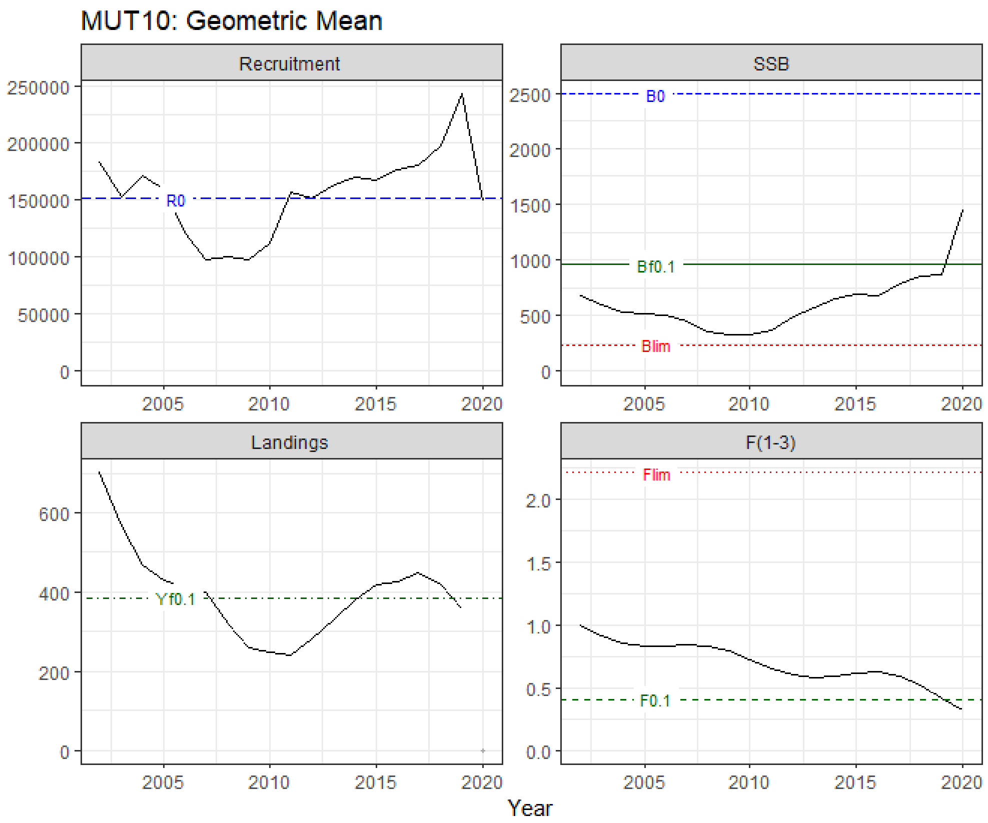

Figure 6.3.5.13: Red mullet in GSA 10. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

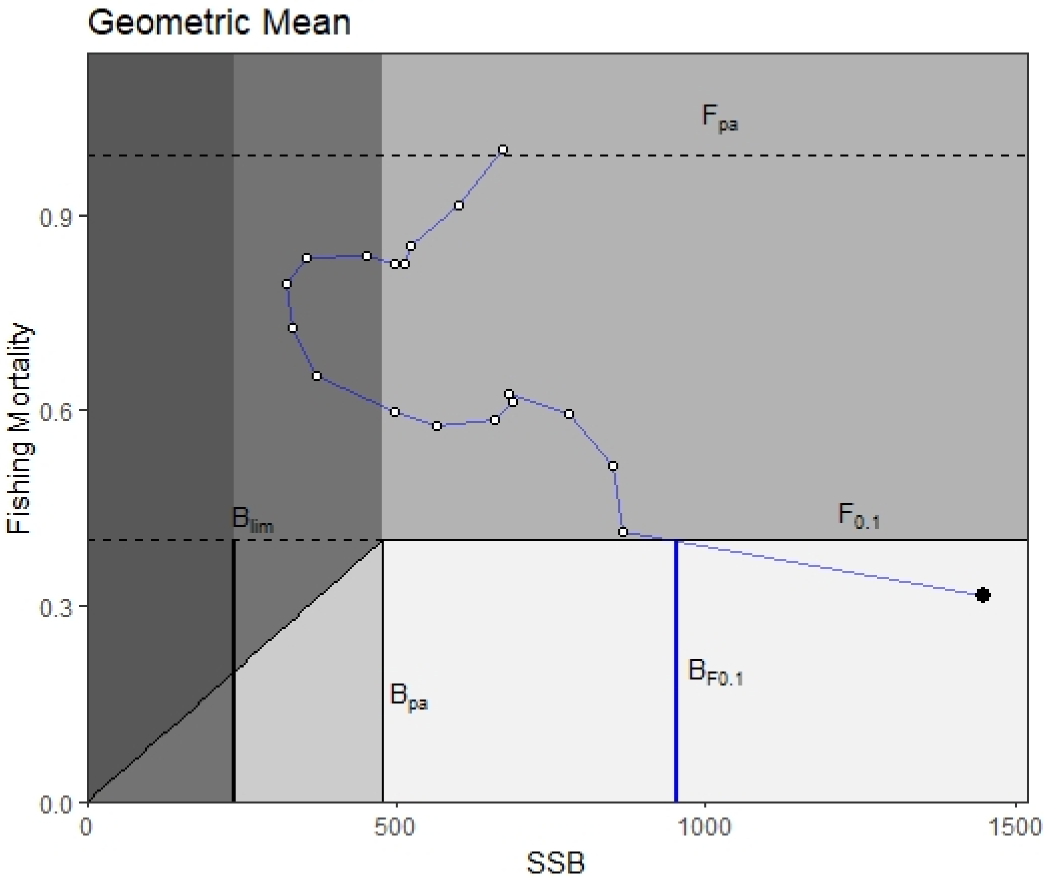

Figure 6.3.5.14: Red mullet in GSA 10. Advice Rule plot, with $B_{pa} = 2B_{lim}$, based on Geometric mean recruitment for $B_{F0.1}$ and $B_{lim} = 0.25B_{F0.1}$.

6.3.5.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above are illustrated in Figure 6.3.5.10. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.95 (Figure 6.3.5.15).

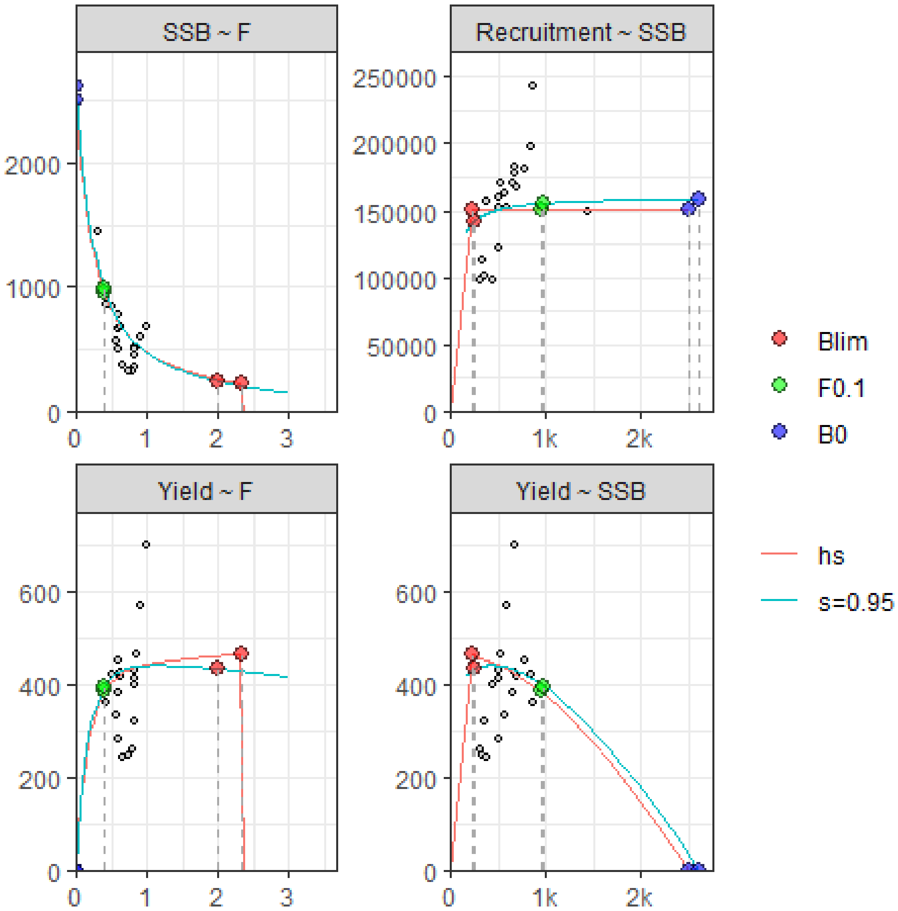

Figure 6.3.5.15: Red mullet in GSA 10. Equilibrium yield: relative reference points for HS and BH (steepness 0.95) models.

6.4 Nephrops

6.4.1 Norway lobster (NEP) in GSA 6

6.4.1.1 Stock assessment

During the STECF EWG 21-11 a statistical catch-at-age assessment (SCAA) using the Assessment For All (a4a) framework was carried out for the Norway lobster *Nephrops norvegicus* in GSA 6 (Figure 6.4.1.1)

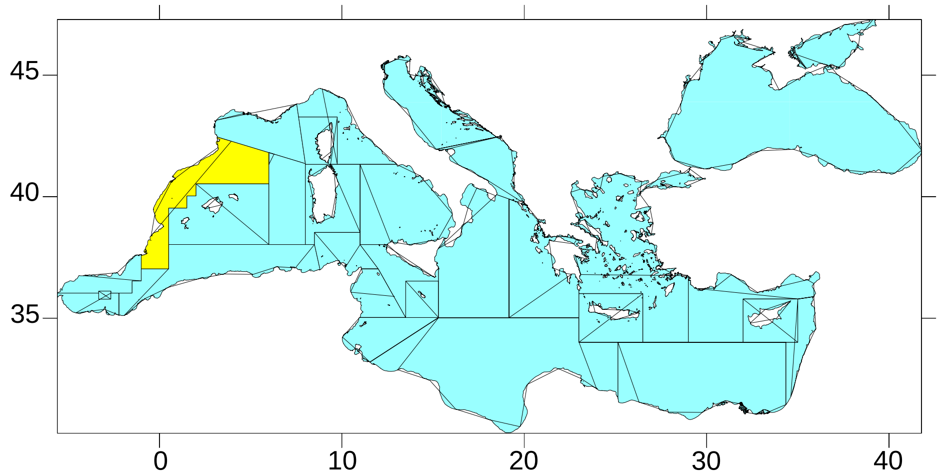

Figure 6.4.1.1: Norway lobster in GSA 6. Limit of Geographical Sub-Area.

The SCAA output of NEP06 from EWG21-11 for the years 2009-2020 is summarized below in Figure 6.4.1.2. It shows high recruitment and biomass until 2014, then a gradual decreasing trend to low levels in 2018 with a sharp increase in the last two years. Both catches and fishing mortality peak in show a decreasing trend from 2011 with a drastic reduction after 2017. Fbar (3-6) reached the lowest value in the series (0.258) in 2020, very close to $F_{0.1}$ = 0.257.

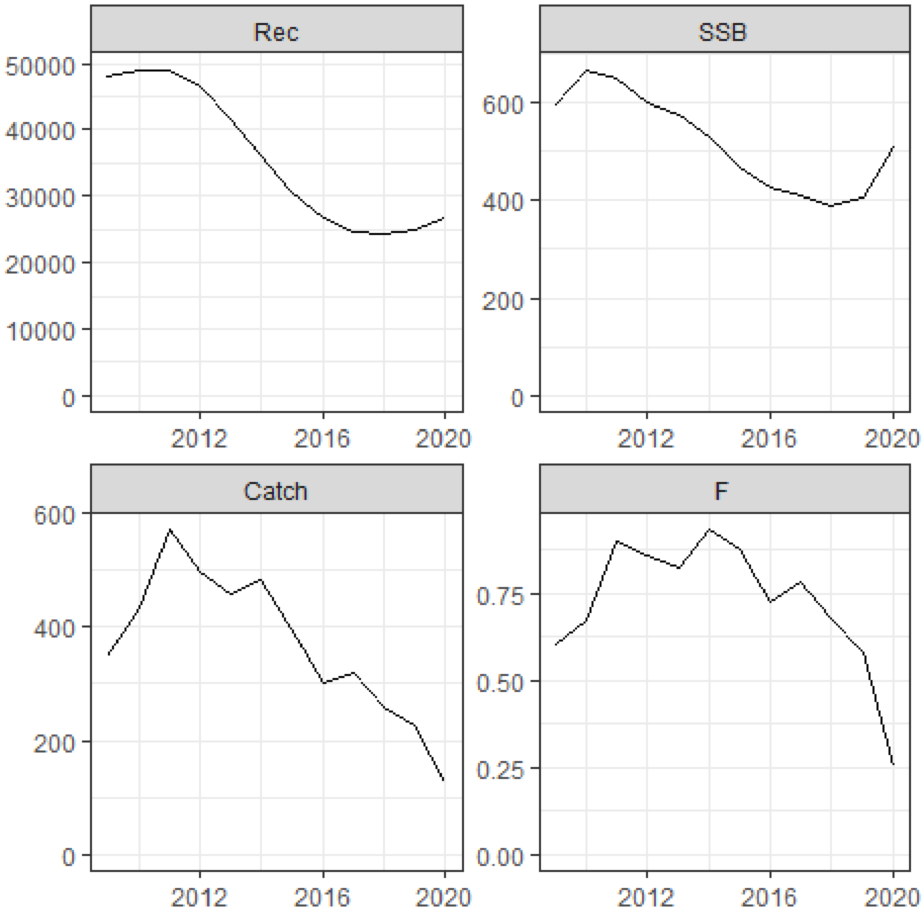

Figure 6.4.1.2: Norway lobster in GSA 6. Stock summary from the final a4a model.

An overview of the biological data used in the assessment show that the stock is composed of 8 age classes (from 2 to 9+), but most of the vulnerable biomass would be in ages 3, 4 and 5 (Figure 6.4.1.3).

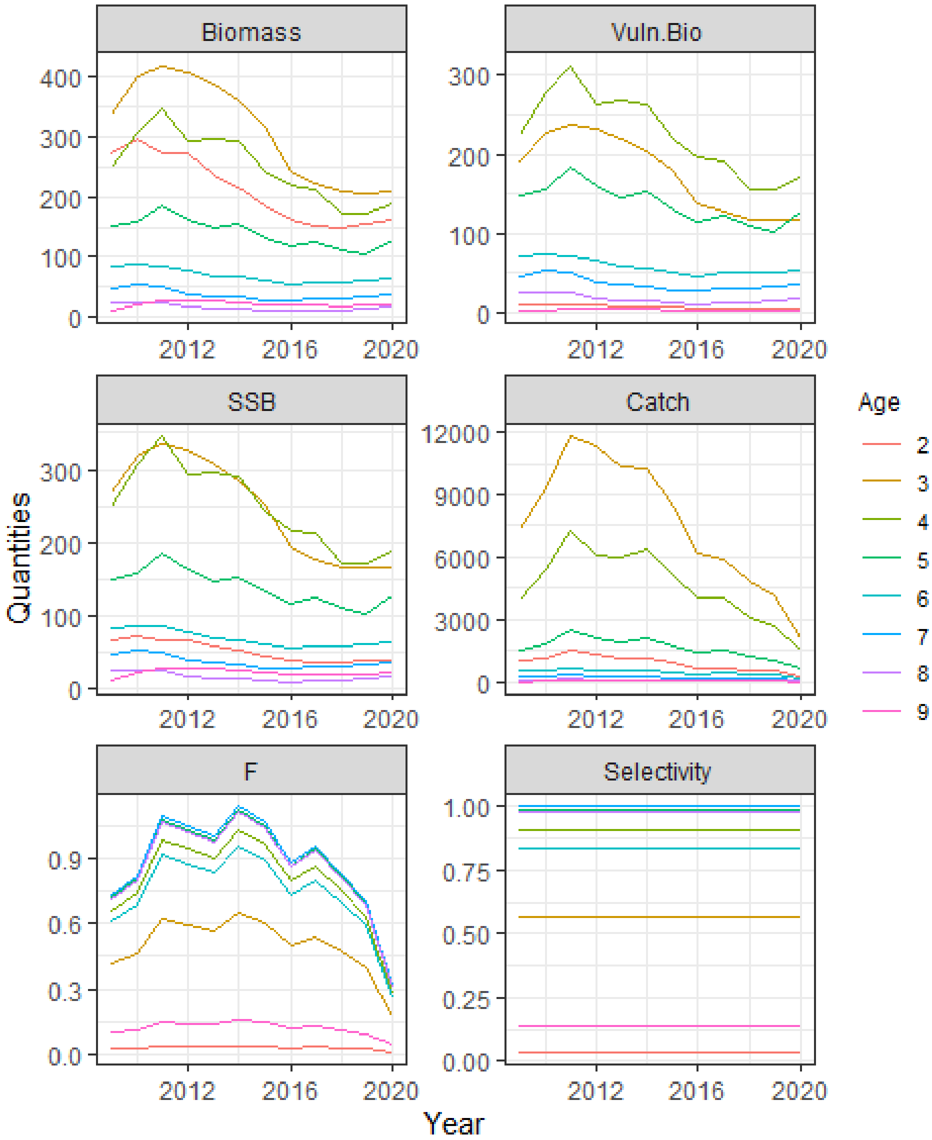

Figure 6.4.1.3: Norway lobster in GSA 6. Stock assessment trajectories at age from the assessment output.

According to the biology of the species, age 3 would already contribute to SSB; with a maturity rate estimated at 0.8 and all age classes would be fully selected from age 4 onwards (Figure 6.4.1.4).

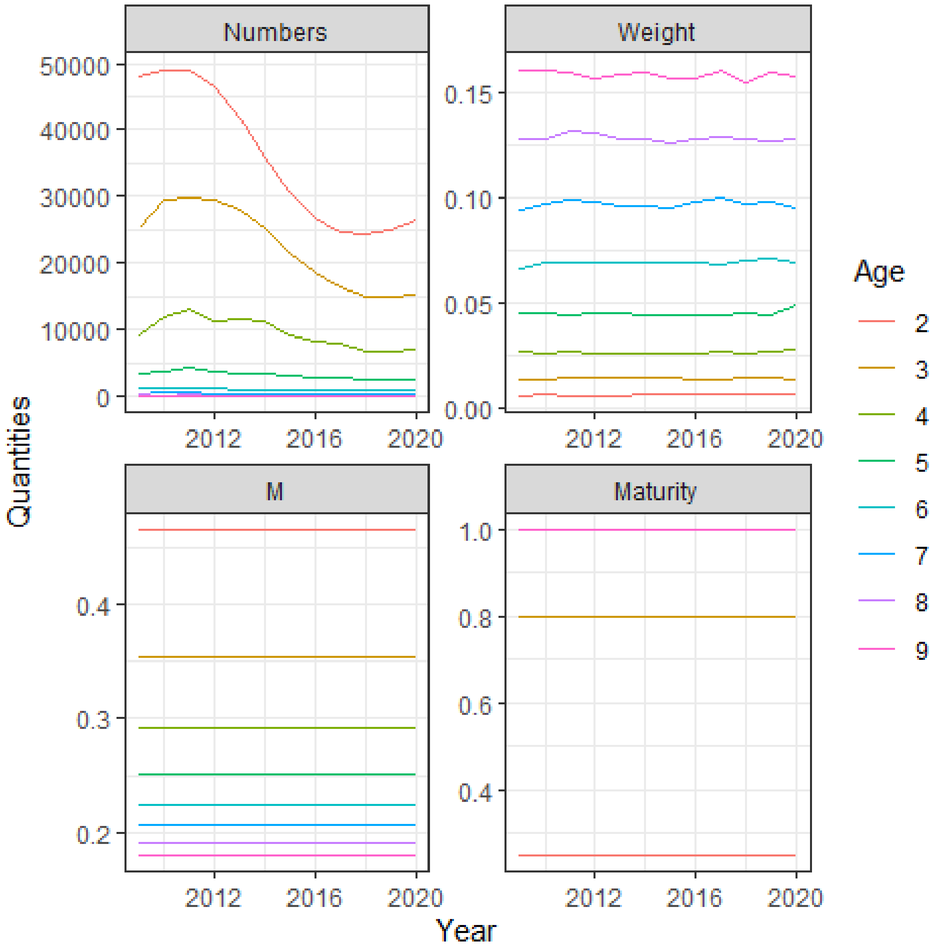

Figure 6.4.1.4: Norway lobster in GSA 6. Stock biology trajectories at age. Numbers from the fitted assessment the other values from input data to the assessments.

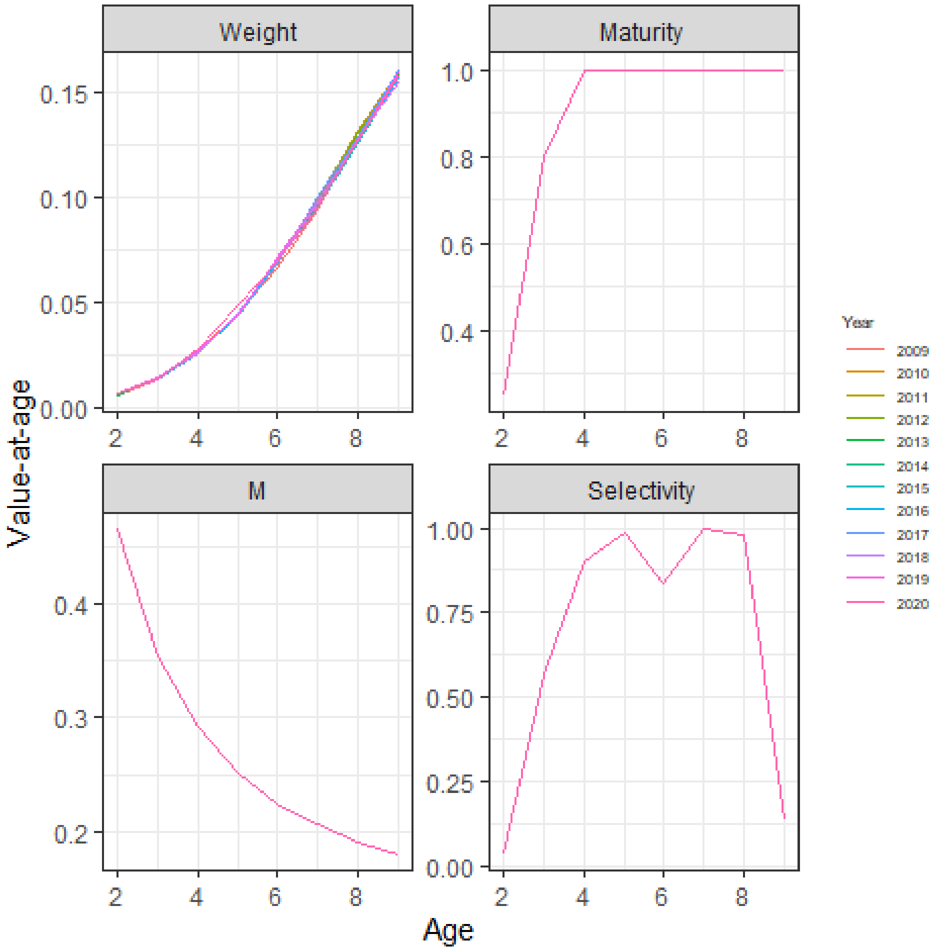

Figure 6.4.1.5: Norway lobster in GSA 6. Annual stock quantities at age weights, maturity and M are input data by age in the assessment, Selectivity in the fishery is fitted in the model.

6.4.1.2 Exploratory analysis

An exploratory per-recruit analysis was performed using a4a assessments and stock object provided by EWG 21-11. The per-recruit reference points of interest are summarized in Table 4.1.2.1 and Figure 6.4.1.6.

Table 6.4.1.1: Norway lobster in GSA06. Per-recruit reference points.

params	$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
data	0.257	0.041	0.010	0.968	0.010	0.103

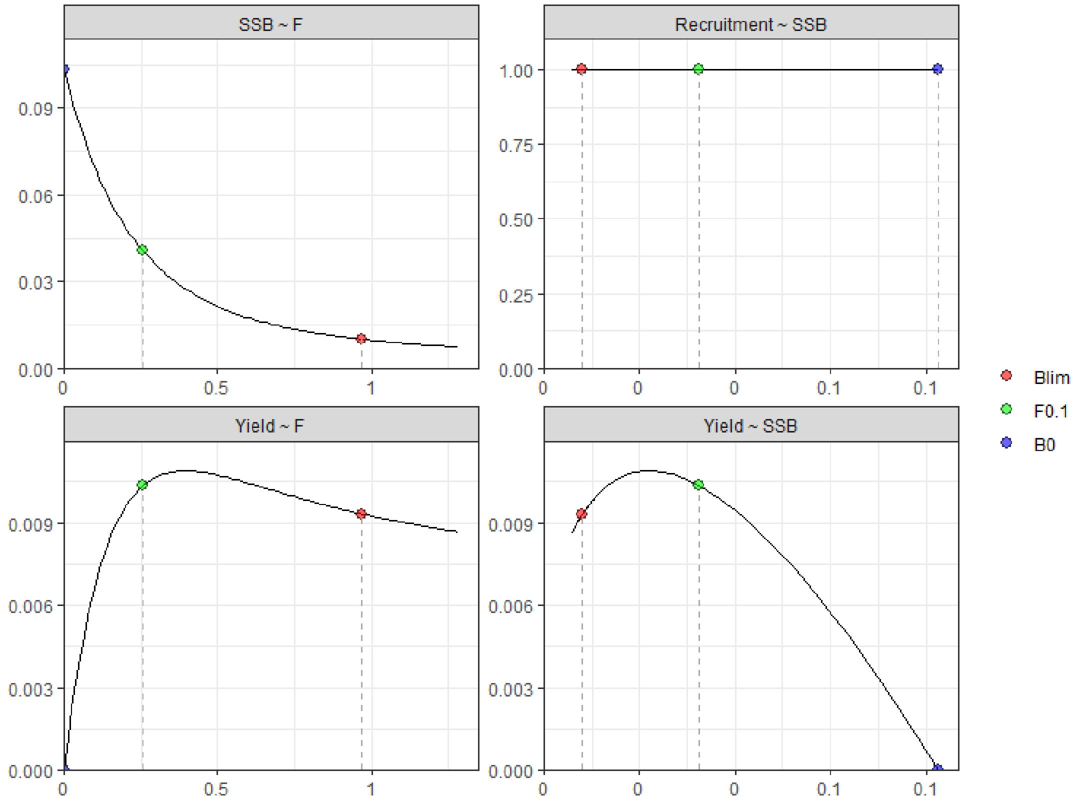

Figure 6.4.1.6: Norway lobster in GSA 6. Per-recruit analysis.

The contribution by age class to spawning potential ratio (SPR) shows that the current population is higher compared to an un-fished population for ages > 4 (Figure 6.4.1.7).

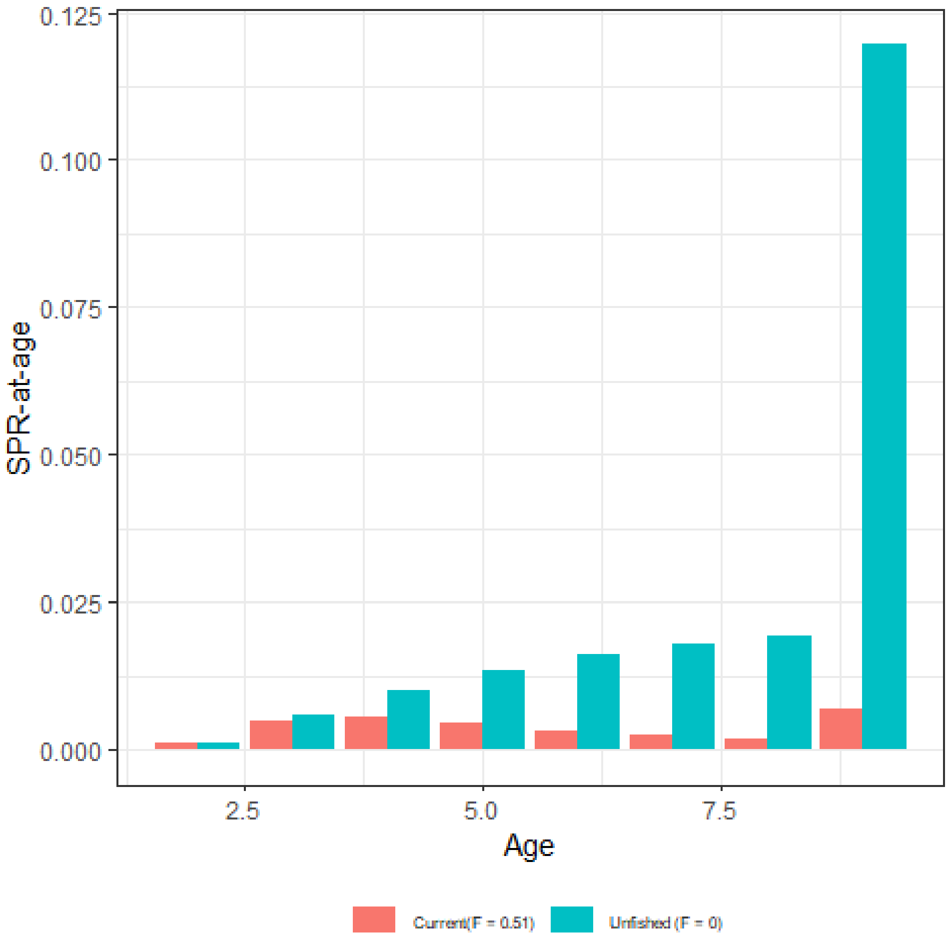

Figure 6.4.1.7: Norway lobster in GSA 6. Comparison of the spawning biomass per recruit SPR_F at current F (last years) and SPR_0 with F=0.

SSB has been quite above B_{lim} in the first years and in the last years, with a sharper decrease in 2018. At the same time, F has been slightly below F_{lim} in the middle of the time series, though gradually decreases since 2014 and drops in 2017 approaching $F_{0.1}$ in the last year (Figure 6.4.1.8).

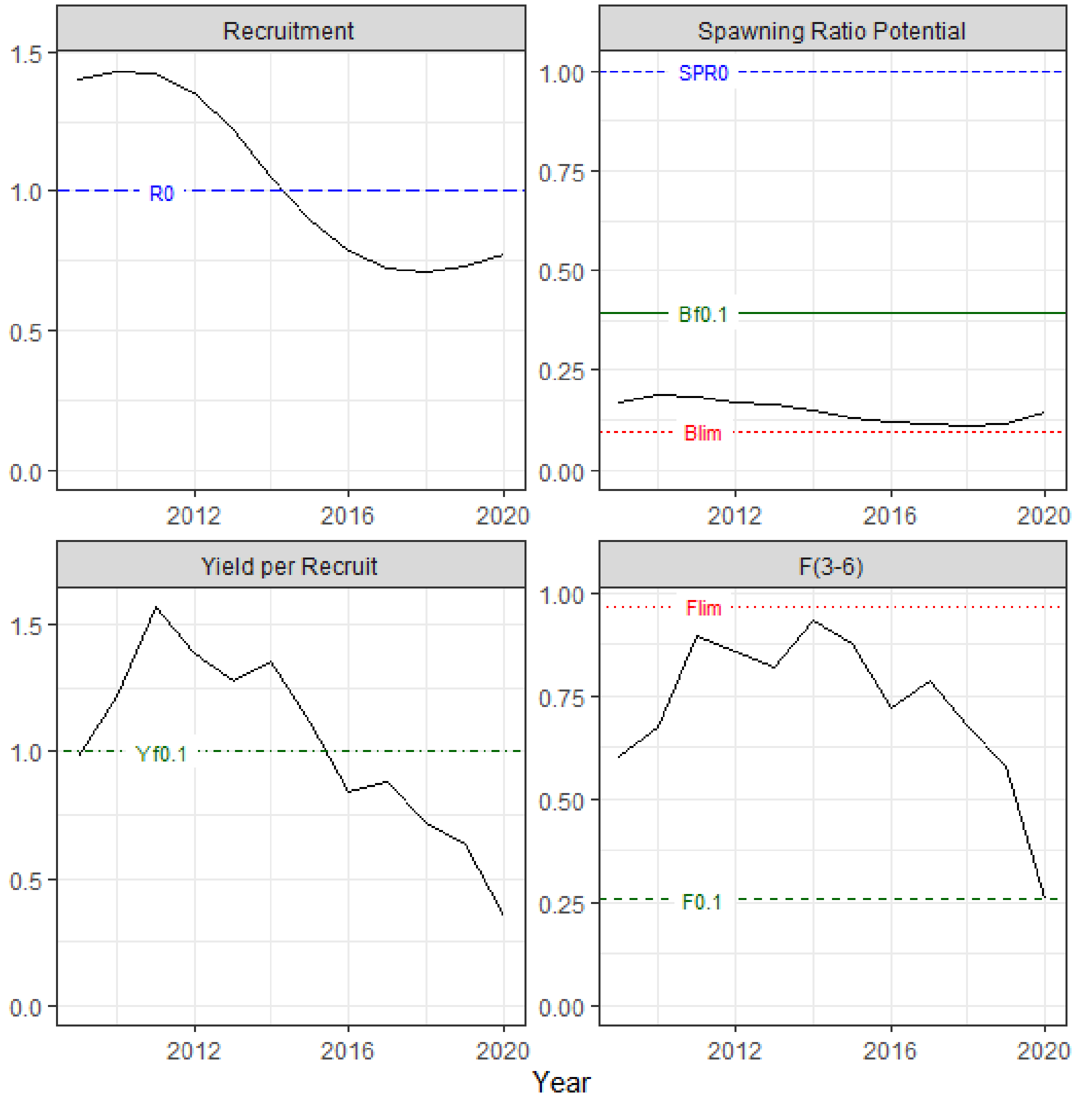

Figure 6.4.1.8: Norway lobster in GSA 6. Per-recruit analysis: stock dynamics against refpts.

Four recruitment functions are explored, using the function **`ssrTMB`** in the package **`FLSRTMB`**:

- Geometric Mean (**`model=geomean`**)
- Hockey-Stick (**`model=segreg`**)
- Beverton-Holt (**`model=bevholtSV`**)
- Ricker (**`model=ricker`**)

The Hockey-Stick is constrained to search for solutions of the break-point so that it falls within a lower bound (**`lplim`**) and upper bound (**`uplim`**) of spawning ration potential $SRP_{lim} = SPR_{lim}/SPR_0$. Note that in the specific case of the Hockey-Stick $SRP_{lim} = B_{lim}/B_0$, but SRP_{lim} can be generalized even if the $b = B_{lim}$ estimate is inputted into another S-R.

The initial bounds are chosen by default to be fairly unconstrained for a range of $SRP_{lim} = SRP_{0.1-20}$ by setting `lplim=0.001` and `uplim=0.2`. A further exploration has been carried out by setting the upper bound to 0.1.

In the initial fits of the Beverton-Holt and Ricker models, steepness s and $R0$ are estimated given the input SPR_{0_y} (where uplim is the upper bound to the ratio SPR/SPR_0).

The estimates of the four candidate models differ widely for R_0 and B_0. The breakpoint of the hockey-stick (uplim=0.1) is estimated at b = 310, below the lowest observation. This corresponds to an SRP_{lim} = 0.05 and the corresponding R_0 match the geometric mean recruitment. In contrast the break-point of the hockey-stick (uplim=0.2) is estimated at b = 711, which lies outside the upper range of the data (max at 668 tonnes) corresponding to an SRP_{lim} = 0.08 and the corresponding R_0 is more than 1.35 times the geometric mean recruitment. Both HS models are effectively rejected because the breakpoints lie outside the data. A geometric mean model should provide the same R_0 as the Hockey-stick model with the breakpoint below the data. The estimate of R_0produced by the BH model was 30 times the value obtained with the GM model. The steepness of this BH model was

Table 6.4.1.2: Norway lobster in GSA 6. Summary of S/R candidate models estimations.

0.76, leading to very high estimates of $R_0$and B_0. Hence, BH models with higher s values were explored.

mod	s	sigmaR	R_0	rho	B_0
gm	NA	0.27	32002	0.97	6487
hs.1	NA	0.26	32002	0.97	6487
hs.2	NA	0.14	43779	0.79	8874
bh	0.76	0.14	976491	0.80	197930
ri	1.51	0.14	976491	0.77	197930

Per-recruit analysis' results show that the recruitment variation is fairly low (σ_r = 0.14) for the Beverton-Holt model, associated with a steepness of s = 0.76. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the two models differ in scale of their R_0 and B_0 estimates (Figure 6.4.1.9).

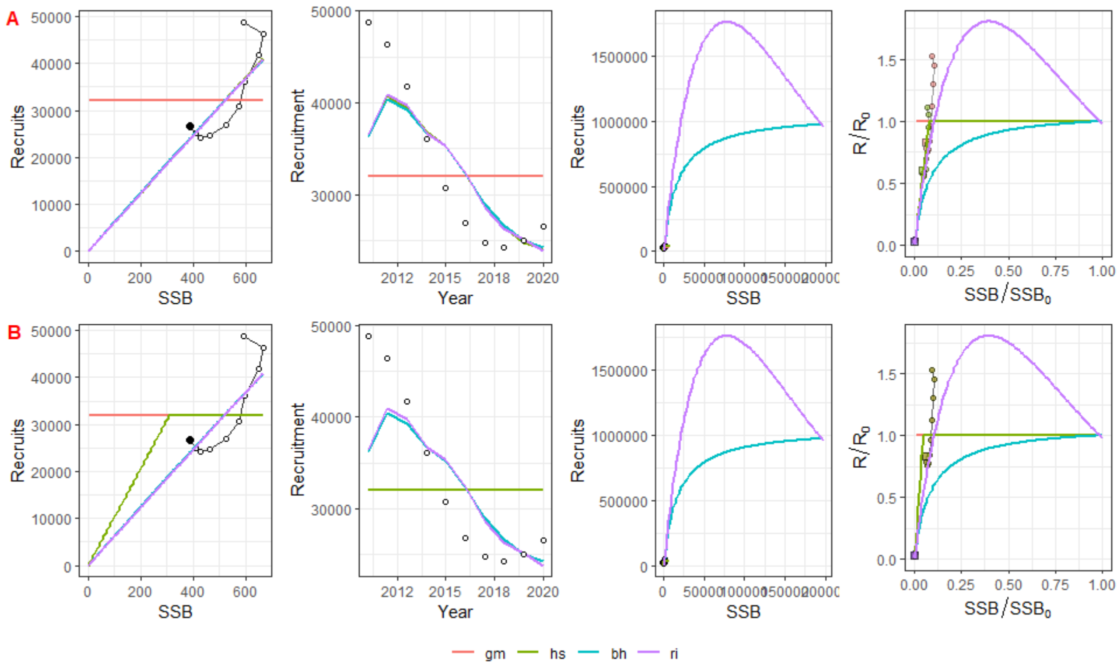

Figure 6.4.1.9: Norway lobster in GSA 6. Summary of the four SR models. (A= uplim 0.2, B= uplim 0.1)

Figure 6.4.1.10 and Table 6.4.1.3 show the results of the sensitivity analysis of the BH model to a range of steepness values $s = 0.7 - 0.95$. These results show that increasing s helps bring down R_0 and B_0 to levels compatible with the HS model estimates. Considering the highest values of R ever observed in the study period (around 50 000 thousand recruits) a BH model with s= 0.90 would be a good alternative to the HS model. However, it is not possible to obtain consistent values of steepness from the given the available data.

Table 6.4.1.3: Norway lobster in GSA 6. Summary of S/R for BH model with different slope (s, steepness) scenarios

s	sigmaR	R_0	rho	B_0
0.70	0.34	976491	0.80	198605
0.75	0.16	976491	0.80	198605
0.80	0.16	144437	0.87	29377
0.85	0.18	70415	0.92	14321
0.90	0.21	48592	0.95	9883
0.95	0.23	38134	0.96	7756

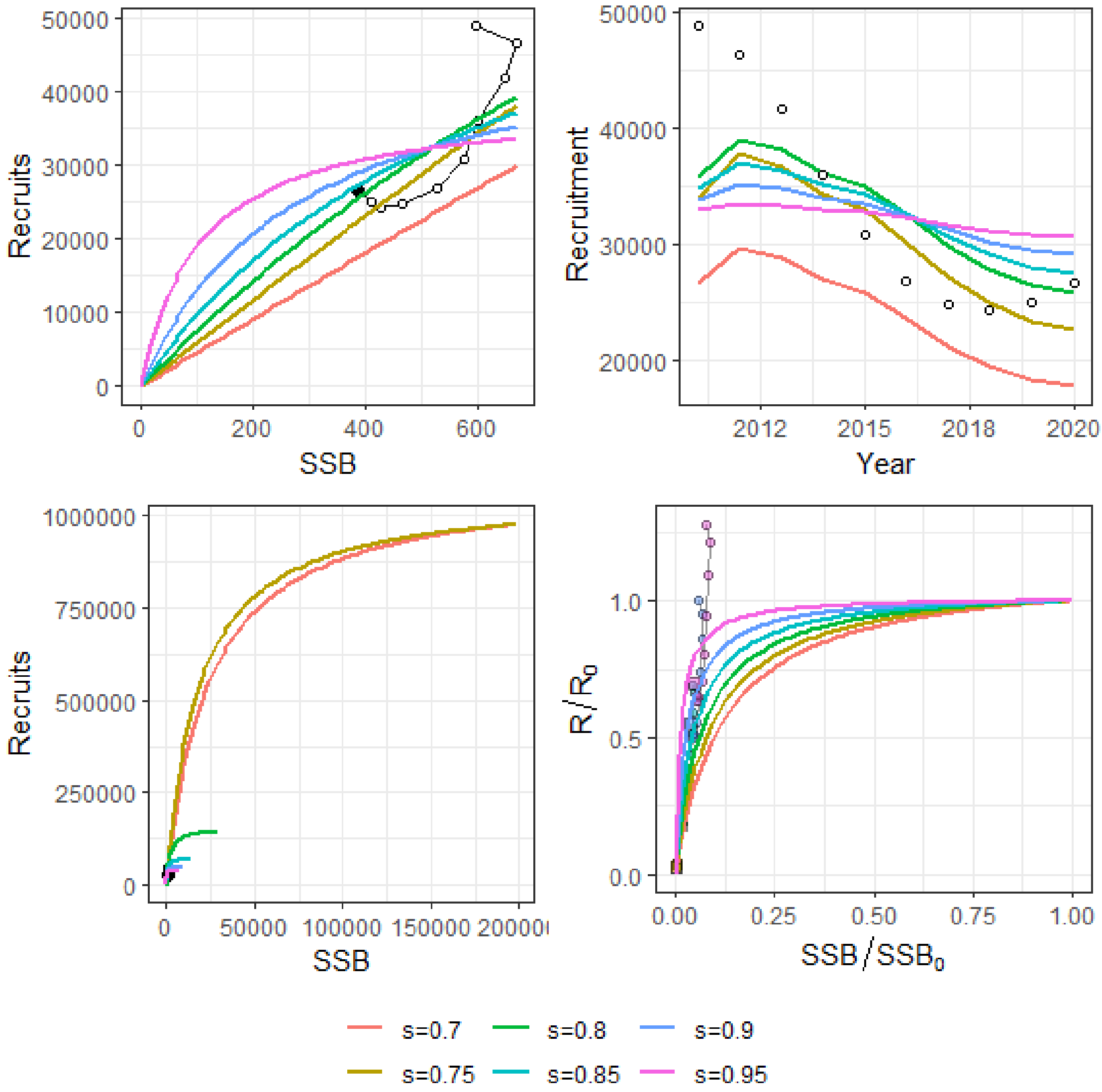

Figure 6.4.1.10: Norway lobster in GSA 6. Equilibrium yield with GM, HS and BH with different slope (s, steepness) scenarios for the BH model.

The following candidate S-R models are considered for initial reference point estimation:

- Hockey-Stick with B_{lim} set to the break-point b = 711 and 310 for uplim setting of 0.2 and 0.1 respectively.
- Beverton-Holt with a fixed $s = 0.85$ with $B_{lim} = 0.25B_{F0.1}$

Overall the model that most reasonably explains the observations is a Geometric Mean, using the default value from B_{Lim} of 25% $B_{F0.1}$.

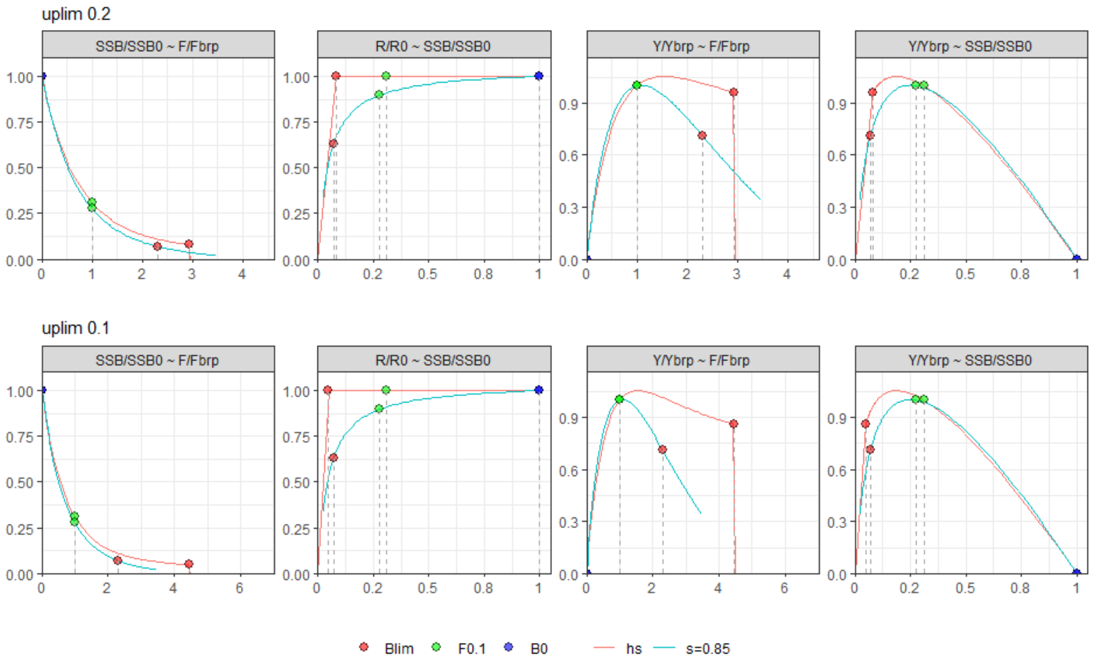

Figure 6.4.1.11: Norway lobster in GSA 6. Relative reference point estimates of F0.1, BLim and B0 shown as functions of SSB/SSB0, F/F0.1, Yield/Y_ F0.1 and R/R0. Grey dots show the relative values of the corresponding observations.

6.4.1.3 Results

From the considerations made in the previous section, the GM model with B_{Lim} based on 25% $B_{F0.1}$ (Table 6.4.1.4) was selected to provide reference points for Nephrops norvegicus in GSA06. The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in (Figure 6.4.1.12) Nephrops in GSA 6. The equivalent Kobe plot is reported in given in Figure 6.4.1.13, B_{pa} is based on 2* B_{Lim} (see Section 4.2). In conclusion the stock is considered to be between B_{Lim} and B_{pa} in 2020.

Table 6.4.1.4: Nephrops in GSA 6. Final reference points based on Geometric mean and a default value of B_{Lim} =25% $B_{F0.1}$.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	F_{pa}
0.228	503	1007	2013	6499	0.409

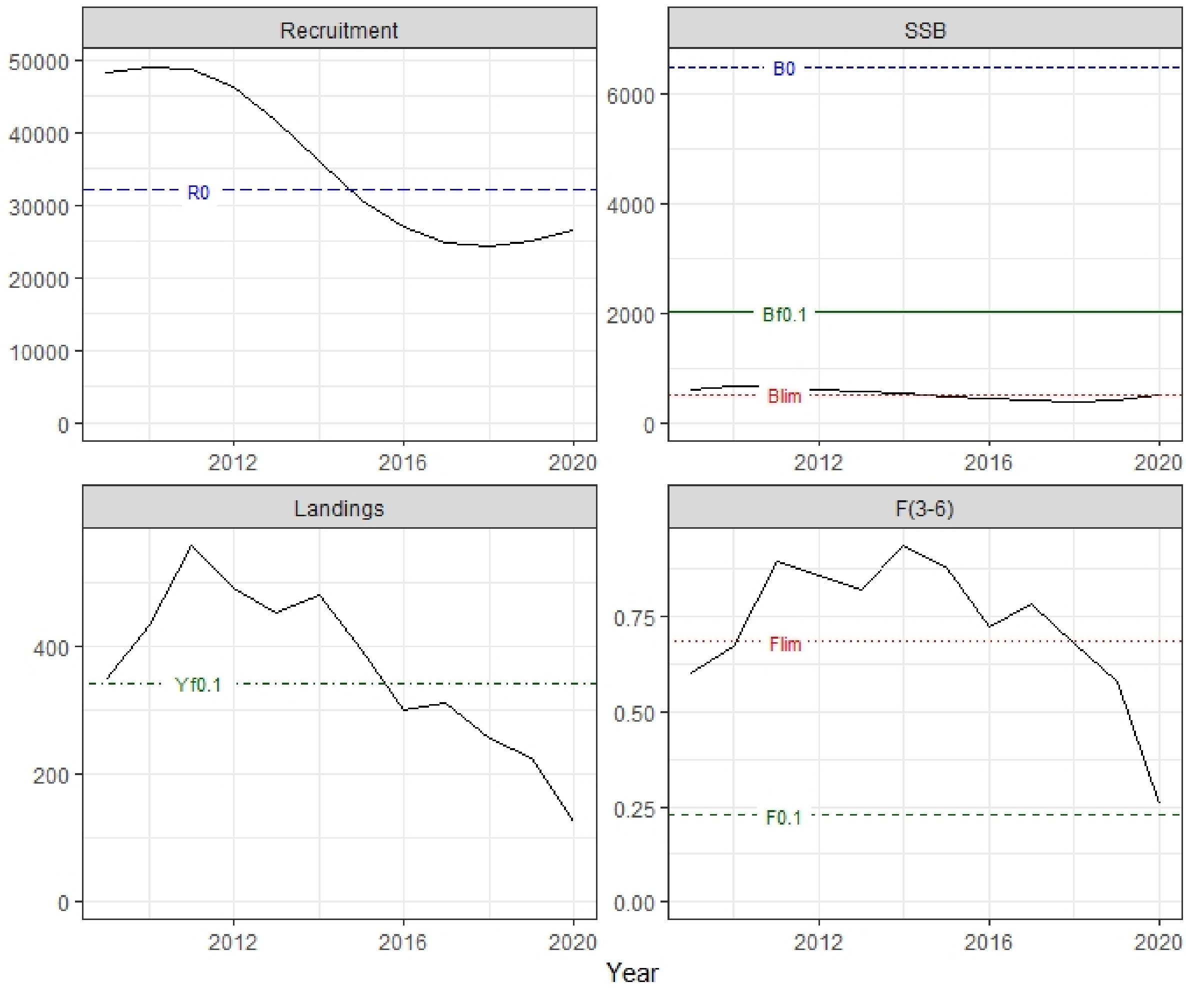

Figure 6.4.1.12: Norway lobster in GSA 6. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a GM stock-recruitment relationship.

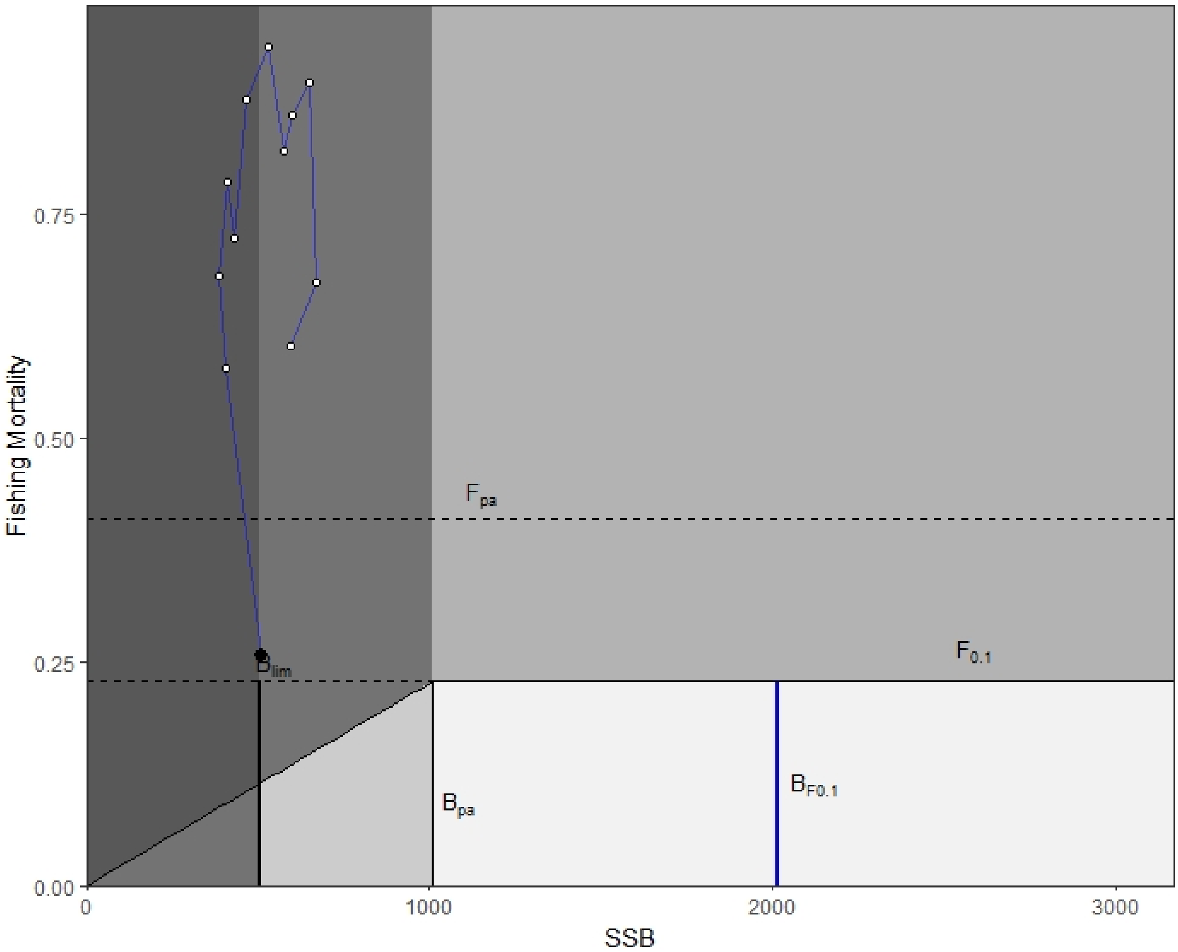

Figure 6.4.1.13: Norway lobster in GSA NEP06. Advice Rule plot with Bpa=2 BLim, based on the GM model for BF0.1 with a default BLim=0.25BF0.1.

6.4.1.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modeling. A Beverton-Holt model may be helpful to as a modeling option. The steepness options considered above are illustrated in Figure 6.4.1.10 The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.90 (Figure 6.4.1.14).

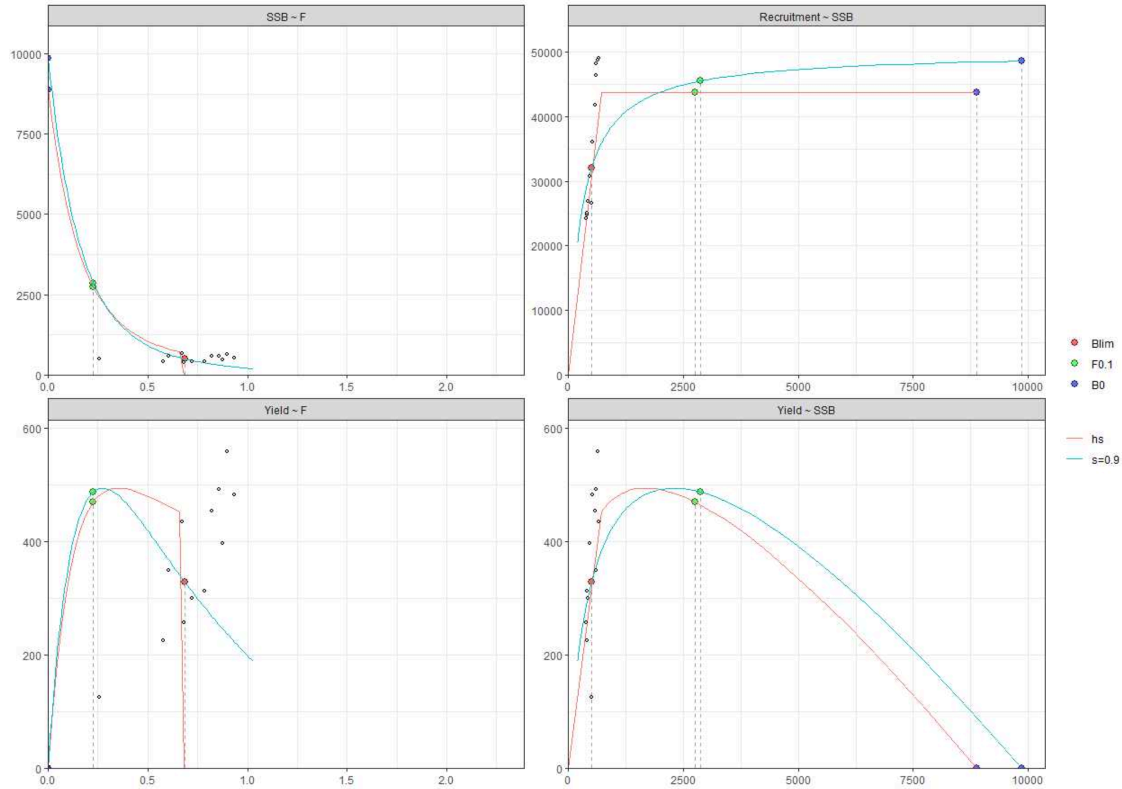

Figure 6.4.1.14: Nephrops in GSA 6. Equilibrium yield relative reference points for HS and BH (steepness = 0.9) models.

6.4.2 Norway lobster (NEP) in GSA 9

6.4.2.1 Stock assessment

During the STECF EWG 21-11 a statistical catch-at-age assessment (SCAA) using the Assessment For All (a4a) framework was carried out for Norway lobster, *Nephrops norvegicus*, in GSA 9 (Figure 6.4.2.1).

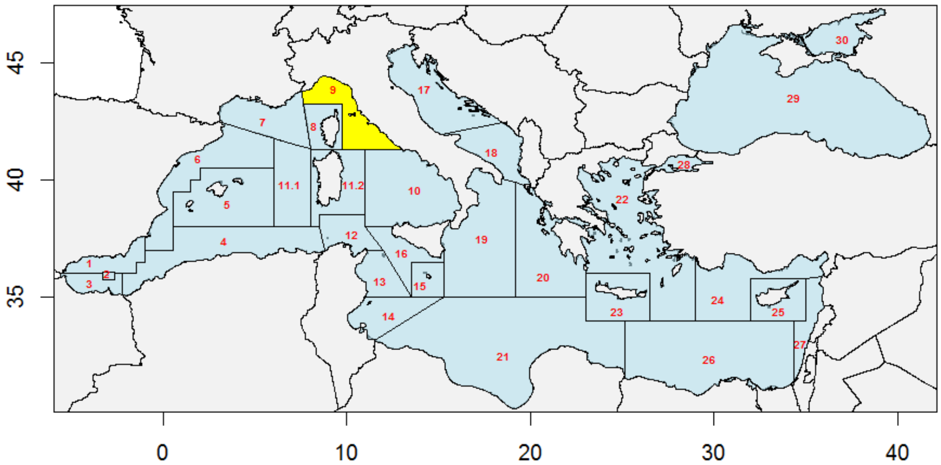

Figure 6.4.2.1: Limit of Geographical Sub-Area (GSA) 9.

The SCAA outputs of NEP09 from EWG21-11 are summarized below in Figure 6.4.2.2. However, EWG22-03 noted that:

- stock trajectory shows a peak in 2018 where biomass is largely driven by age 1.
- An unreliable weight at age for age 1 in 2018 and 2019.
- An unreliable maturity vector.

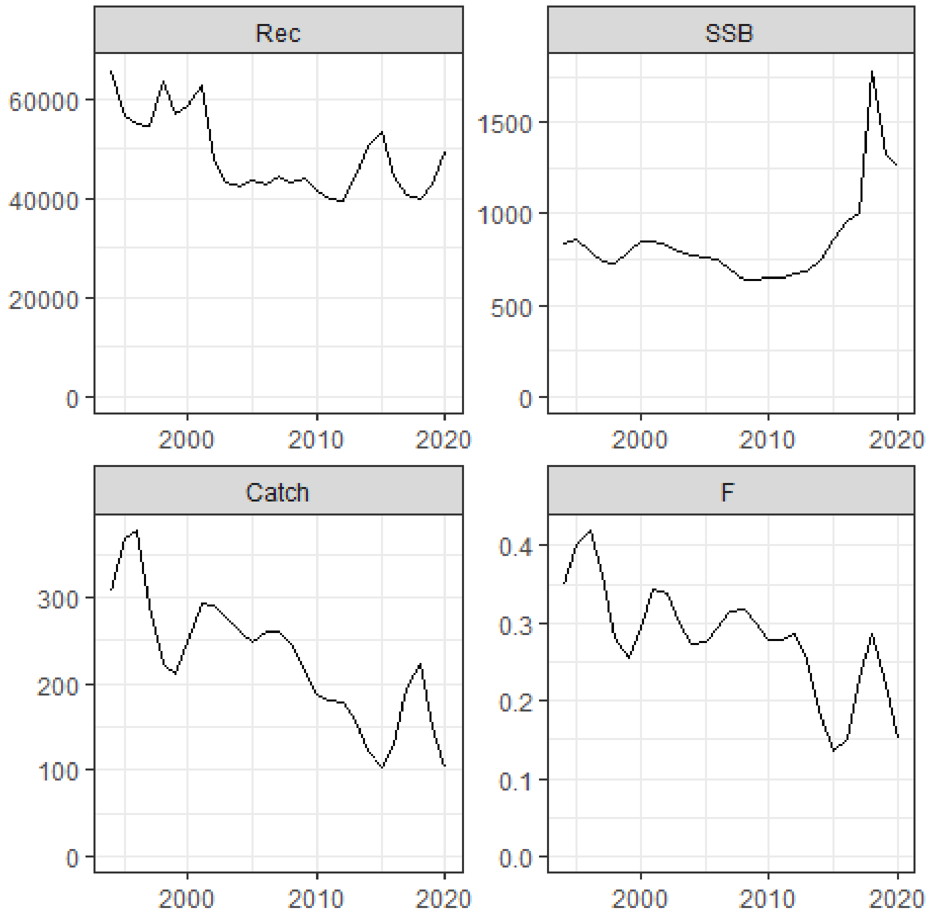

Figure 6.4.2.2: Norway lobster in GSA 9. Stock summary from the final a4a model.

Figure 6.4.2.3: Norway lobster in GSA 9. Stock assessment trajectories at age.

According to the biology of the species, age 2 would already contribute to SSB, with a maturity rate estimated at 0.75 and all age classes would be fully selected from age 3 onwards.

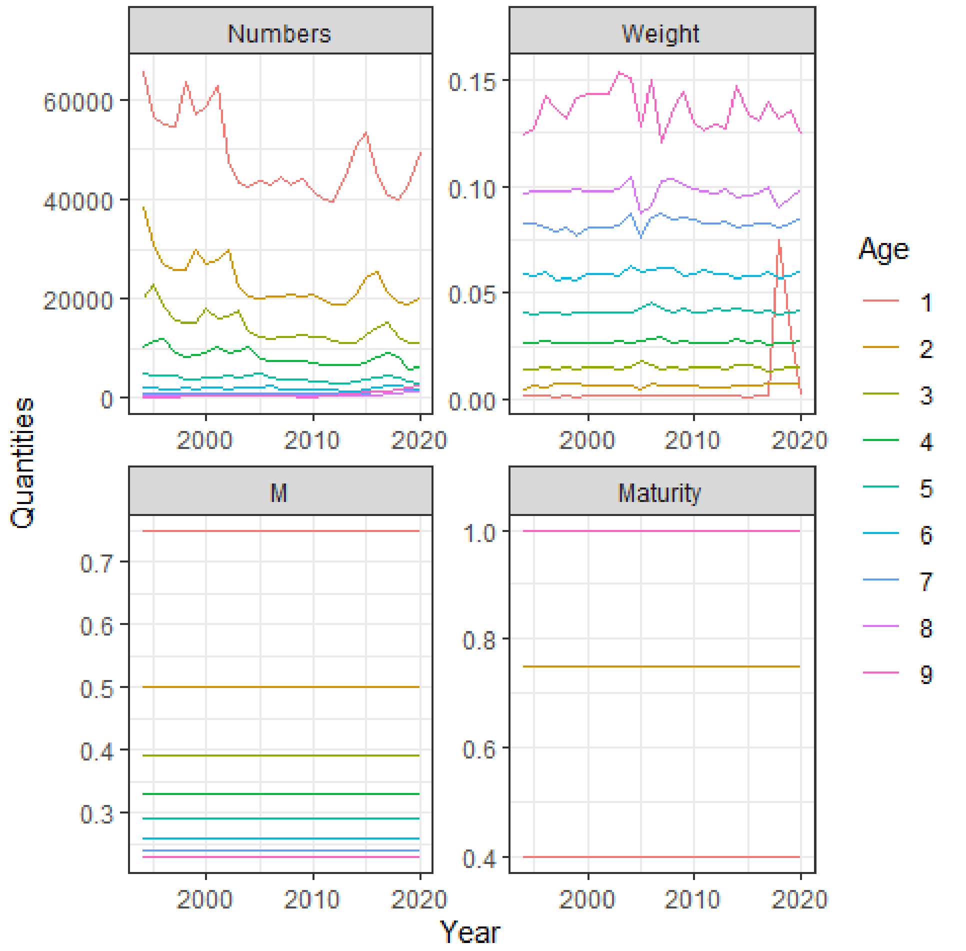

Figure 6.4.2.4: Norway lobster in GSA 9. Stock biology trajectories at age.

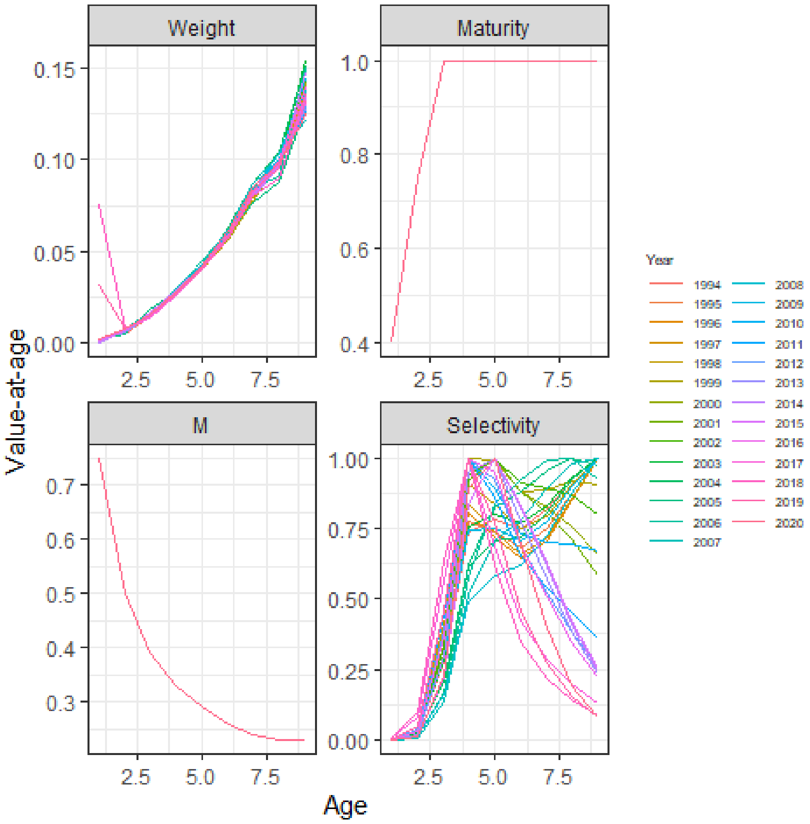

Figure 6.4.2.5: Norway lobster in GSA 9. Annual stock quantities at age.

6.4.2.2 Exploratory analysis

To explore the effects on stock dynamics and per-recruit analysis different stock object and a new assessment were considered. The following figures compare:

- original assessment (NEP09.org, “original”)
- a new assessment performed by EWG22-03 (NEP09.new, “new”)
- a subset of the original sock object that exclude last 3 years, then from 1994 to 2017 (NEP09.9417)
- a subset of the original sock object which include years from 1994 to 2010 (NEP09.9410)
- a revised stock object (NEP09, “revised”) with changes in the maturity vector

age	1.0	2.0	3.00	4.0	5	6	7	8	9
data	0.1	0.4	0.75	1	1	1	1	1	1

and in the catch weight for age 1 in 2018 and 2019

age	1.0000	1.0000
data	0.0018	0.0018

To simplify, in the following figures only the comparisons between the original one, the stock with the new maturity and catch weight matrix and the new assessment are shown.

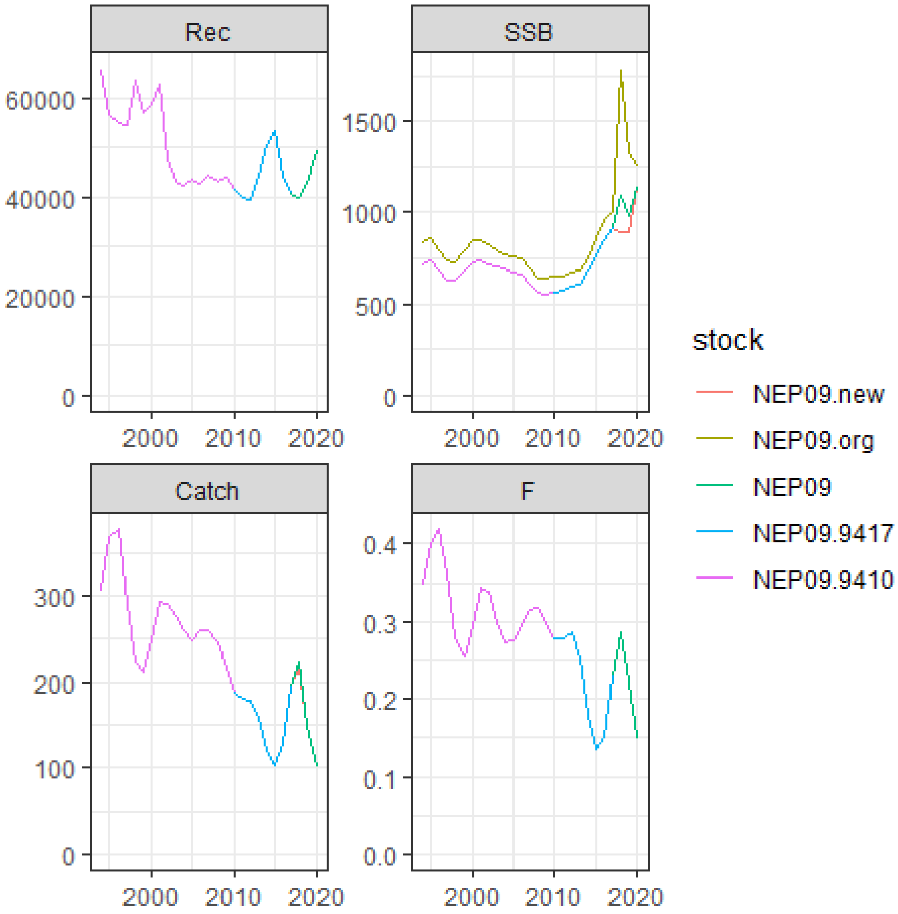

Figure 6.4.2.6: Norway lobster in GSA 9. Comparison of the estimated stock assessment trajectories based on the original (org) two selected (1994-2017 and 1994-2010) / two amended stock objects detailed in the text above.

An overview of the biological data used in the assessments shows that the original assessment overestimates the SSB. Apart the biomass, the outcomes from the new assessment and the assessment with changes in mat and catch.wt are similar. The charts show that the stock is composed of 9 age classes (the oldest age class being +), but most of the vulnerable population would be in ages 4 and 5, according to the biology of the species in other GSAs. Further, with changes in the maturity, age 1 and age 2 wouldn't contribute a lot to SSB, and all age classes would be fully selected from age 4 onwards. Values of total catch and mean F and $F_{0.1}$ are not affected by the issues involved.

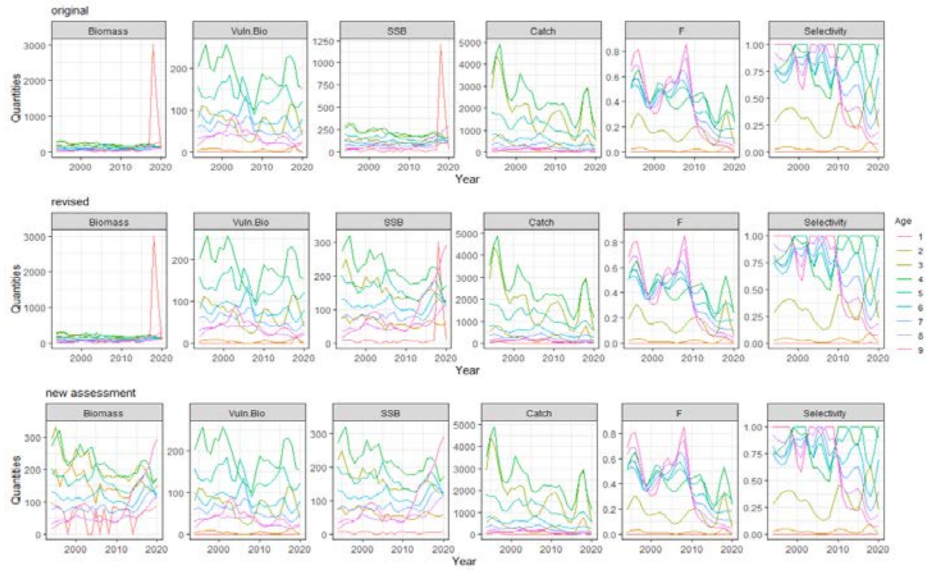

Figure 6.4.2.7: Norway lobster in GSA 9. Stock assessment trajectories at age for all NEP09 options

Figure 6.4.2.8: Norway lobster in GSA 9. Stock assessment trajectories at age for all NEP09 options tested.

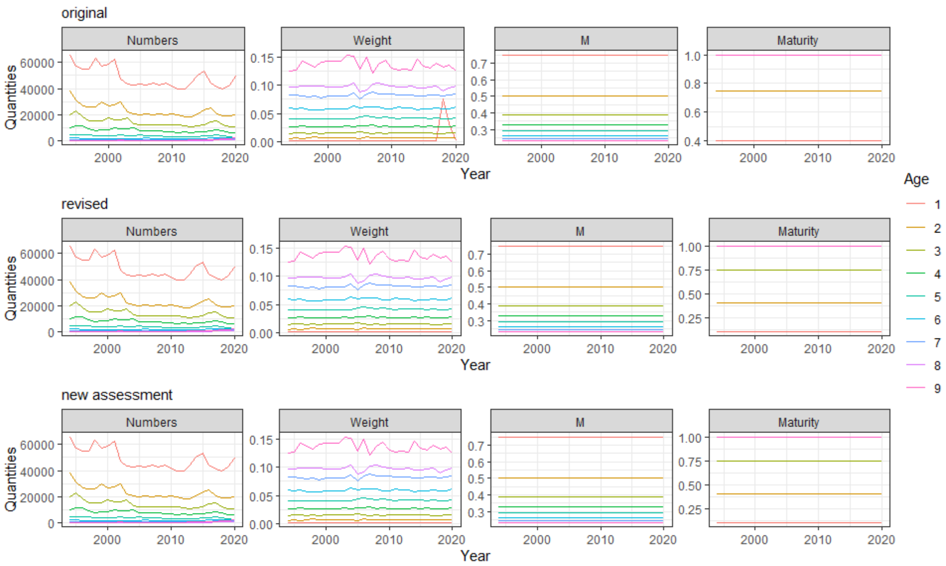

Figure 6.4.2.9: Norway lobster in GSA 9. Stock biology trajectories at age for all NEP09 options tested.

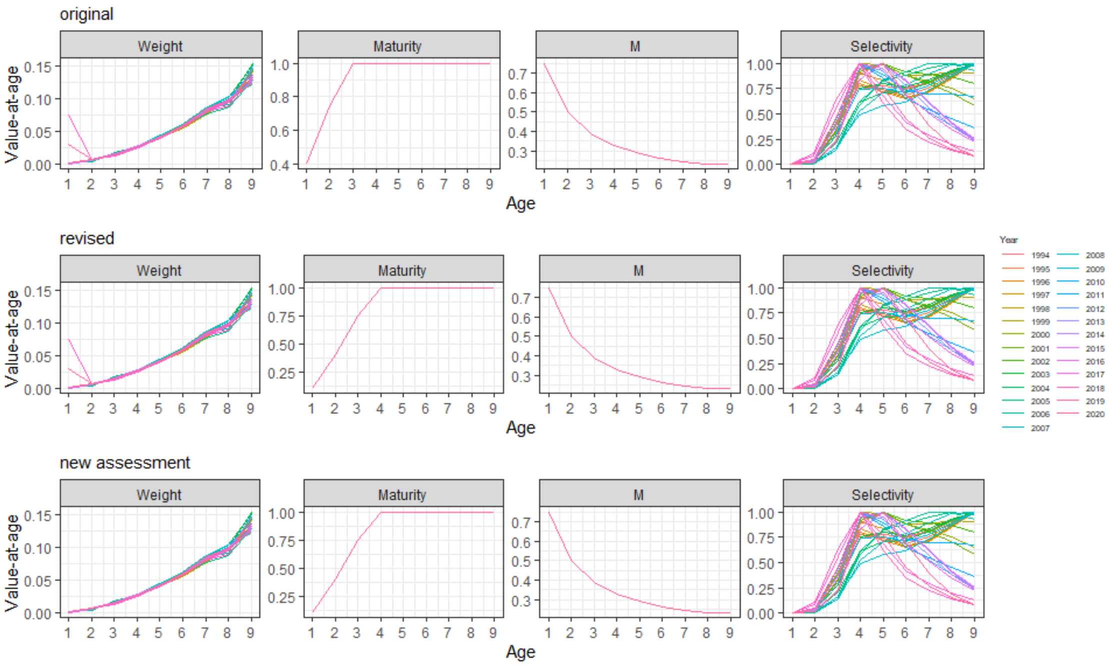

Figure 6.4.2.10: Norway lobster in GSA 9. Stock assessment trajectories at age for all NEP09 options tested.

An exploratory per-recruit analysis was performed using a4a assessments and stock object provided by EWG 21-11 and produced by EWG 22-03. The per-recruit reference points of interest are summarized in Table 6.4.2.1 and Figure 6.4.2.11.

Table 6.4.2.1: Norway lobster in GSA09. Per-recruit reference points.

original						
params	$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
data	0.2972	0.0300	0.0160	1.4845	0.0038	0.0740
revised						
params	$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
data	0.2972	0.0198	0.0061	1.4842	0.0038	0.0636
new assessment						
params	$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
data	0.2972	0.0171	0.0043	1.0986	0.0038	0.0610

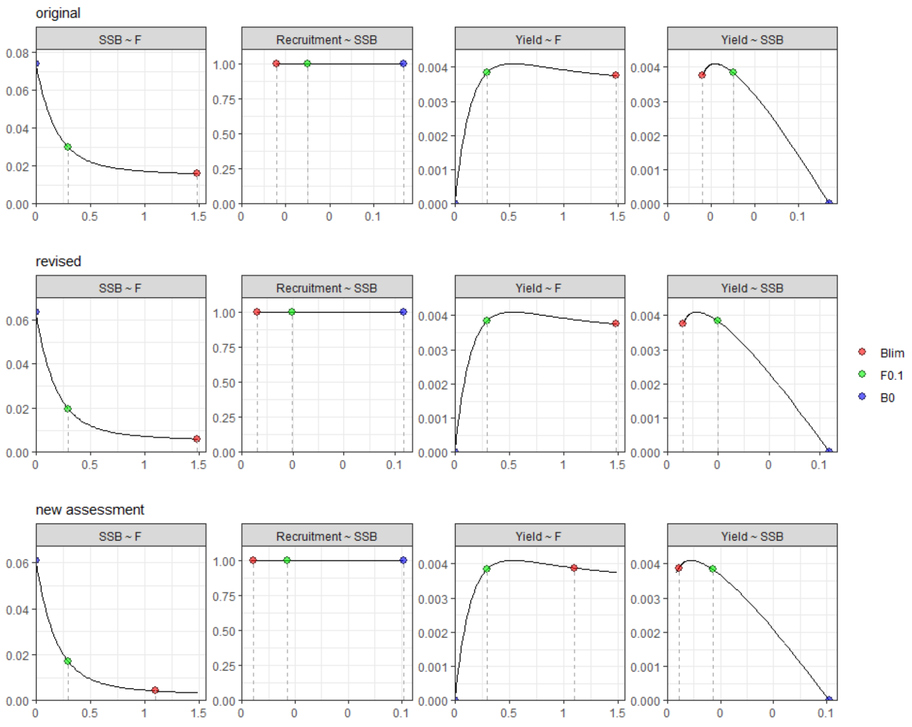

Figure 6.4.2.11: Norway lobster in GSA 9. Per-recruit analysis for all NEP09 stocks.

The contribution by age class to spawning potential ratio (SPR) shows that the current biomass is similar across the options, except for the youngest ages, where the changes are coming directly from the change in maturity that is assigned in the new ‘corrected’ assessment. The structure in the current catch is lower compared to an un-fished biomass for ages > 4 (Figure 6.4.2.12), the scale of the differences suggest a stock which is not currently heavily exploited.

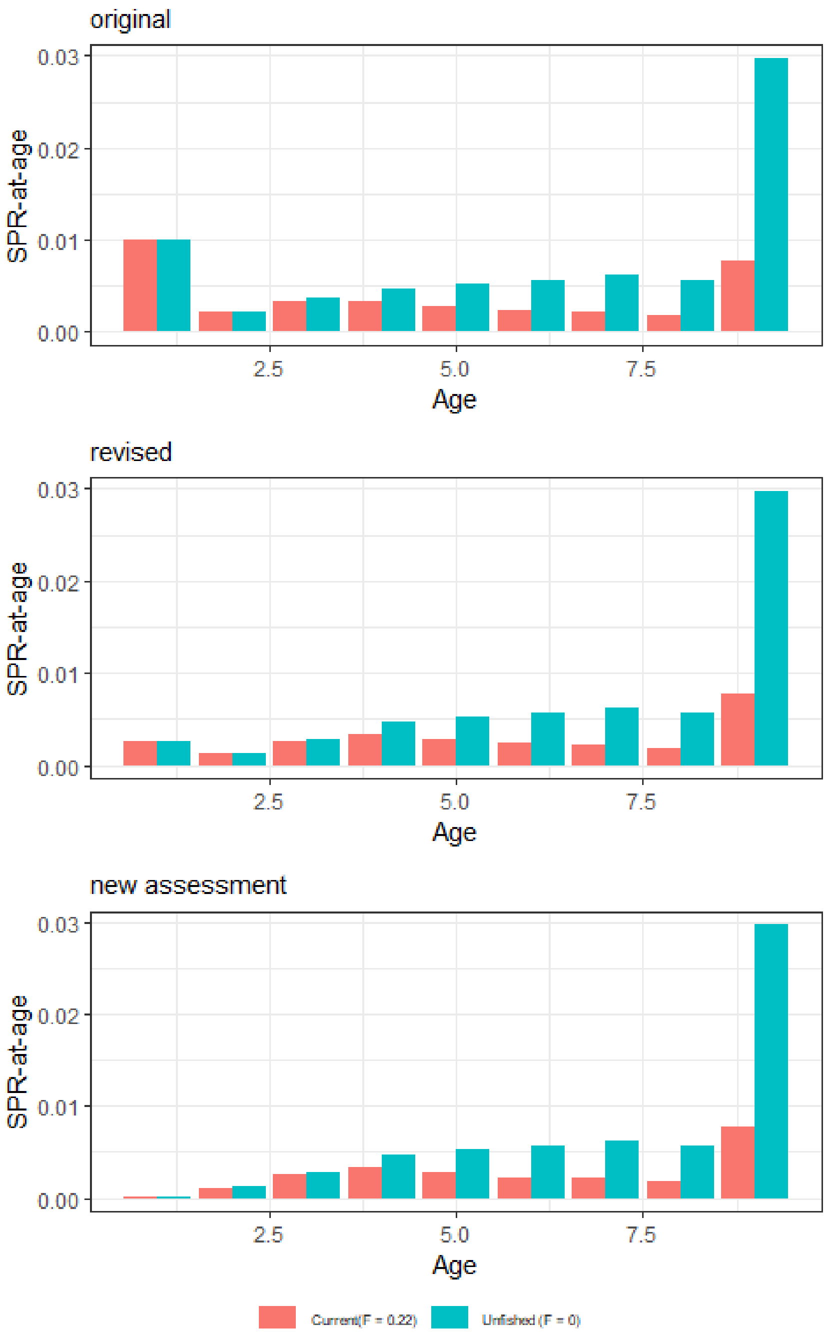

Figure 6.4.2.12: Norway lobster in GSA 9. Comparison of the spawning biomass per recruit SPR_F at current F (last years) and SPR_0 with

EWG 22-3 note that current and all F since 2002 are well above Flim. The status of B_{Lim} depends on the amendments to the assessment (Figure 6.4.2.13) the new assessment that SSB is found to be below $B_{F0.1}$ in the early part of the series and rising above $B_{F0.1}$ B_{Lim} in the recent years

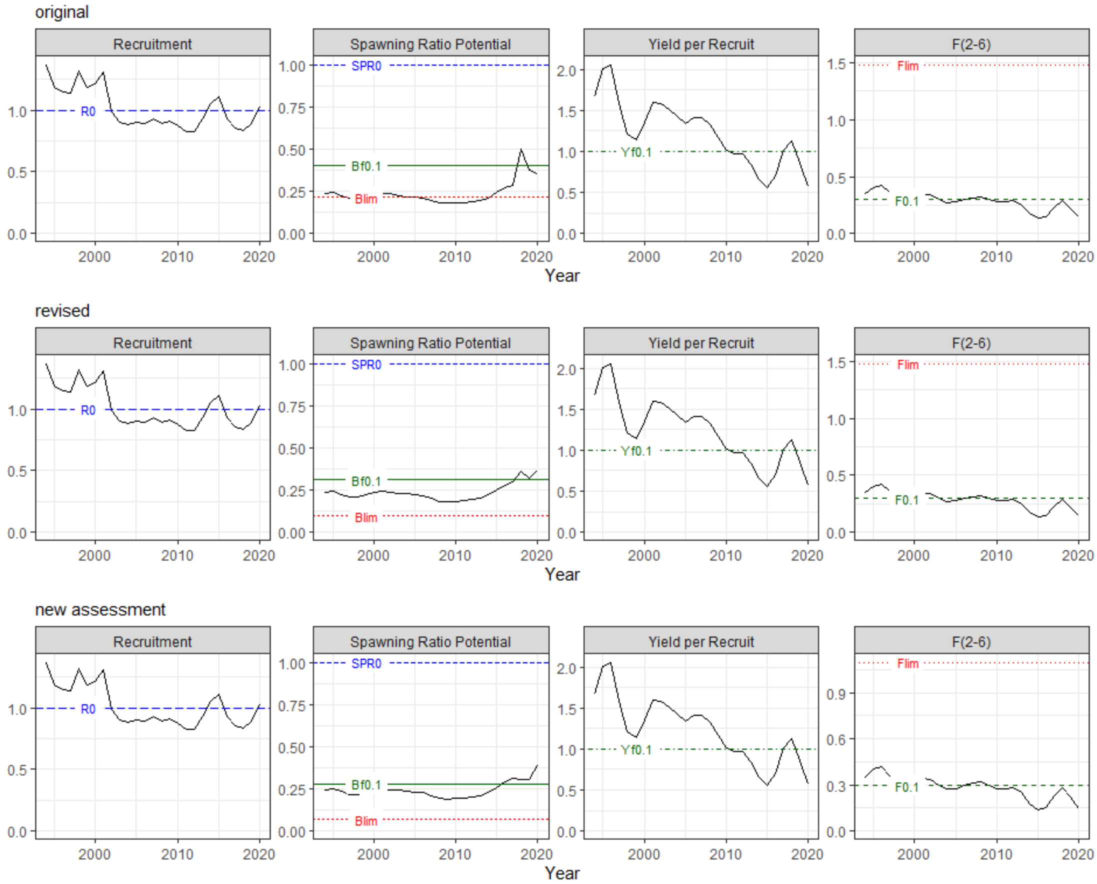

Figure 6.4.2.13: Norway lobster in GSA 9. Per-recruit analysis: Stock dynamics against refpts for all NEP09 stocks.

(Figure 6.4.2.13).

Four recruitment functions are explored, using the function **`ssrTMB`** in the package **`FLSRTMB`**:

- Geometric Mean (**`model=geomean`**)
- Hockey-Stick (**`model=segreg`**)
- Beverton-Holt (**`model=bevholtSV`**)
- Ricker (**`model=ricker`**)

The Hockey-Stick is constrained to search for solutions of the break-point so that it falls within a lower bound (**`lplim`**) and upper bound (**`uplim`**) of spawning ration potential $SRP_{lim} = SPR_{lim}/SPR_0$. Note that in the specific case of the Hockey-Stick $SRP_{lim} = B_{lim}/B_0$, but SRP_{lim} can be generalised even if the $b = B_{lim}$ estimate is inputted into another S-R.

The initial bounds are chosen by default to be fairly unconstrained for a range of $SRP_{lim} = SRP_{0.1-20}$ by setting **`lplim=0.001`** and **`uplim=0.2`**.

In the initial fits of the Beverton-Holt and Ricker models' steepness s and $R0$ are estimated given the input SPR_{0_y}.

The estimates of the four candidate models among each stock follow the same pattern (Table 6.4.2.4). Generally, the estimates of R_0 and B_0 for the gm and HS models do not differ and are close to the BH models. Ricker model is the more different and was not further considered. The comparison across all stock found that B_0 is always higher in the original stock (primarily due to the incorrect maturity vector). No greater differences are noted between the revised and new stock.

Table 6.4.2.2: Summary of S/R candidate models estimations by stock.

stock	mod	s	sigmaR	R_0	rho	B_0
new ass	gm	NA	0.15	47467	0.78	2893
new ass	hs	NA	0.14	47467	0.78	2893
new ass	bh	0.93	0.14	50310	0.77	2973
new ass	ri	0.99	0.15	39699	0.78	2346

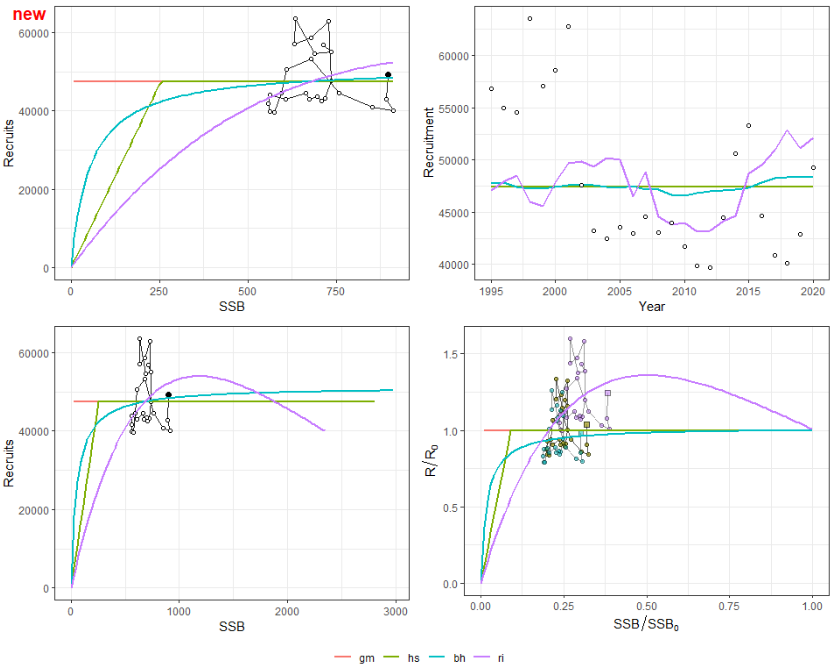

Figure 6.4.2.14: Norway lobster in GSA 9. Summary comparison of the SR models for all NEP09 new assessment.

Per-recruit analysis' results for the revised stock show that the recruitment variation is fairly low (σ_r = 0.14) for the Beverton-Holt model, associated with a steepness of s = 0.93. The predicted recruitment by Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the two models differ in scale of their R_0 and B_0 estimates. The break-point of the hockey-stick is found to be well below the biomass observed in the assessment, the $B_{F0.1}$= 811 default value of 25% $B_{F0.1}$ is used and estimated at b = 203 corresponding to an SRP_{lim} = 0.09 and the corresponding R_0 matches the geometric mean recruitment.

For the new assessment of NEP09 the sensitivity to alternative fixed steepness values of $s = 0.7 - 0.95$ for the Beverton-Holt model was explored and summarized together with the GM and HS models for comparison (Table 6.4.2.3 and Figure 6.4.2.15). The results show that decreasing s = 0.93 to 0.7-0.95 substantially increase the R_0 and B_0 estimates to a scale that is not comparable to the Hockey-Stick estimates.

Table 6.4.2.3: Norway lobster in GSA 9. Sensitivity of reference points to choice of fixed steepness.

s	sigmaR	R_0	rho	B_0
0.70	0.15	75568	0.76	4512
0.75	0.15	66196	0.76	3953
0.80	0.15	59952	0.76	3580
0.85	0.14	55493	0.76	3314
0.90	0.14	52148	0.77	3114
0.95	0.14	49546	0.77	2959

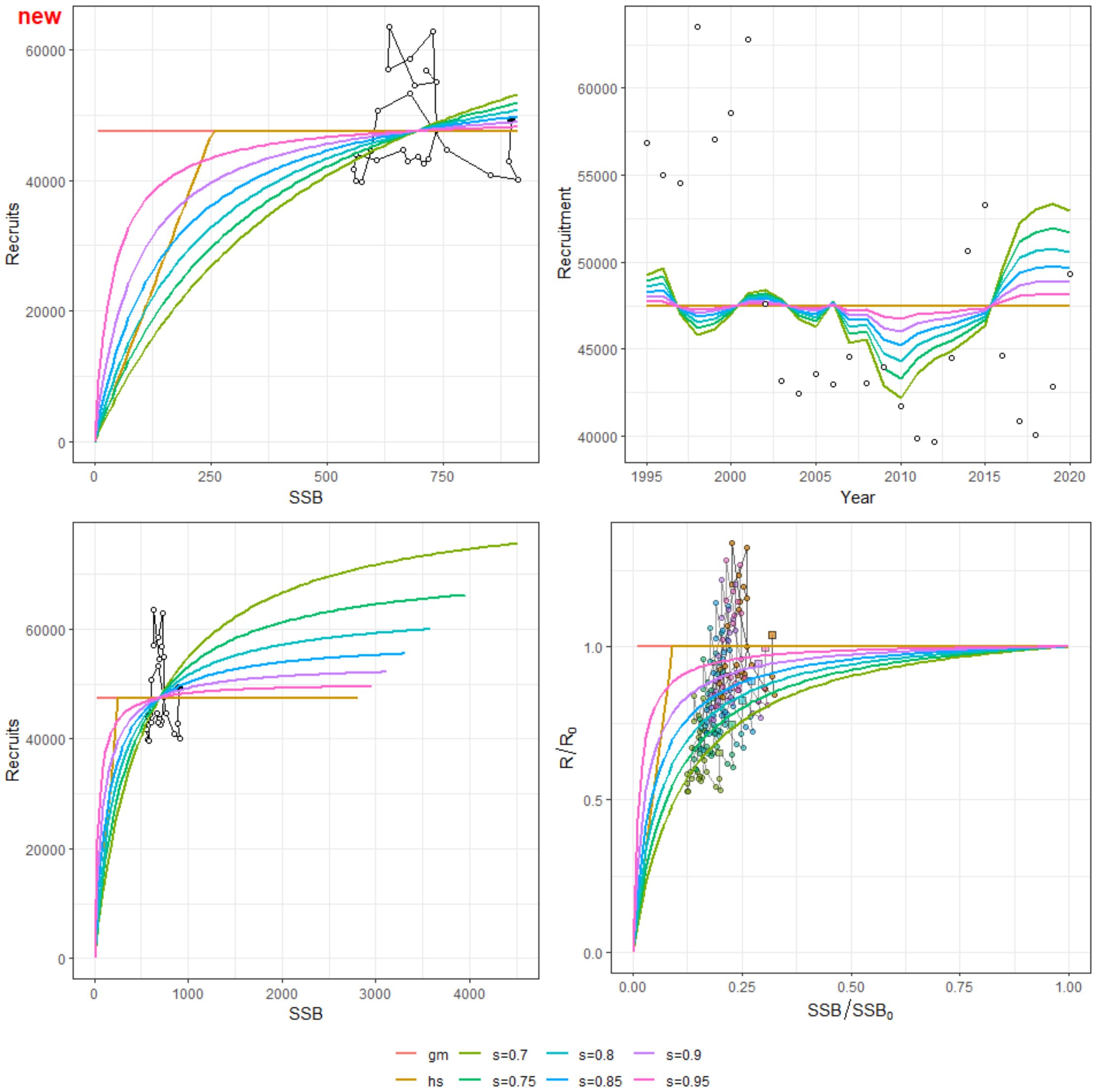

Figure 6.4.2.15: Norway lobster in GSA 9. Equilibrium yield: comparison of the BH models different slope (s, steepness) scenarios (for the new stock assessment).

The following candidate S-R models are considered for initial reference point estimation of the revised stock:

- Hockey-Stick with B_{lim} set to the break-point b = 203 new assessment.
- Beverton-Holt with a fixed $s = 0.85$ with $B_{lim} = 0.25B_{F0.1}$`

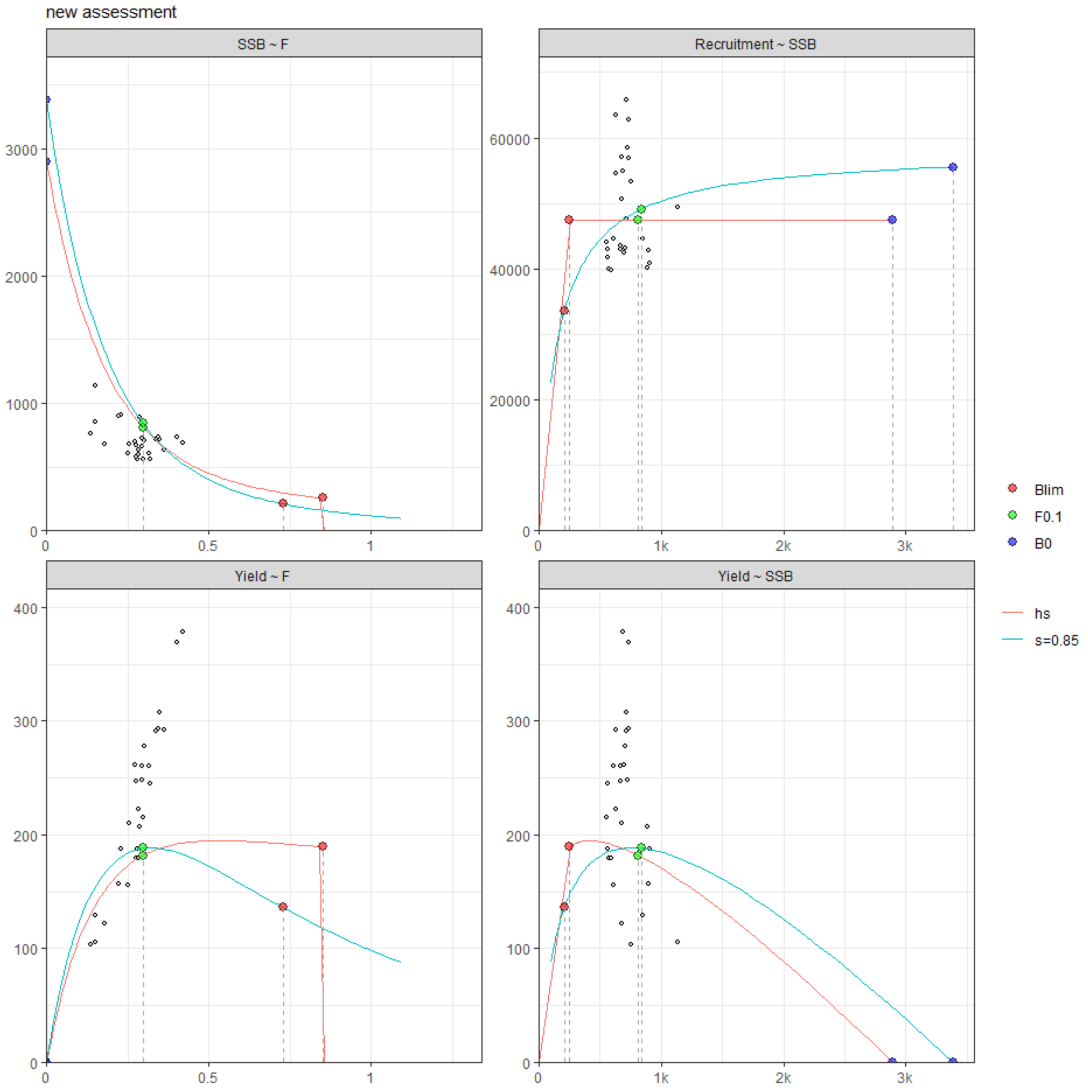

Figure 6.4.2.16: Norway lobster in GSA 9. Reference point estimates of $F_{0.1}$, B_{Lim} and B_0 shown as functions of SSB, F, Yield and Recruitment. Grey dots show the corresponding observations for NEP09 new assessment.

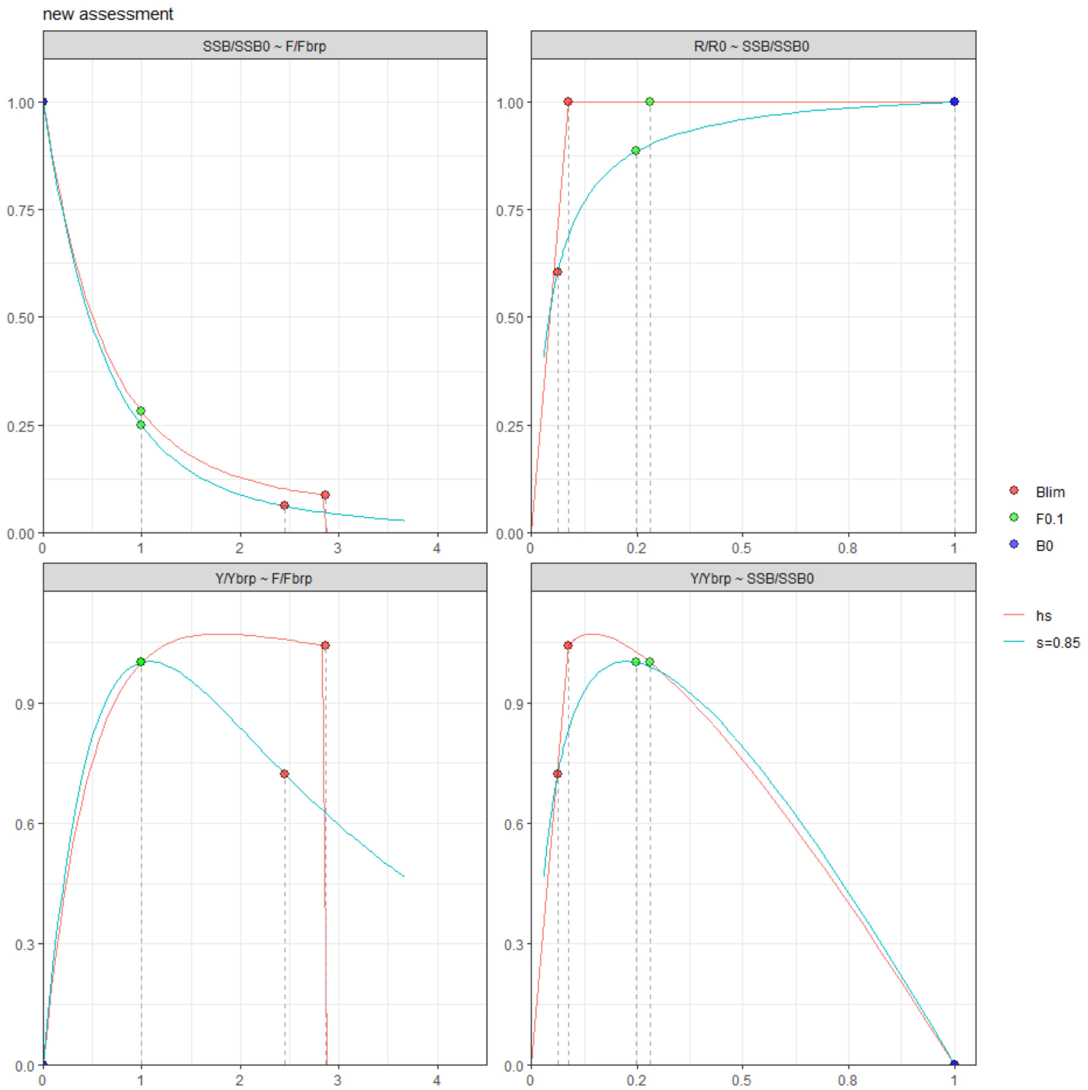

Figure 6.4.2.17: Norway lobster in GSA 9. Relative reference point estimates of F0.1, BLim and B0 shown as functions of SSB/SSB0, F/F0.1, Yield/YF0.1 and R/R0. Grey dots show the relative values of the corresponding observations for NEP09 new assessment

6.4.2.3 Results

In the light of the outcomes of the exploratory analysis, it was decided to use the new revised stock assessment to estimate the biomass reference points for Nephrops norvegicus in GSAs 9. Among the models the Geometric mean is used to give R_0 because the break point of the Hockey-stick lies well to the left of the observations (557). B_{Lim} is based on the default value of 25% $B_{F0.1}$ and B_{pa} is 2* B_{Lim} (Table 6.4.2.4). Figure 6.4.2.19 shows the advice based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$. The equivalent Kobe plot is reported in Figure 6.4.2.20. These Figures show that according to the GM model the stock has been around $F_{0.1}$ and $B_{F0.1}$ for most of the time series, and is estimated to be above $B_{F0.1}$ in 2020.

Table 6.4.2.4: Nephrops in GSA 9. Final reference points based on Geometric mean and a default value of B_{Lim} =25% $B_{F0.1}$.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa

0.297	203	406	811	2893	0.548

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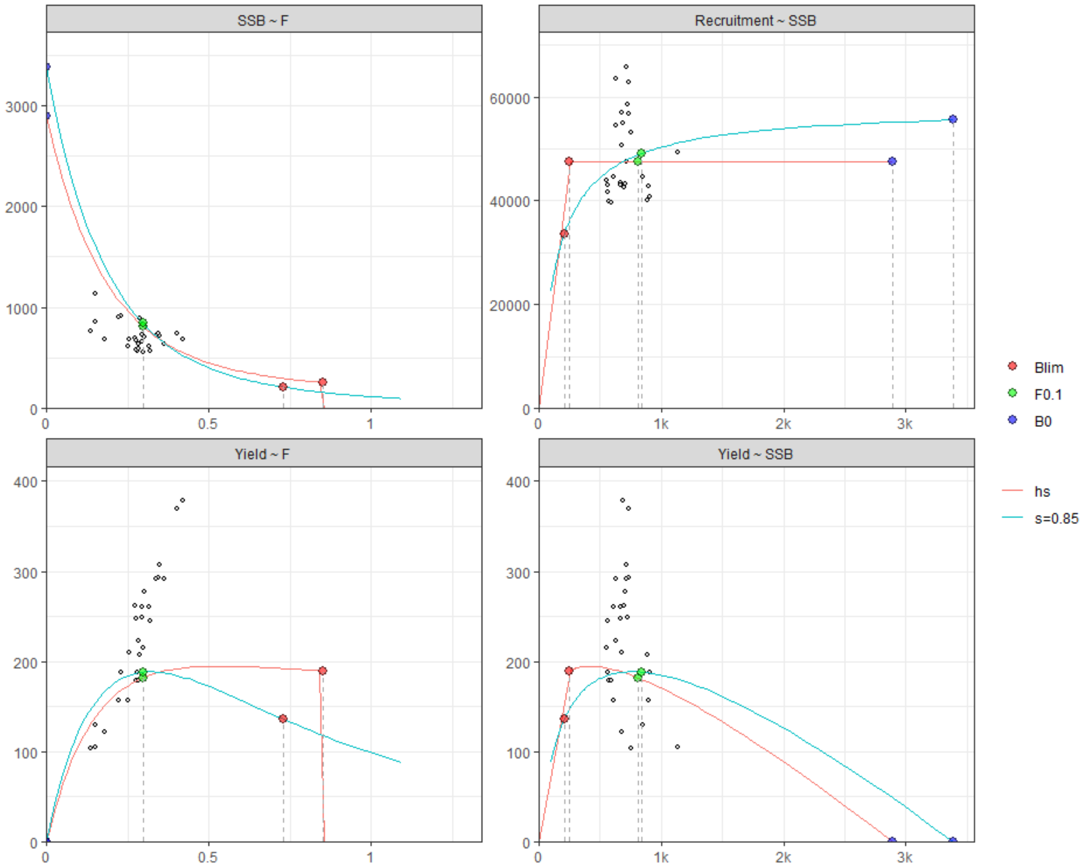

Figure 6.4.2.18: Norway lobster in GSA 9. Reference point estimates of $F_{0.1}$, B_{Lim} and B_0 shown as functions of SSB, F, Yield and Recruitment. Grey dots show the corresponding observations based on the revised assessment.

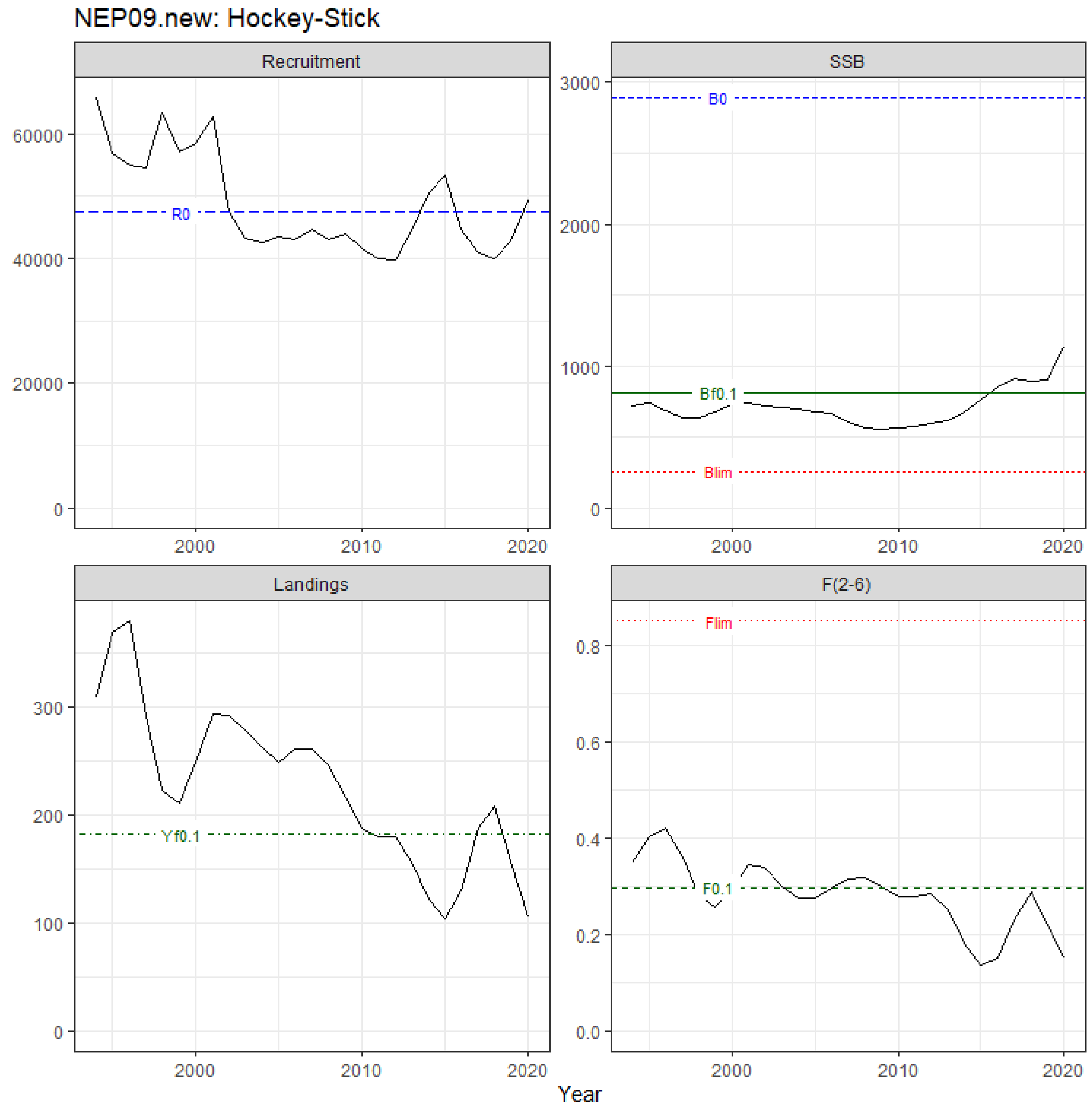

Figure 6.4.2.19: Norway lobster in GSA 9. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

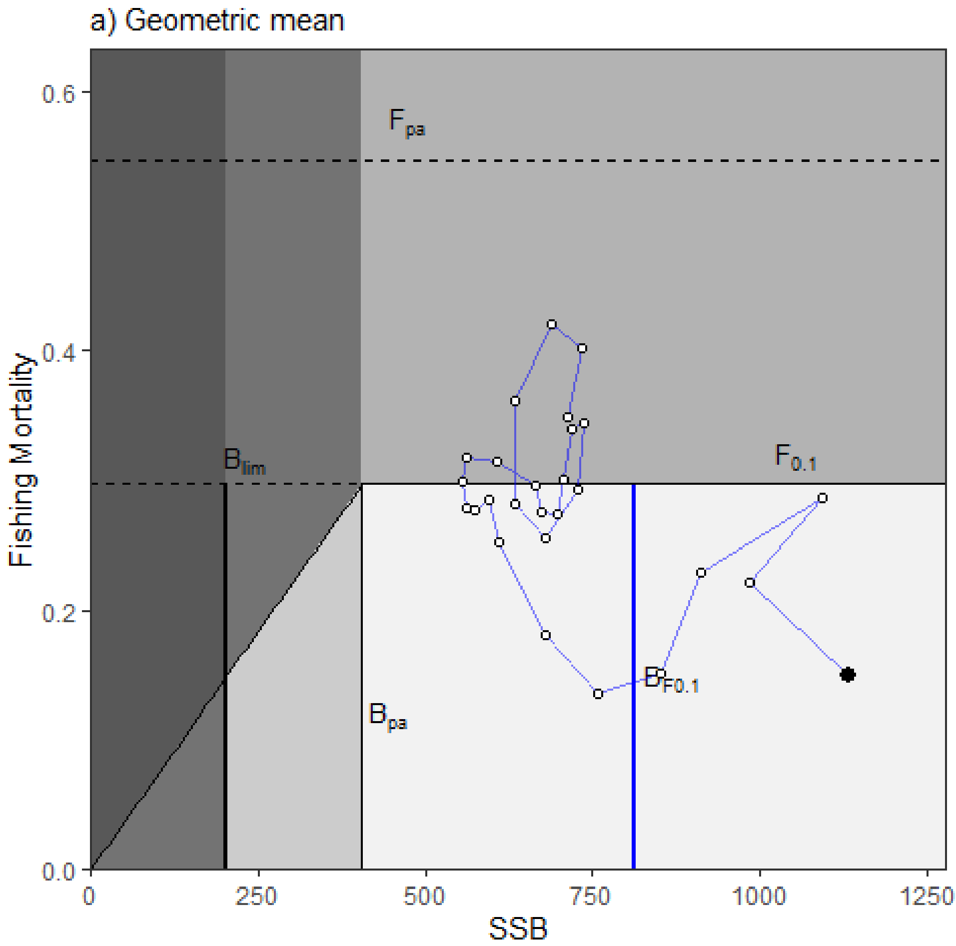

Figure 6.4.2.20: Norway lobster in GSA 9. Advice Rule plot with $B_{pa}=2B_{Lim}$, with $B_{F0.1}$ based on geometric mean recruitment and a default $B_{Lim}=0.25B_{F0.1}$

6.4.2.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for population modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above are illustrated in Figure 6.4.2.15. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.90 (Figure 6.4.2.20).

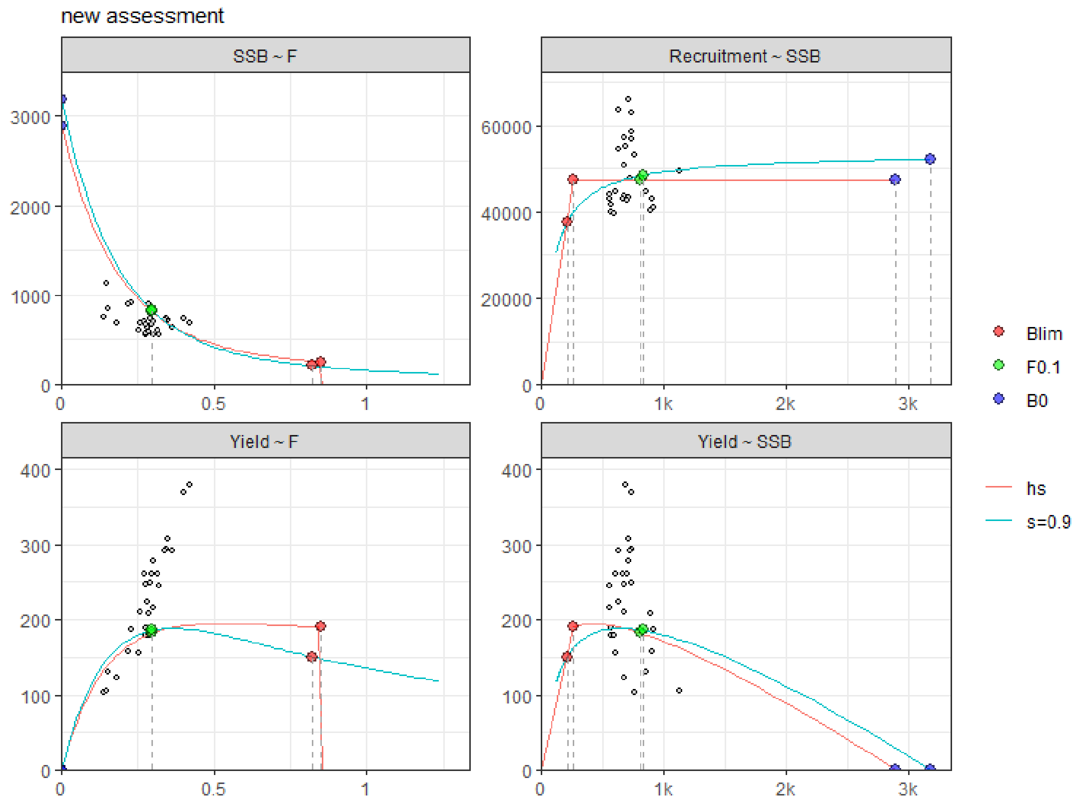

Figure 6.4.2.21 Norway lobster in GSA NEP09. Equilibrium yield: relative reference points for HS and BH (steepness 0.90) models.

6.5 Blue and red shrimp

6.5.1 Blue and red shrimps (ARA) in GSAs 8, 9, 10 and 11

6.5.1.1 Stock assessment

The assessment of blue and red shrimp, *Aristeus antennatus*, carried out during the STECF EWG 21-11 considered the stock shared by the GSAs 9, 10 and 11. No information from GSA 8 was included in the assessment (Figure 6.5.1.1)

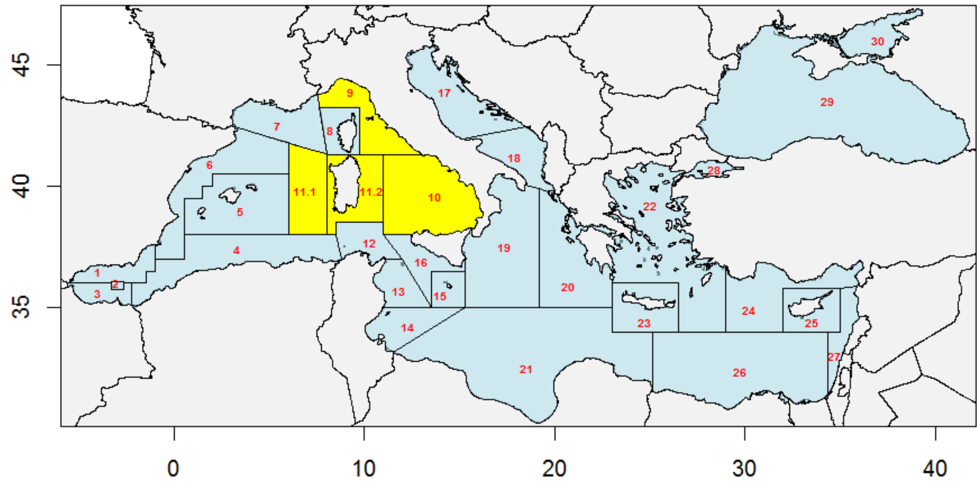

Figure 6.5.1.1: Blue and red shrimp in GSAs 9, 10 and 11. Limit of Geographical Sub-Areas (GSAs) 9, 10, 11.

The assessment was performed using catch-at-age data from commercial fisheries in the period 2006-2020, tuned with the index-at-age data from the MEDITS survey in GSAs 9, 10 and 11 (2006-2020). The assessment was performed with SCAA using a4a. The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.5.1.2.

An overview of the input data used in the assessment and outcomes is provided in Figure 6.5.1.3 - Figure 6.5.1.4

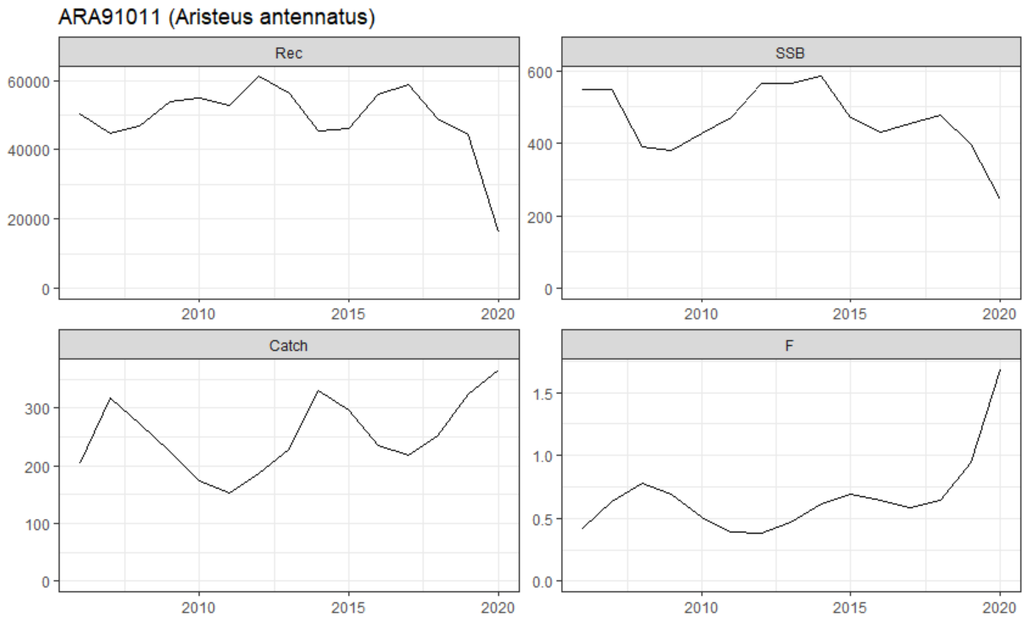

Figure 6.5.1.2: Blue and red shrimp in GSAs 9, 10 and 11. Stock summary from the final a4a model.

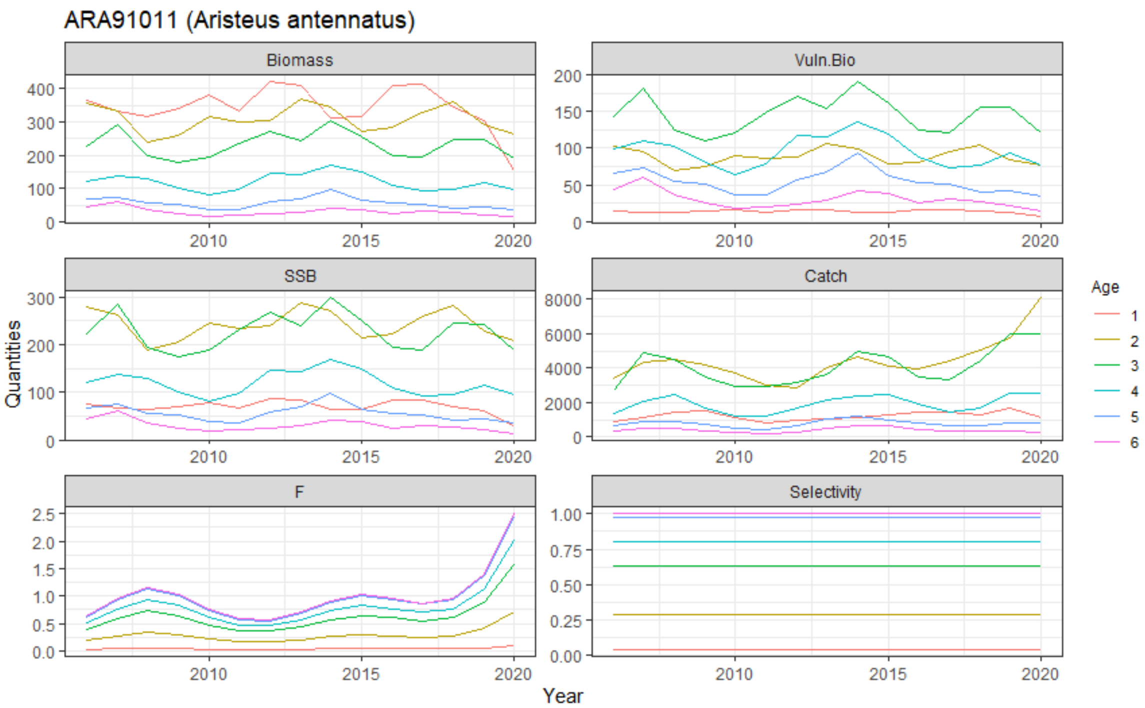

Figure 6.5.1.3: Blue and red shrimp in GSAs 9, 10 and 11. Stock assessment trajectories at age estimated by the stock assessment model.

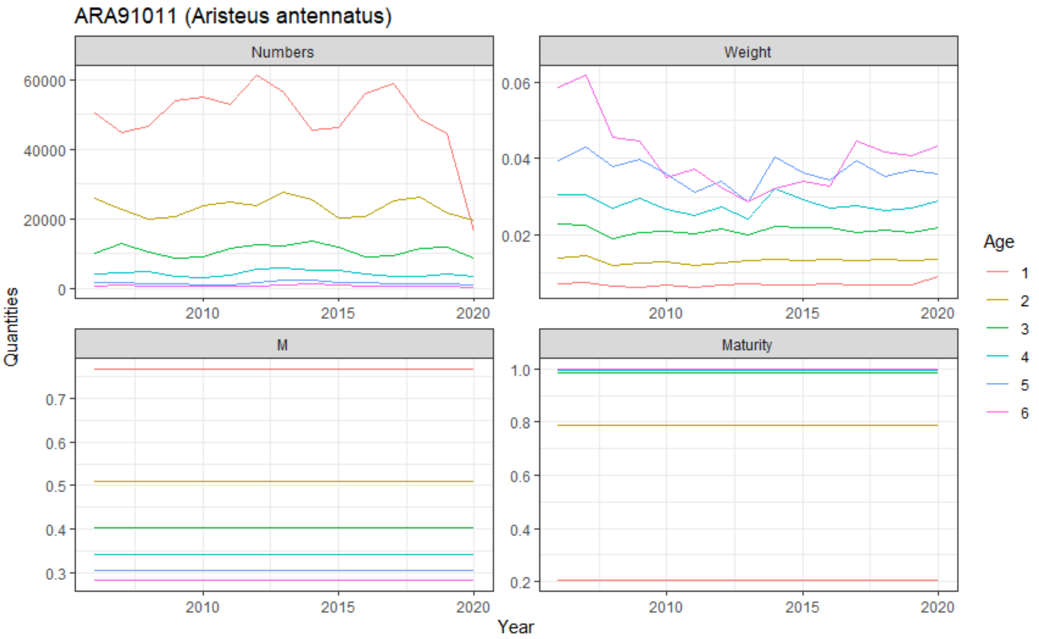

Figure 6.5.1.5: Blue and red shrimp in GSAs 9, 10 and 11. Stock biology trajectories at age. Numbers from the fitted assessment the other values from input data to the

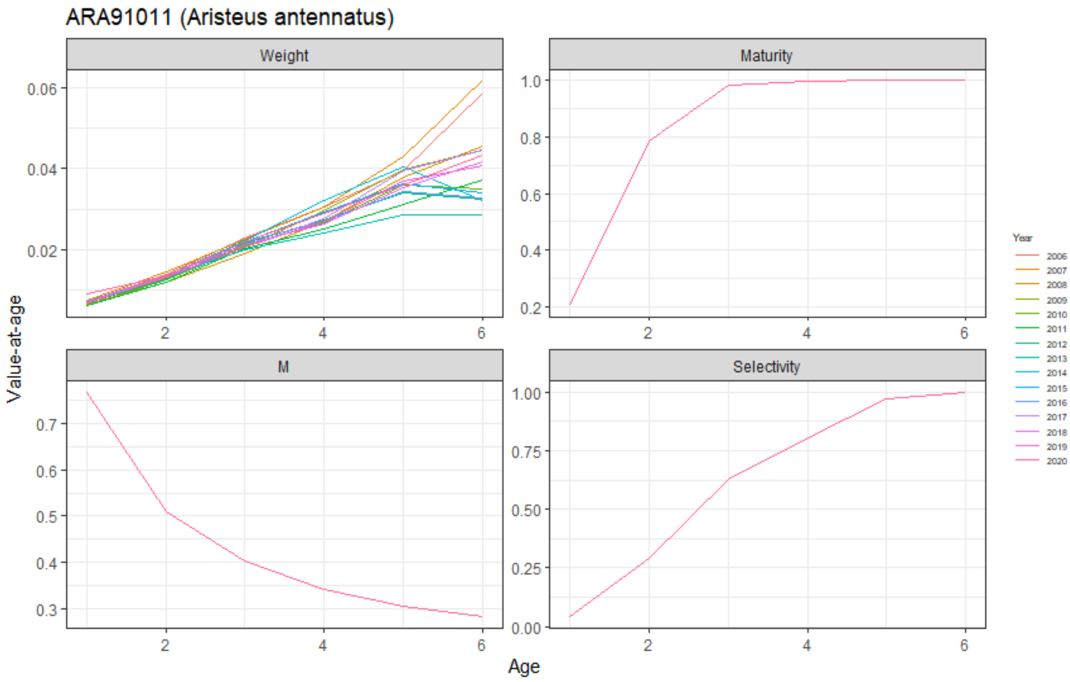

Figure 6.5.1.4: Blue and red shrimp in GSAs 9, 10 and 11. Annual stock quantities at age Individual weights at age, fraction mature at age, natural mortality at age are input data, and selectivity at age in the fishery is estimated in the model.

6.5.1.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.5.1.1 and Figure 6.5.1.6

Table 6.5.1.1: Blue and red shrimp in GSAs 9, 10 and 11. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.29	0.01374	0.00499	1.47	0.00396	0.03243

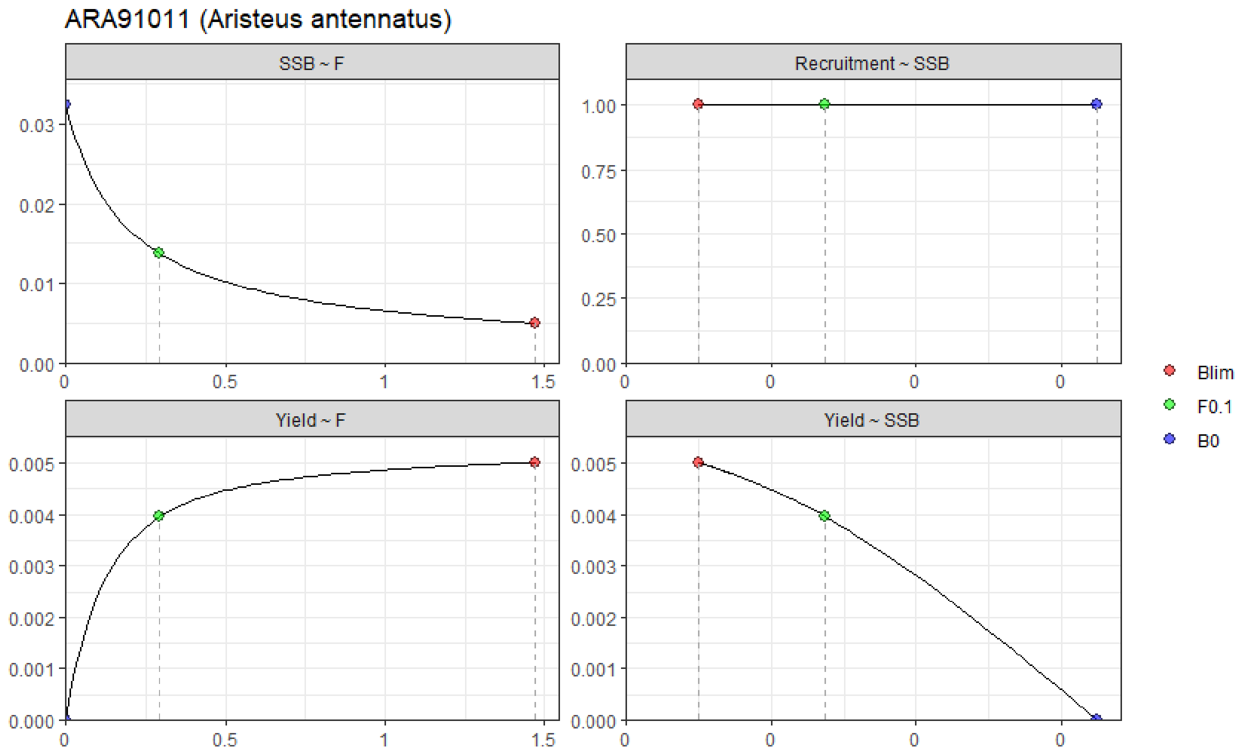

Figure 6.5.1.6: Blue and red shrimp in GSAs 9, 10 and 11. Per-recruit analysis.

Figure 6.5.1.7 shows the trajectories of the assessment outputs against the per-recruit reference points. SSB has been oscillating slightly below the biomass at $F_{0.1}$ ($B_{F0.1}$) and quite above B_{Lim}, with a sharper decrease in the last years. At the same time, F has been slightly above $F_{0.1}$, though increasing in the last years.

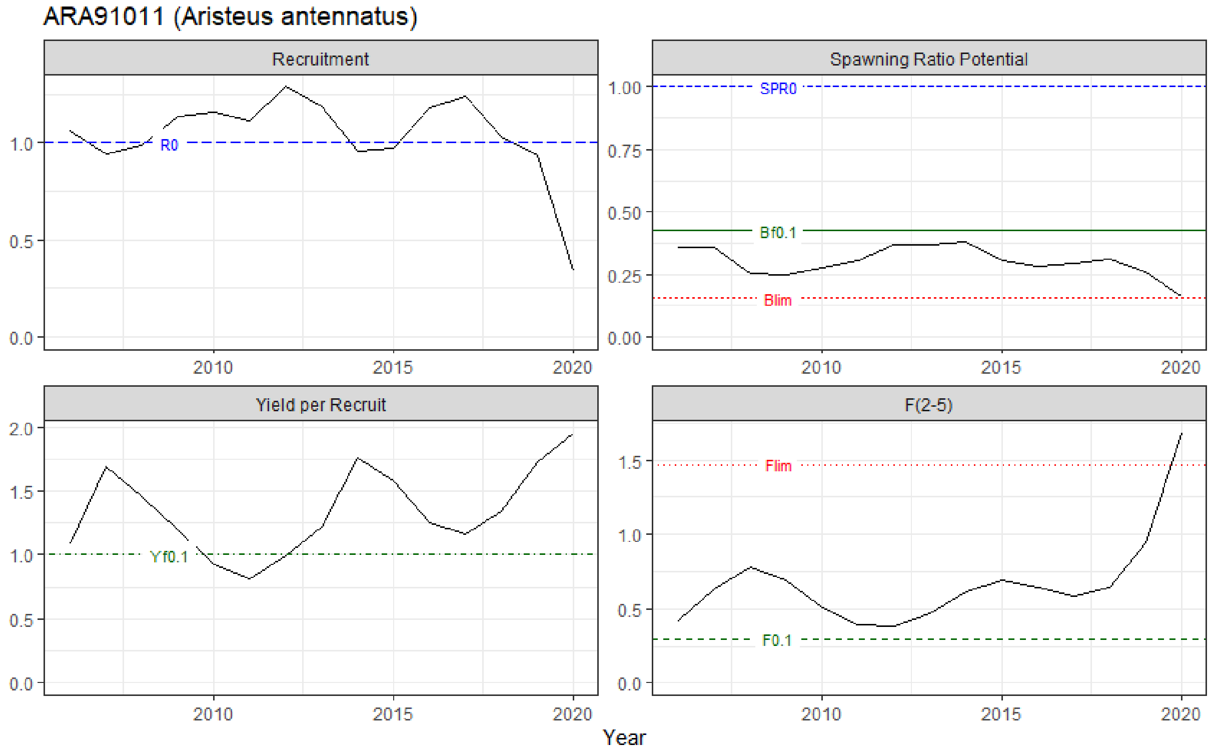

Figure 6.5.1.7: Blue and red shrimp in GSAs 9, 10 and 11. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

Figure 6.5.1.8 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario.

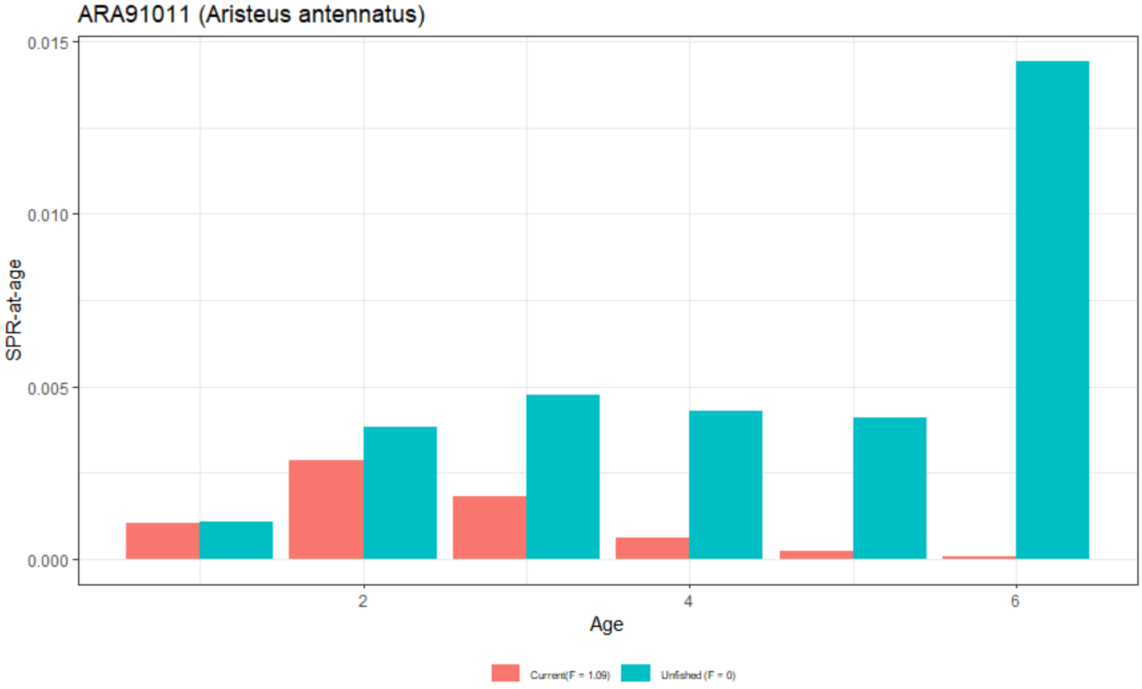

Figure 6.5.1.8: Blue and red shrimp in GSAs 9, 10 and 11. Comparison of the spawning biomass per recruit SPRF at current F (average of last 3 years) and SPR0 with F = 0.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean)

2. Hockey-Stick (model=segreg)

3. Beverton-Holt (model=bevholtSV)

4. Ricker (model=ricker)

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SP R_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y. The Beverton-Holt model was run on the stock object with the full time series (2005-2020), and with reduced time series (BH1 up to 2019, and BH2 up to 2018) to check for consistency in the steepness.

Table 6.5.1.2: Blue and red shrimp in GSAs 9, 10 and 11. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.32391	47258.99	0.4443752	1531.262
Hockey-stick	NA	0.3121274	47258.99	0.4443752	1531.262
Beverton-Holt	0.676	0.304359	67338.83	0.4163282	2181.88
BH1 (data up to 2019)	0.995	0.107514	51448.32	0.292147	1622.689
BH2 (data up to 2018)	0.995	0.103559	52044.88	0.242378	1604.718
Ricker	0.621	0.31791	88126.75	0.3806325	2855.44

The observed SR data are sitting on the right part of the R-SSB plot, and the breakpoint estimated by the HS model is much lower that the observed values based on the default value of 25% $B_{F0.1}$.

The results show that the recruitment variation fairly low, e.g. σr = 0.25 for the Beverton-Holt model, associated with a steepness of s = 0.68. The predicted recruitment by Hockey-Stick, Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the three models differ largely in scale of their R_0 and B_0 estimates. Information on the slope to the origin is not found within the observed SSB Recruitment results from the assessment.

The break-point of the Hockey-Stick is estimated at b = 162 t, and the corresponding R_0 is equal to the one estimated by the geometric mean recruitment. The breakpoint from the Hockey-Stick comes from the control setting of 25% $B_{F0.1}$and is not informed by the data.

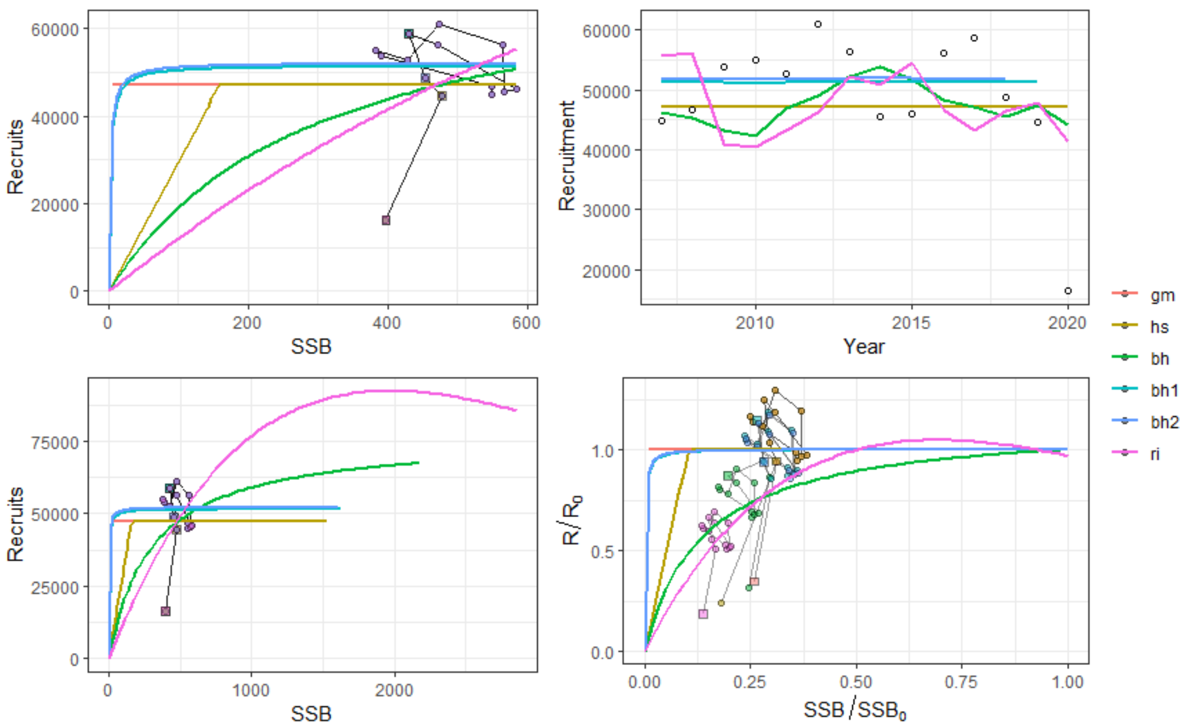

Figure 6.5.1.9: Blue and red shrimp in GSAs 9, 10 and 11. Summary of the four SR models. Two additional tests were made with Beverton-Holt model using reduced time series (BH1 up to 2019, BH2 up to 2018).

Figure 6.5.1.10 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.55 – 0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.9-0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates. It is not possible to obtain consistent values of steepness from the available data.

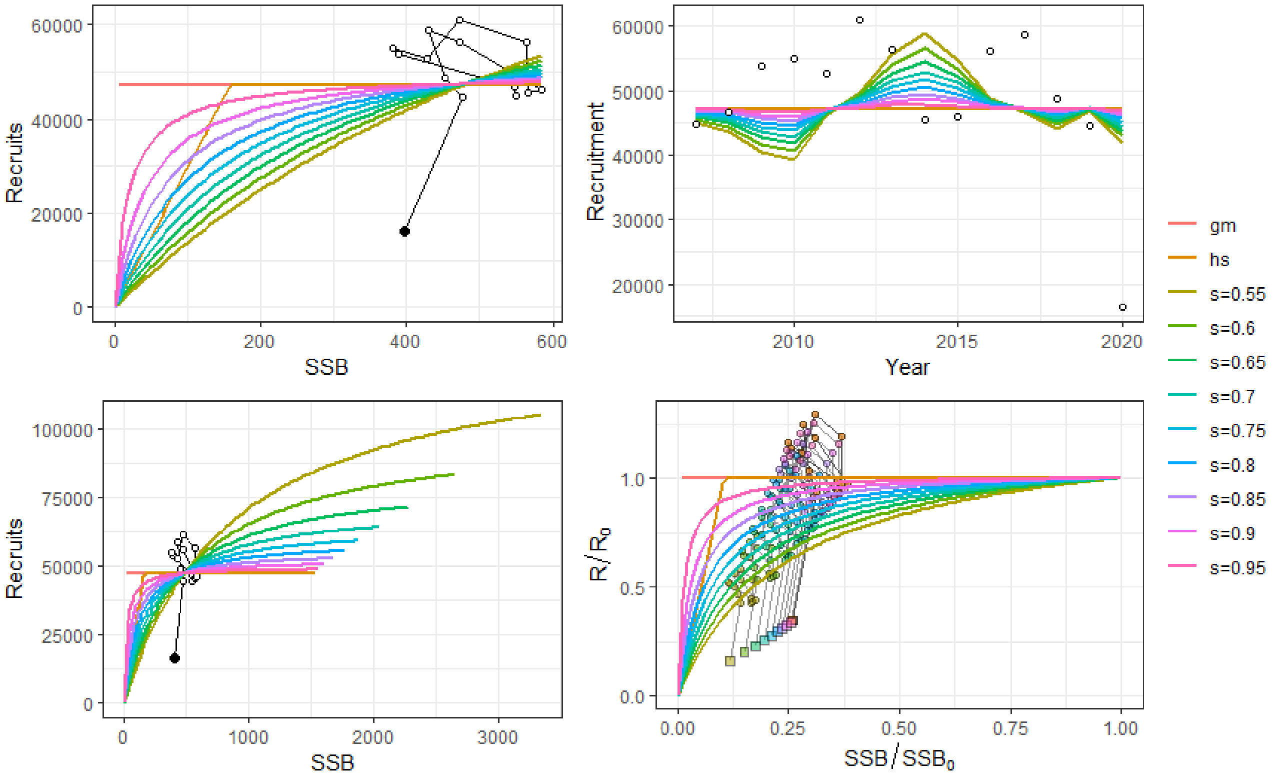

Figure 6.5.1.10: Blue and red shrimp in GSAs 9, 10 and 11. Equilibrium yield with GM, HS and BH models with different slope (s, steepness) scenarios for the BH model.

An investigation of the available historical landings was performed to evaluate whether the results of stock recruit models are in compatible with the past production of the stock. The historical landings were gathered from the Italian national official statistics (ISTAT) as collected and stored in the RECFISH project (Ligas, 2019). Landings for red shrimps (combining both giant red shrimp and blue and red shrimp) were available from 1972 to 1999. Historical landings (by GSA and total) are summarized in Figure 6.5.1.11 and are compared to the EU DCF time series of landings of giant red shrimps in GSAs 9-10-11 (ARS) and blue and red shrimp in GSA 9-10-11 (ARA).

With the exception of some odd peaks in 1987 and early 90s, with production above 2500 t, the landings of the two species are around 1000 t per year. If we consider about 400-500 t of blue and red shrimp (according to the proportion with blue and red shrimp in recent EU DCF landings) this is in line with the results of the SR analysis.

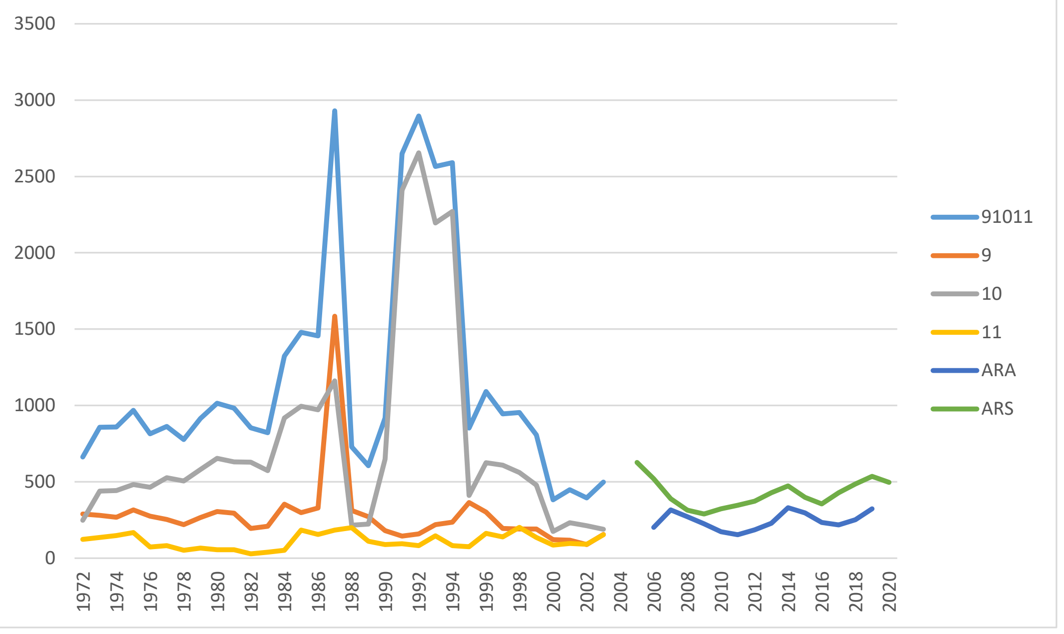

Figure 6.5.1.11: Blue and red shrimp in GSAs 9, 10, 11. Historical landings (tonnes) by GSA and total landings, and EU DCF landings of giant red shrimp (ARS) and blue and red shrimp (ARA) in GSAs 9-10-11.

6.5.1.3 Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Geometric Mean approach as the most suitable to estimate the biomass reference points for the stock of blue and red shrimp in GSAs 9, 10 & 11. This being also equivalent to the asymptote of the HS. Table 6.5.1.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in Figure 6.5.1.12, and the historic assessment information is shown in this context in Figure 6.5.1.13 and Figure 6.5.1.14. In conclusion the stock is considered to be between B_{Lim} and $B_{F0.1}$ in 2020.

Table 6.5.1.3: Blue and red shrimp in GSAs 9, 10 & 11 . Final reference points based on Geometric mean stock recruit model fitted to the data and the default B_{Lim} = $B_{F0.1}$ / 4.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa

0.294	162	324	649	1531	0.924

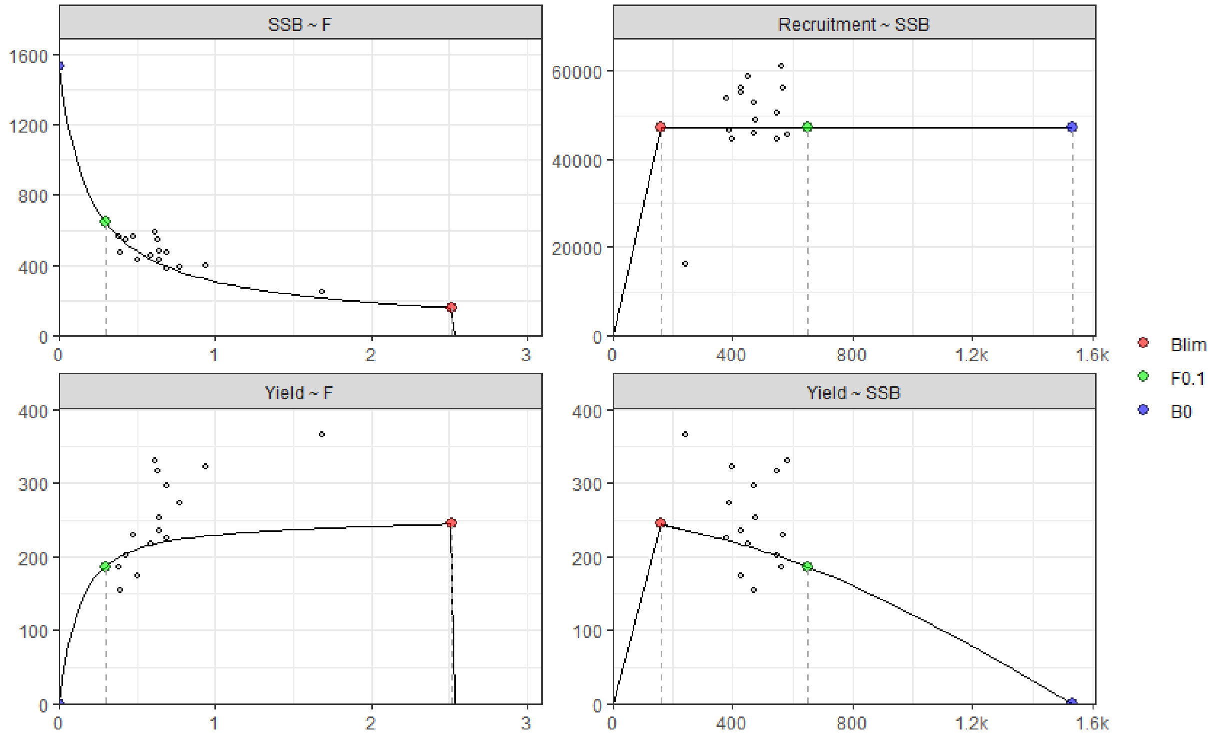

Figure 6.5.1.12: Blue and red shrimp in GSAs 9, 10 and 11. Equilibrium yield with the Hockey-Stick model.

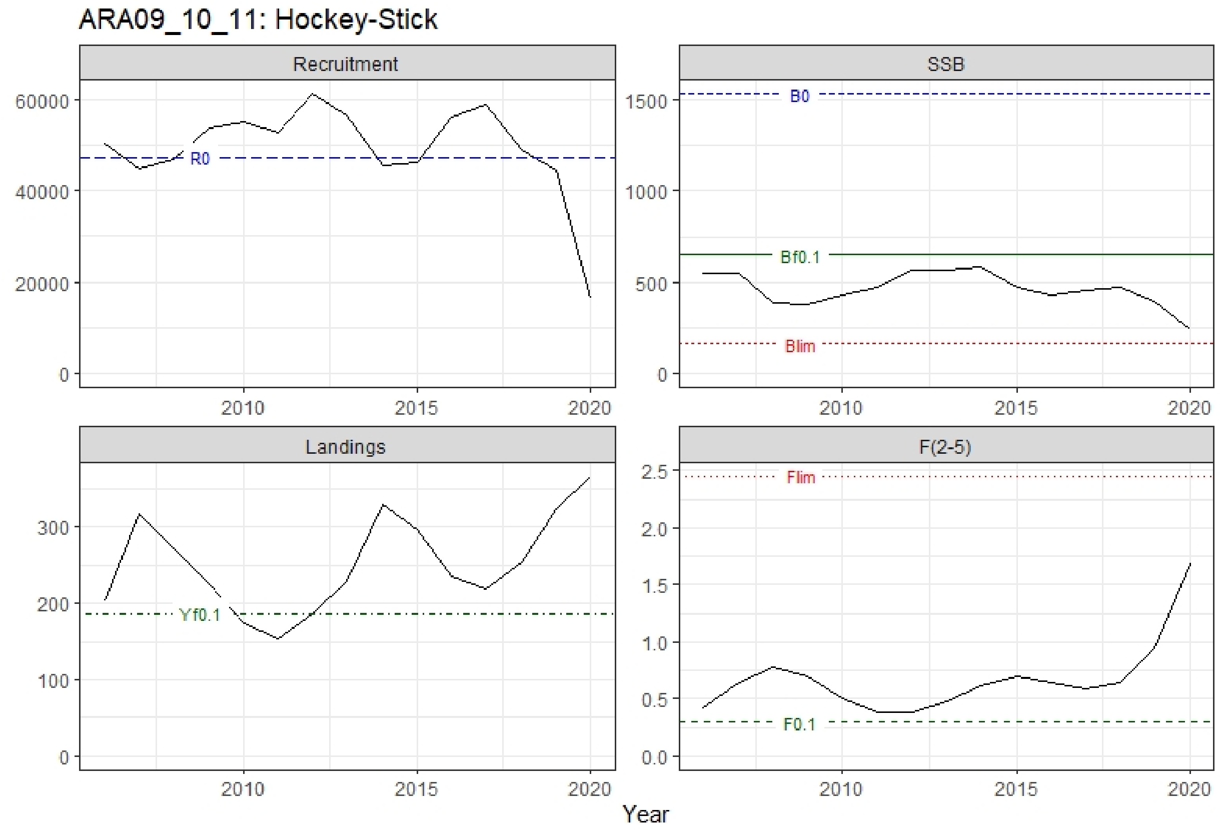

Figure 6.5.1.13: Blue and red shrimp in GSAs 9, 10 and 11. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

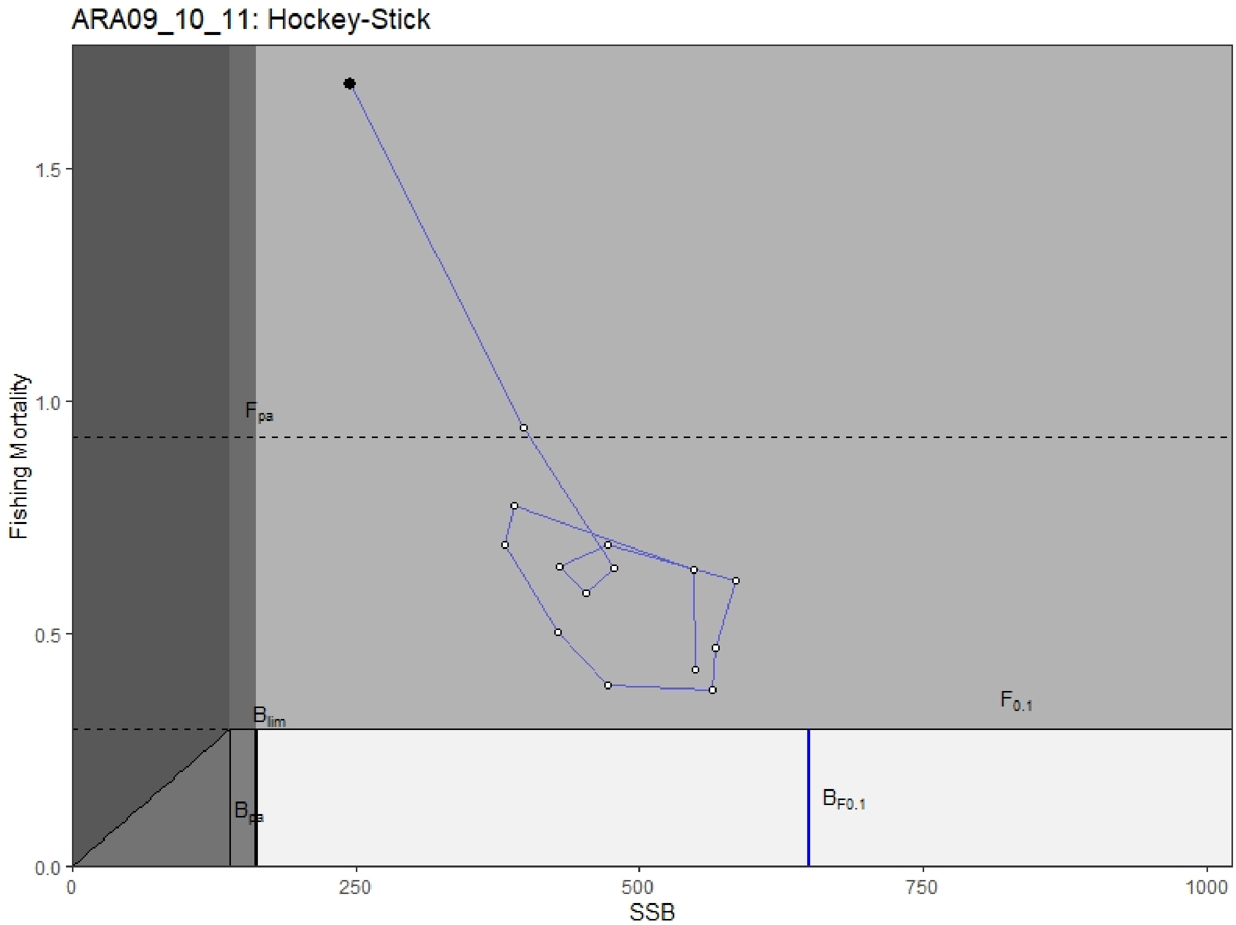

Figure 6.5.1.14: Blue and red shrimp in GSAs 9, 10 and 11. Advice Rule plot for the Hockey-Stick model, with a default B_{Lim} = 0.25 $B_{F0.1}$ and B_{pa} = 2x B_{Lim}.

6.5.1.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above and illustrated in Figure 6.5.1.10. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.95 (Figure 6.5.1.15).

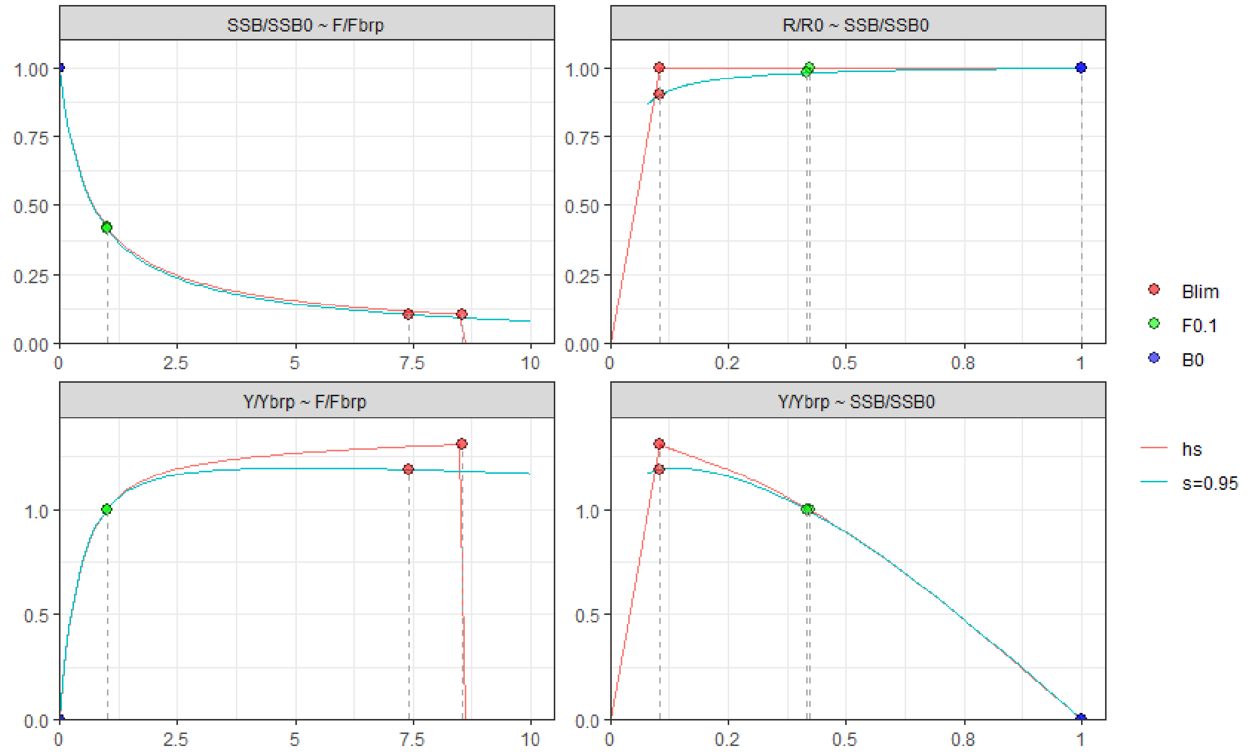

Figure 6.5.1.15: Blue and red shrimp in GSAs 9, 10 and 11. Equilibrium yield: relative reference points for HS and BH (steepness 0.95) models.

6.5.2 Blue and red shrimp (ARA) in GSAs 01

6.5.2.1 Stock assessments

For blue and red shrimp in GSA01(Figure 6.5.2.1) the stock assessment method was statistical catch at age with the FLR library **a4a**, using catch at age data from the commercial fishery (deep water trawling) for the period 2002-2020, using the index-at-age of the MEDITS survey as tuning index. The results of the assessments in STECF EWG 21-11 were provided by the JRC to this working group as FLR objects to calculate the biomass-based reference points using the library FLRef, developed by the JRC.

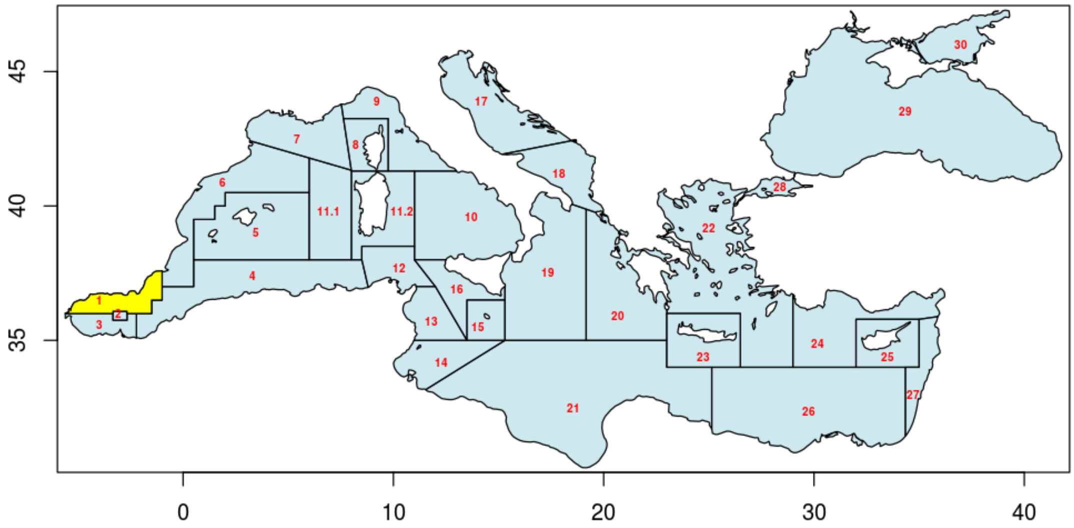

Figure 6.5.2.1: Blue and red shrimp in GSA 1. Geographical location of the stock.

The results of the STECF EWG 21-11 assessment for blue and red shrimp in GSA01 for the years 2002-2020 are summarized in Figure 6.5.2.2, highlighting the indicators Rec (recruitment), SSB (spawning stock biomass, Catch (catches) and F (fishing mortality). The chart shows high recruitment, biomass and catches for the first six years of the series. These series show and abrupt decline in 2008 and they fluctuate around relatively lower levels up to the present. The data series of catches and the MEDITS index used for the stock assessment were checked again to confirm that the level of abundance of the population is likely to have indeed declined abruptly.

Fishing mortality is high: current F for ages 1-2 was estimated at 1.69 in the last three years (2018-2020) and corresponds to 5.84 times the target fishing mortality F_{01}, estimated at 0.29 .

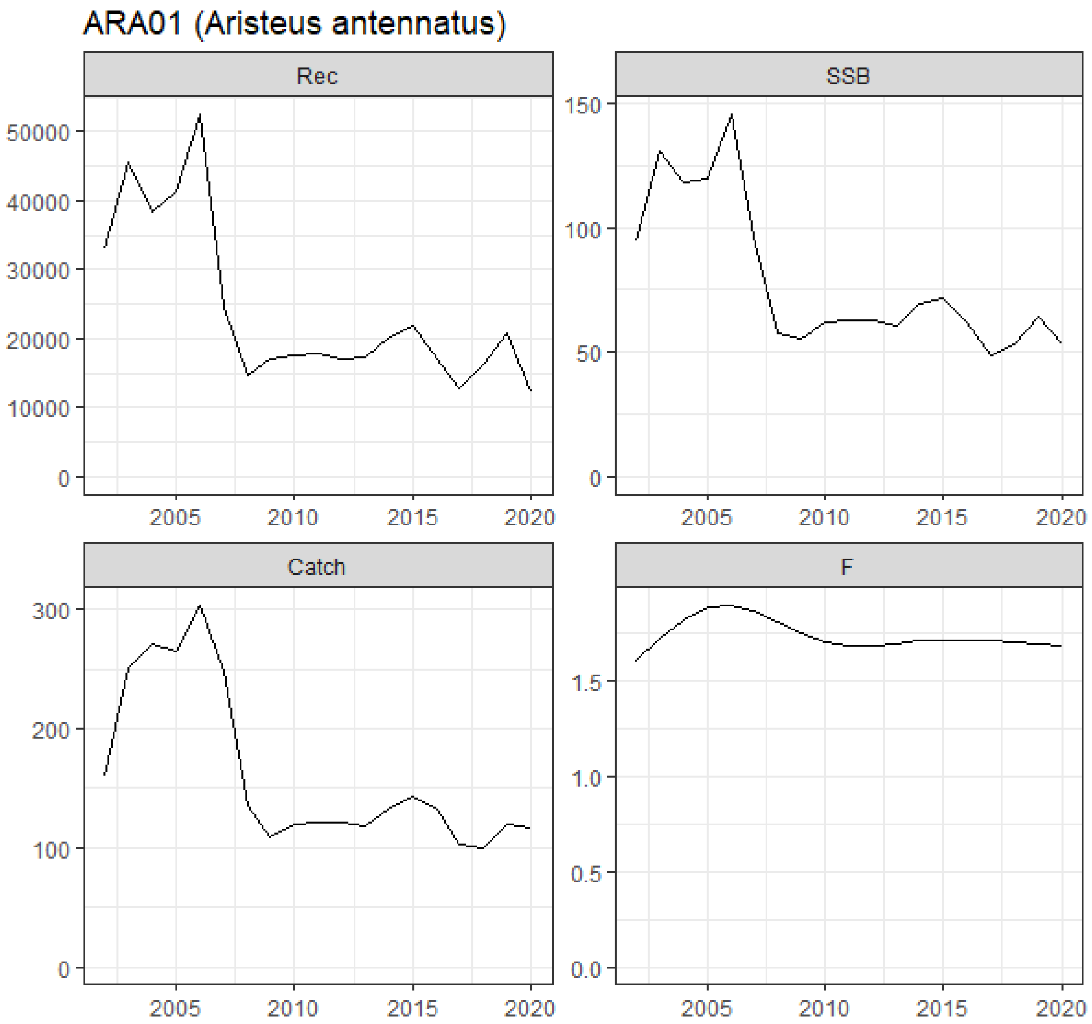

Figure 6.5.2.2: Blue and red shrimp (Aristeus antennatus "ARA") in GSA01. Stock summary from the final a4a model produced in STECF EWG 21-11.

An overview of the biological data used in the assessment is shown in Figure 6.5.2.2 to Figure 6.5.2.5. The charts show that the stock is composed of 5 age classes (the oldest age class being +), but most of the vulnerable population would be in ages 1 and 2. According to the biology of the species, age 1 would already contribute to SSB, with a maturity rate estimated at 0.7 and all age classes would be fully selected from age 2 onwards.

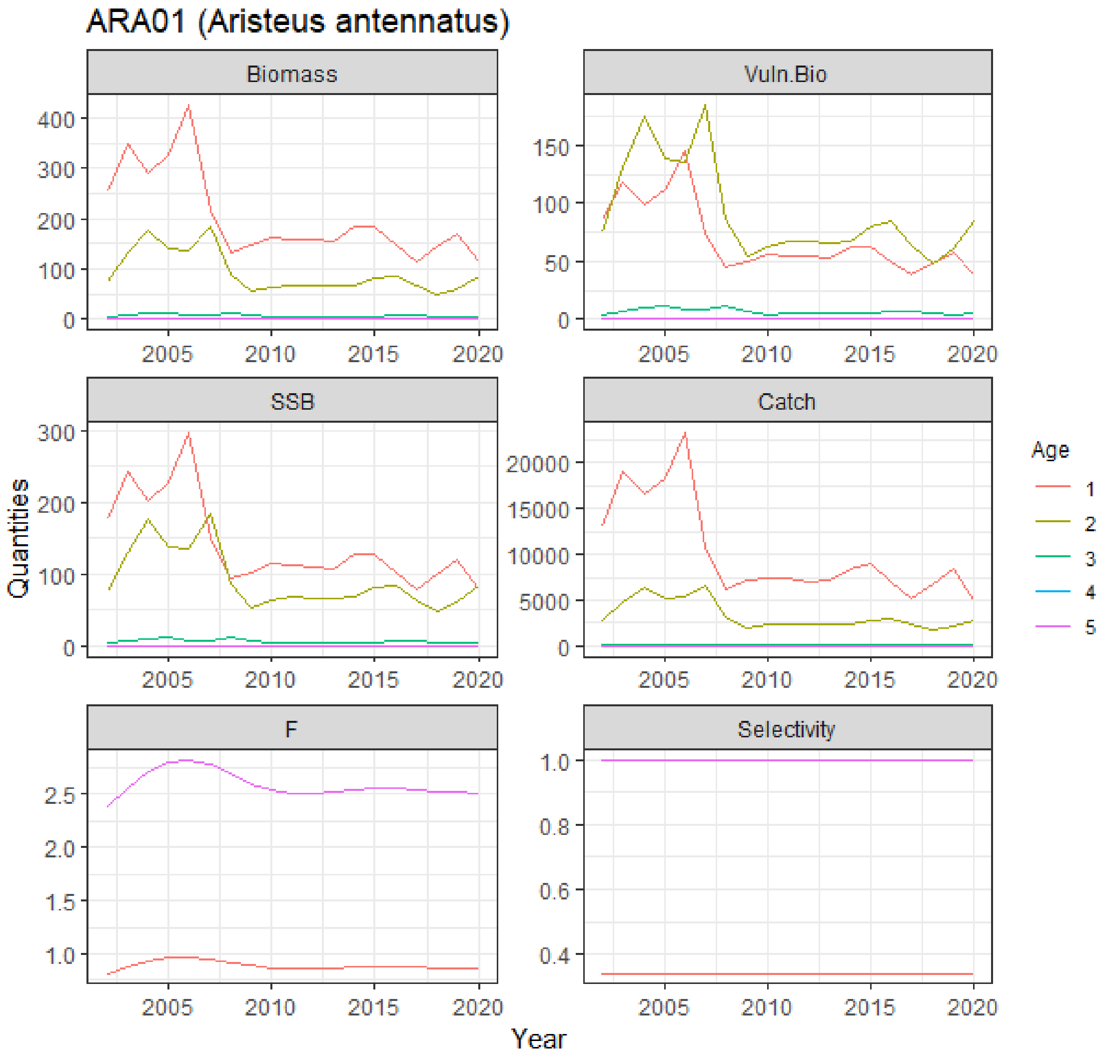

Figure 6.5.2.3: Blue and red shrimp in GSA01. Stock assessment output trajectories of biological and exploitation indicators (continued).

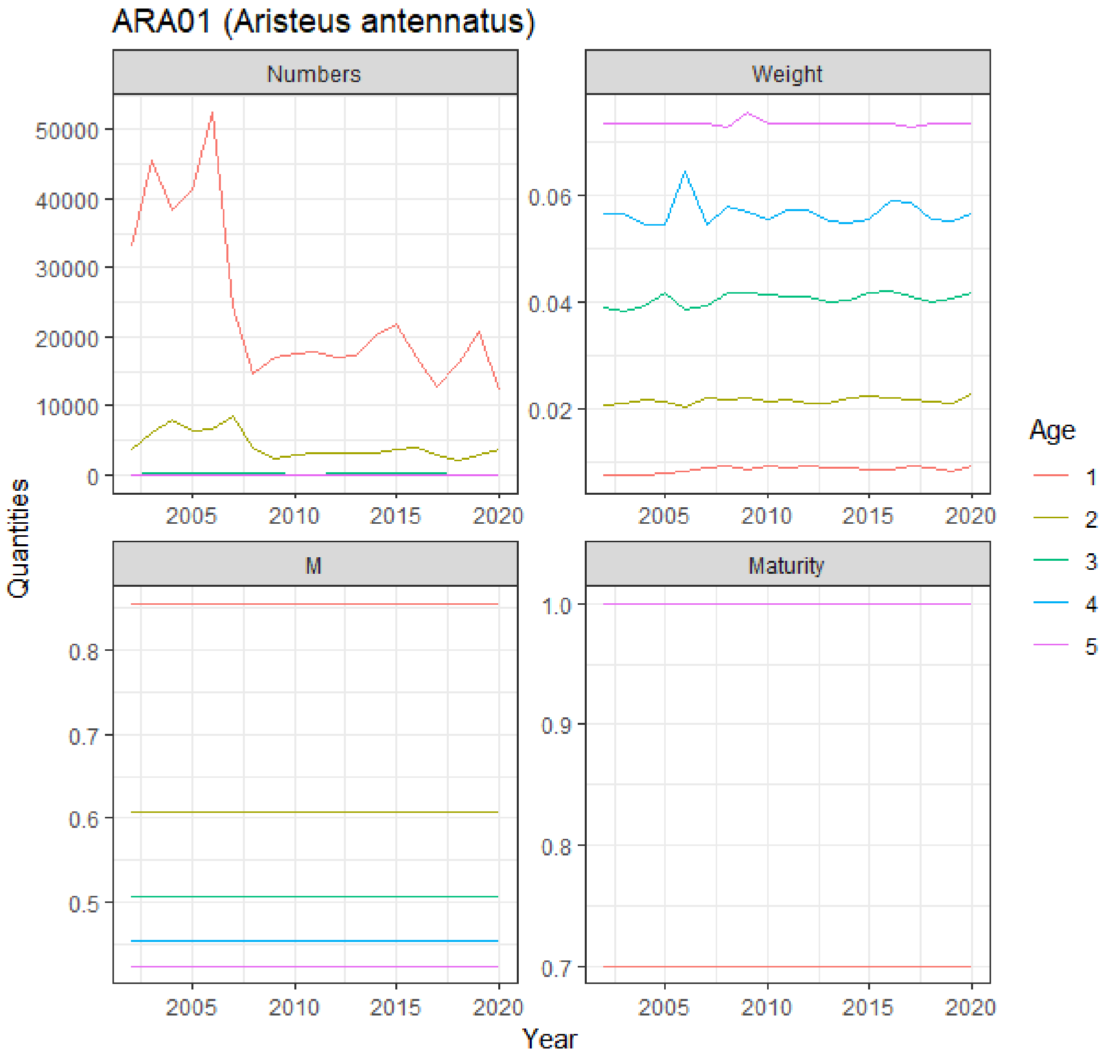

Figure 6.5.2.4: Blue and red shrimp in GSA01. Stock assessment trajectories of biological and exploitation indicators. Numbers from the fitted assessment; the other values from input data to the assessments.

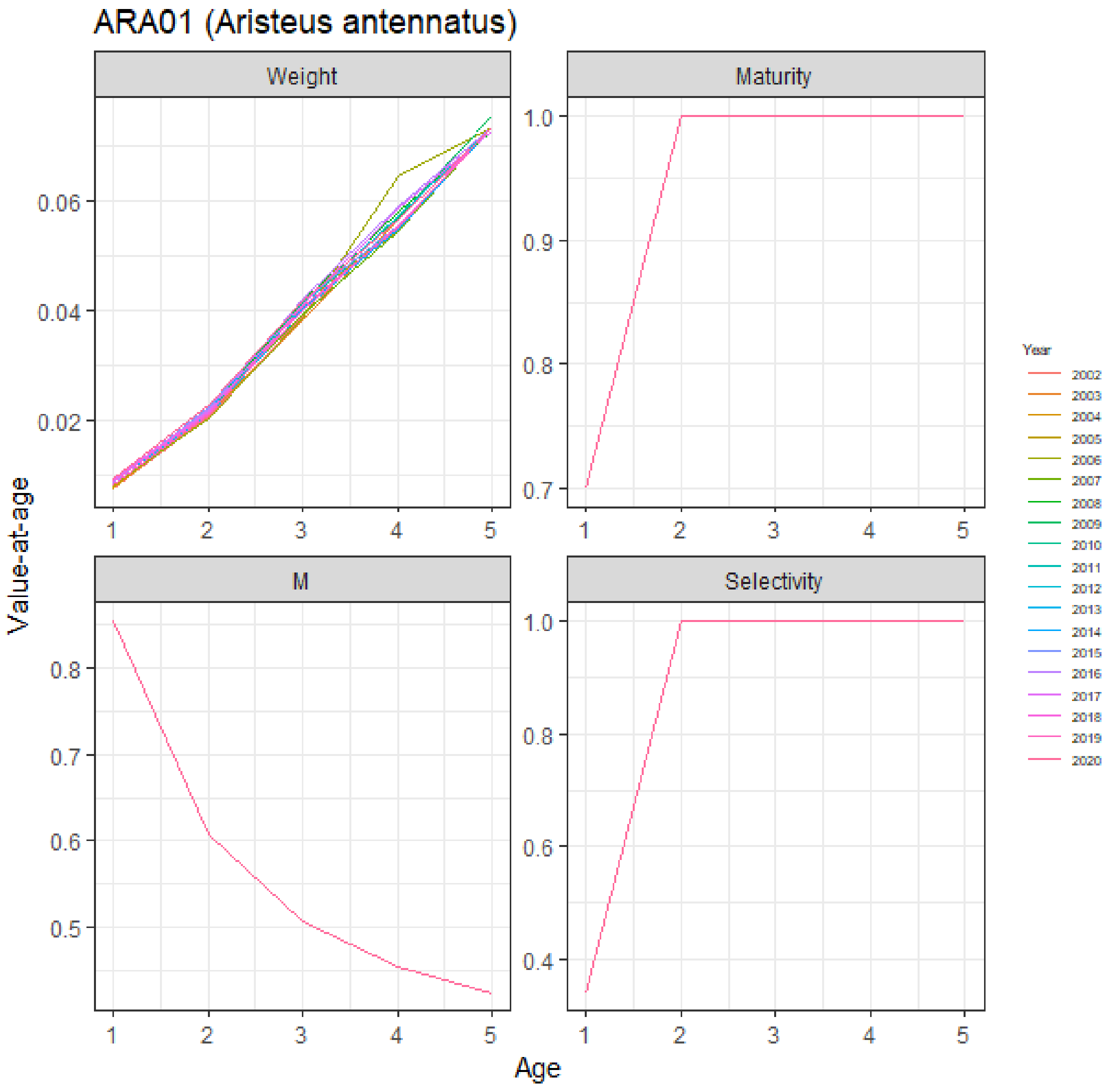

Figure 6.5.2.5: Blue and red shrimp in GSA01. Stock quantities at age (constant in time for maturity, natural mortality M and Selectivity). Individual weights at age, fraction mature at age, natural mortality at age are input data and selectivity at age in the fishery

6.5.2.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 with the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.5.2.1 and Figure 6.5.2.6 Note that current and all F since 2002 are above F_{lim} and that SSB is very low all along the data series and below B_{Lim} in the recent years (Figure 6.5.2.7). The contribution by age class to spawning potential ratio (SPR) shows that the current population is heavily depleted for ages 2 and higher compared to an un-fished population (Figure 6.5.2.8).

Table 6.5.2.1: Blue and red shrimp in GSA01. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.29216	0.01519	0.00398	1.45962	0.00602	0.03944

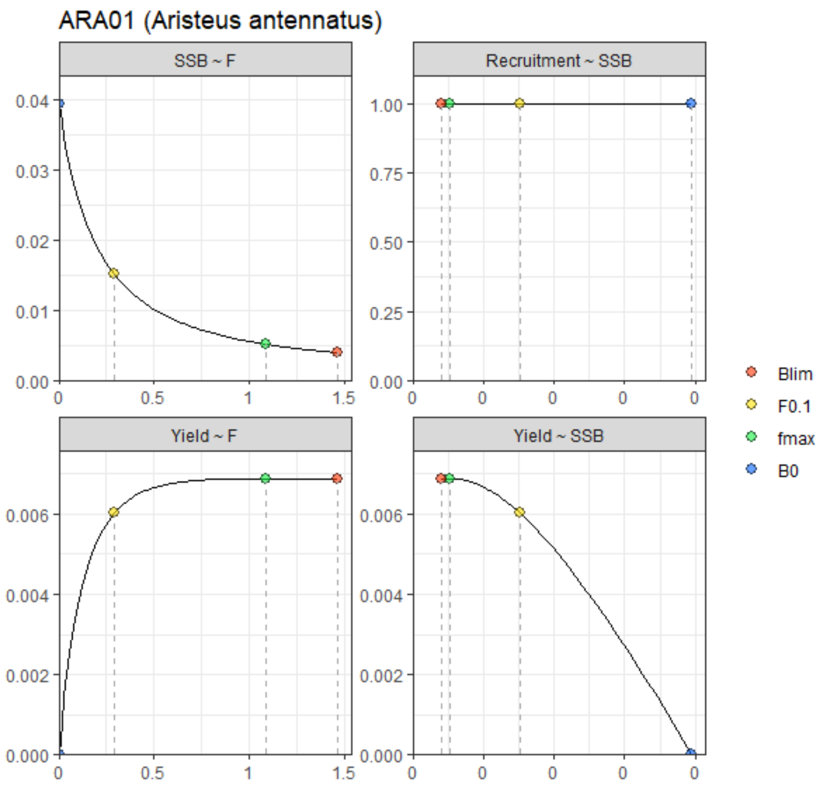

Figure 6.5.2.6: Blue and red shrimp in GSA01. Per-recruit analysis.

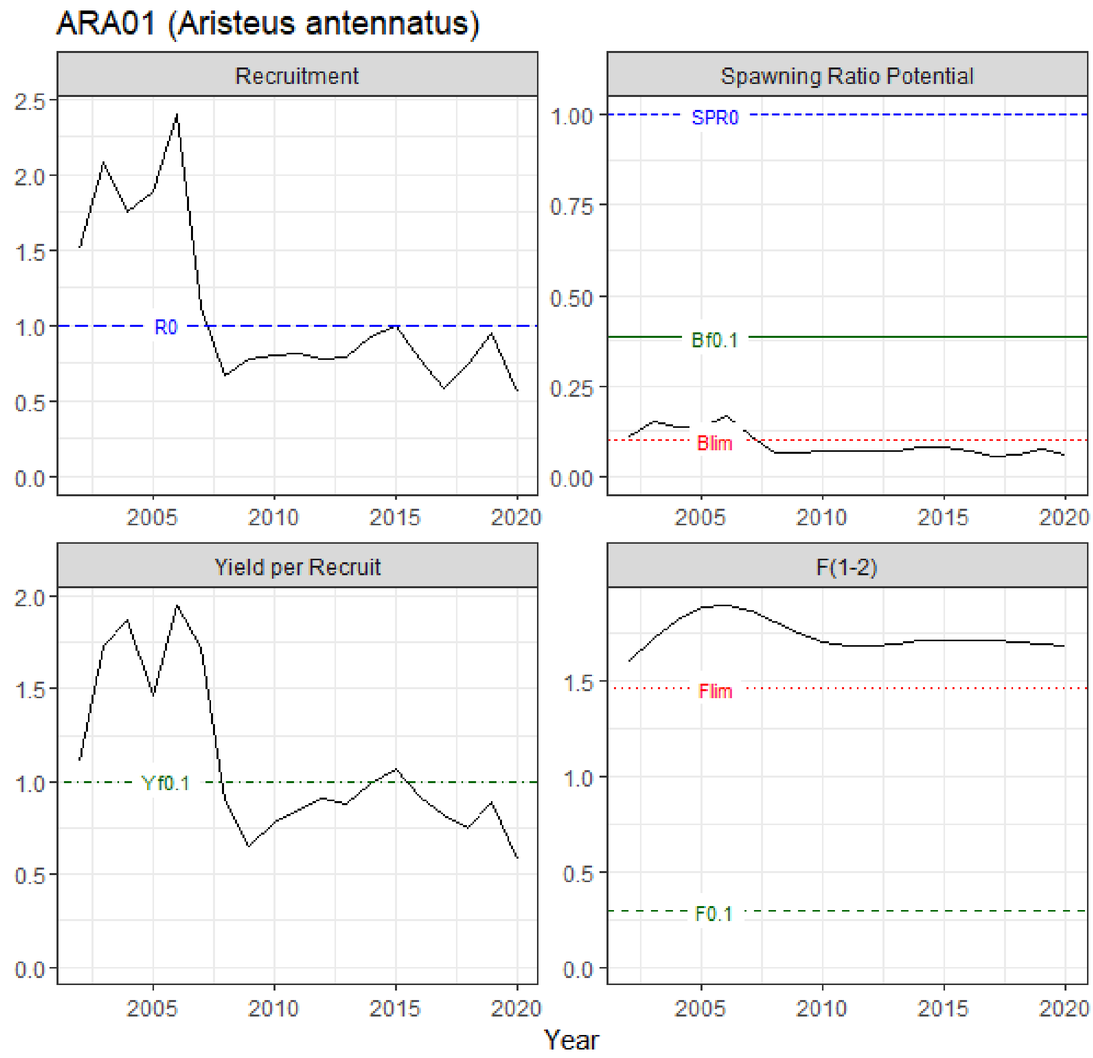

Figure 6.5.2.7: Blue and red shrimp in GSA01. Indicators from the results of the a4a stock assessment in STECF EWG 21-11 compared with the per-recruit reference points.

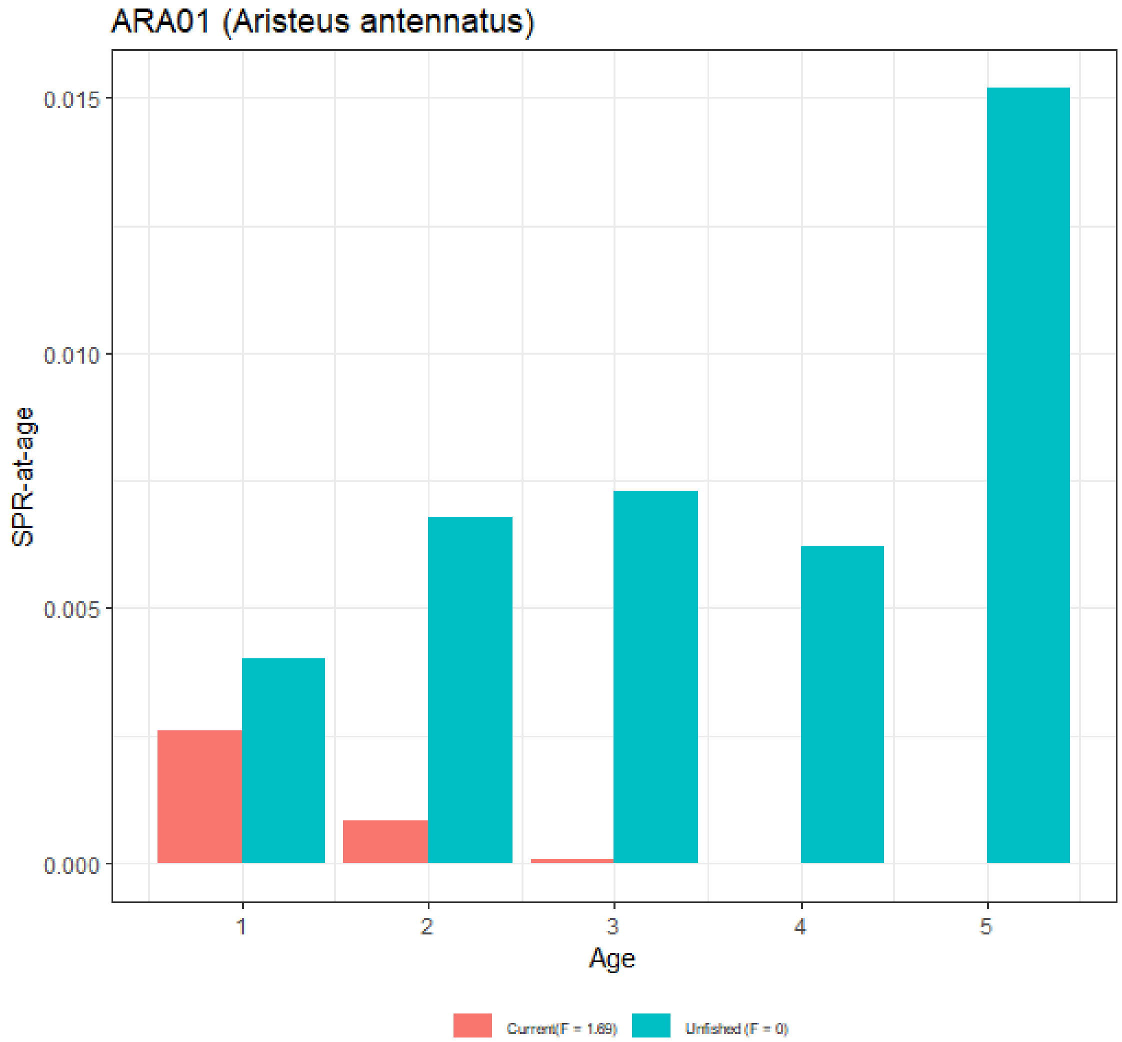

Figure 6.5.2.8: Blue and red shrimp in GSA01. Spawning potential ratio by age class for the current (red bars) and a virgin population (blue bars).

Four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. GM: Geometric Mean (model=geomean)

2. HS: Hockey-Stick or segmented regression (model=segreg), estimated using lplim = 0.001 and uplim = 0.125, after several trials with uplim varying from 0.1 to 0.2 to test for sensitivity of the results to the specification of uplim (where *uplim* is the upper bound to the ratio SPR / SPR_0).

3. BH: Beverton-Holt (model=bevholtSV), with unconstrained estimation of steepness (s).

4. RI: Ricker (model=ricker), with unconstrained estimation of steepness (s).

Table 6.5.2.2: Blue and red shrimp in GSA01. Summary of four S/R candidate models.

	s	sigmaR	R_0	rho	B_0
gm@SV		0.4367	21,388	0.7434	840.4
hs@SV		0.2865	34,809	0.1103	1365.7
bh@SV	0.7558	0.2984	212,661	0.1177	8343.6
ri@SV	1.4629	0.3025	67,265	0.1315	2639.1

The estimates of the four candidate models differ widely for R_0 and B_0. The value of R_0 for the HS model was found to be higher than the geometric mean recruitment. The estimate of R_0 produced by the BH model was 10x the value obtained with the GM model. The steepness of this BH model was 0.76, leading to very high estimates of R_0 and B_0. Hence, BH models with higher s values were explored (next section). The RI model was not further considered because i) it is unlikely, on biological grounds, that blue and red shrimp stocks show density-dependence of R at high values of SSB, ii) the series of SSB and R available allow to examine only the initial part of the SSB/R relationship for this stock.

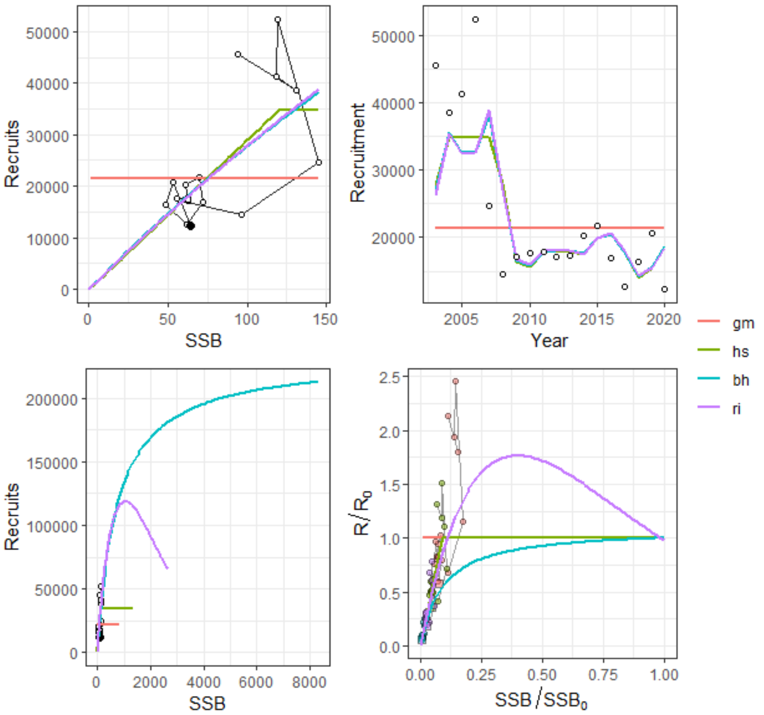

Figure 6.5.2.9: Blue and red shrimp in GSA01. Summary of four candidate S/R models, gm: geometric mean; hs: hockey-stick; bh: Beverton and Holt; ri: Ricker.

Figure 6.5.2.10 shows the results of the sensitivity analysis of the BH model to a range of steepness values from s=0.8 to s=0.95. These results show that increasing s helps bring down R_0 and B_0 to levels compatible with the HS model estimates. Considering the highest values of R ever observed in the study period (ca. 50 000 thousand recruits) a BH model with s= 0.85 would be a good alternative to the HS model. However, it is not possible to obtain consistent values of steepness from the given the available data.

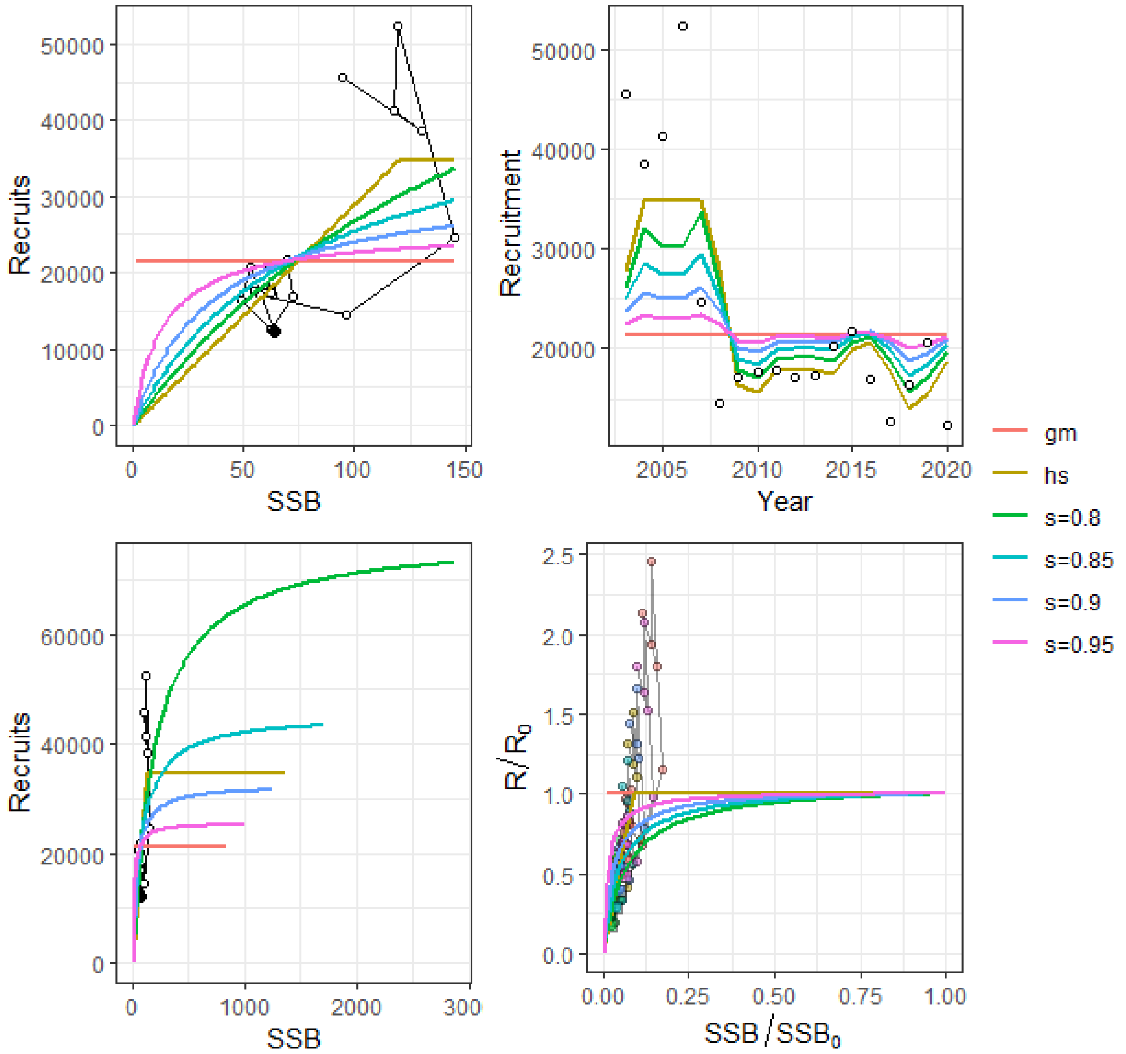

Figure 6.5.2.10: Blue and red shrimp in GSA01. Summary of candidate models based on BH model at four levels of steepness, with the GM and HS models of Fig. 6.5.2.8 for comparison.

Results

From the considerations made in the previous section, because the break point lies within the data, the HS model was selected to provide reference points for the blue and red shrimp in GSA01. Table 6.5.2.3 summaries the reference point values based Hockey-stick breakpoint for B_{Lim} and the asymptote R for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). Figure 6.5.2.11.shows the advice plot from the per-recruit analysis of blue and red shrimp in GSA01, with the equivalent Kobe plot in Figure 6.5.2.12. The figures show that according to the HS model the stock has been around Flim and B_{Lim} for the entire assessment period (2002-2020).

The implied dynamics are illustrated in Figure 6.5.2.13, and the historic assessment information is shown in this context in Figure 6.5.2.11 and Figure 6.5.2.12. In conclusion the stock is considered to be between B_{Lim} and $B_{F0.1}$ in 2020.

Table 6.5.2.3 Blue and red shrimp in GSA 1 . Final reference points based on Hockey-stick stock recruit model fitted to the data and the default B_{Lim} = $B_{F0.1}$/4.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	Fpa
0.29	120	240	529	1372	0.79

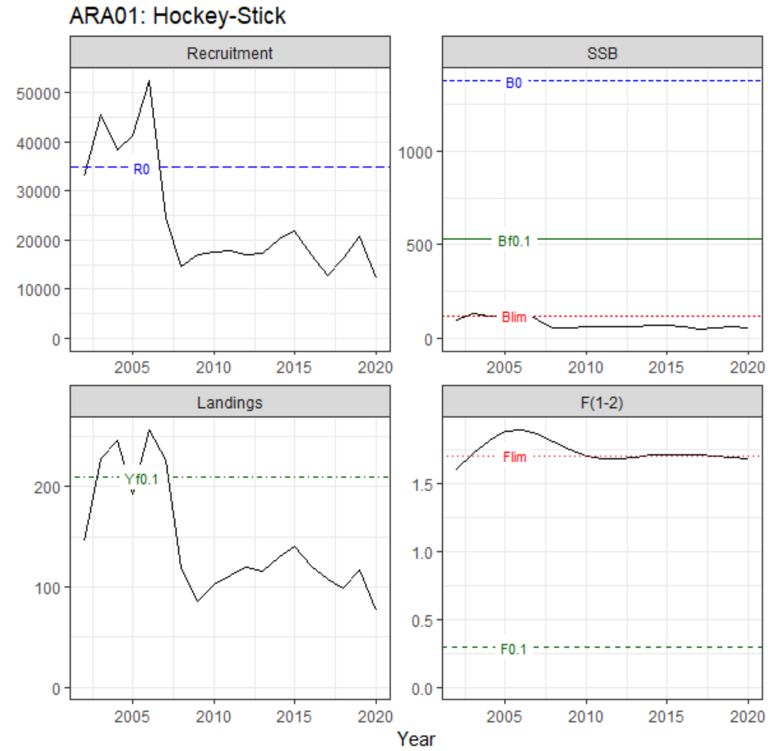

Figure 6.5.2.11: Blue and red shrimp in GSA01. Advice plot showing the trajectory of four stock assessment indicators along with the reference points estimated from a hockey-stick

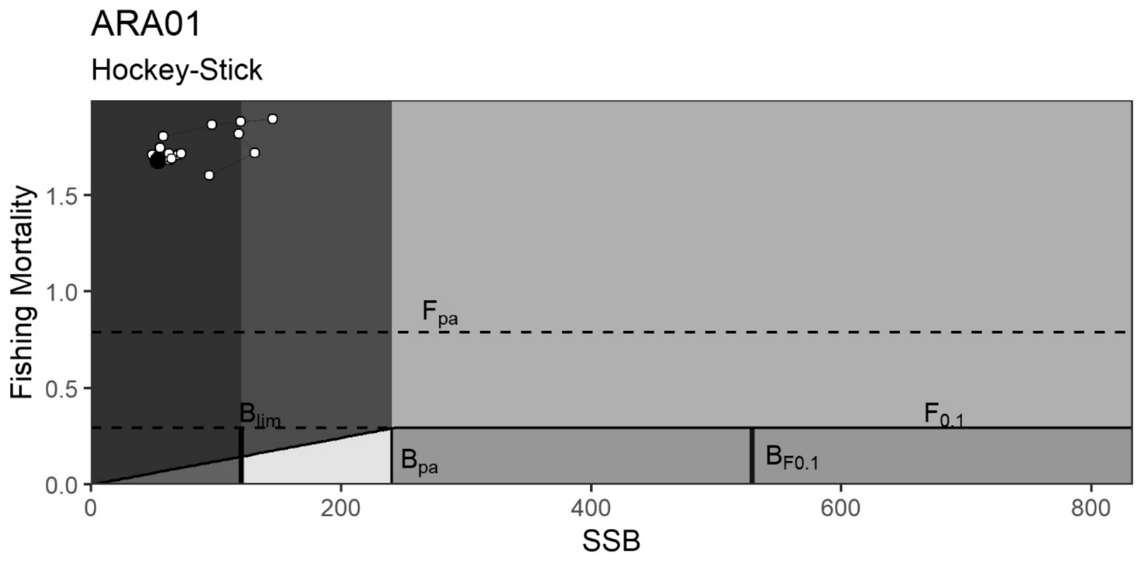

Figure 6.5.2.12: Blue and red shrimp in GSA01. Advice Rule plot: HS model with B_{Lim} fitted to the data and B_{pa} = 2*B_{Lim} .

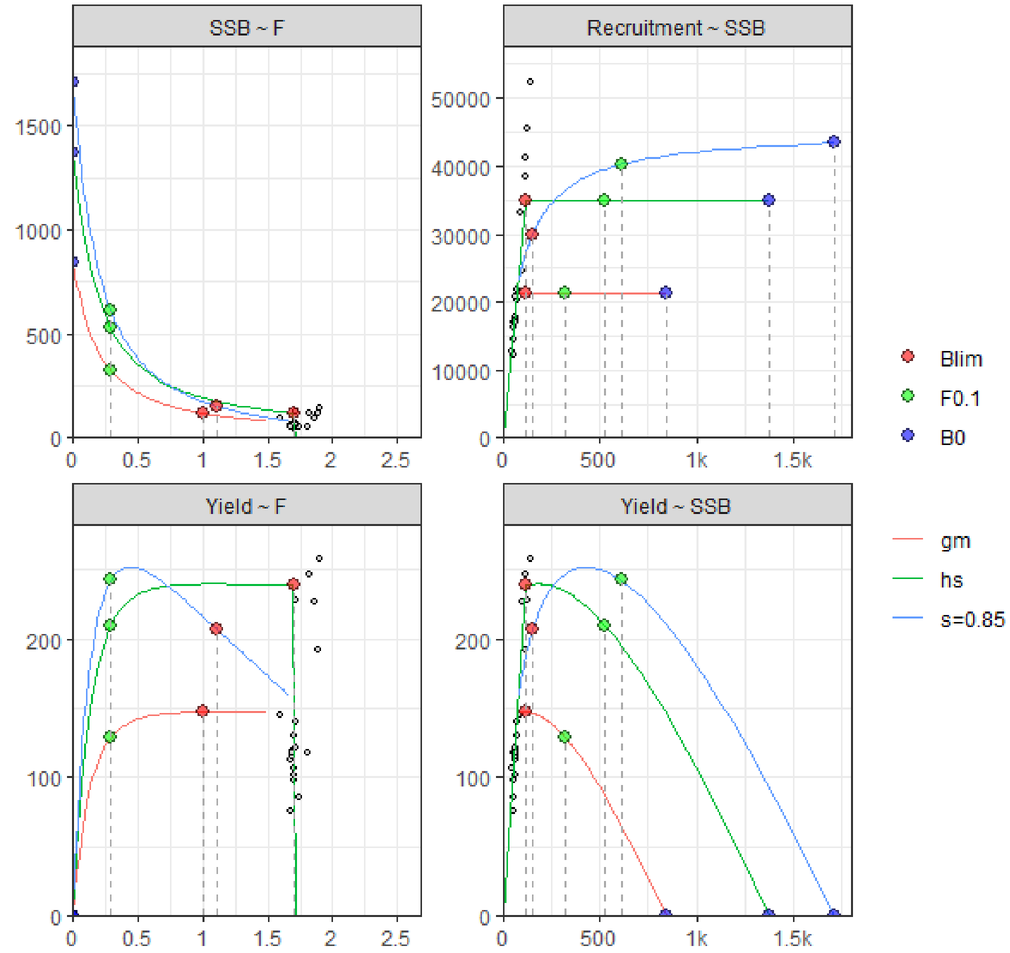

Figure 6.5.2.13: Blue and red shrimp in GSA01. Comparison of per-recruit analysis results produced with different models (gm: geometric mean, hs: hockey-stick, s=0.85: Beverton-Holt with steepness 0.85).

6.5.3 Blue and red shrimp *(ARA)* in *GSA06-07*

6.5.3.1 Stock assessment

The results of the STECF EWG 21-11 assessment for blue and red shrimp in GSA06-07 (Figure 6.5.3.1, two areas combined) for the years 2002-2020 are summarized in Figure 6.5.3.2, highlighting the indicators Rec (recruitment), SSB (spawning stock biomass, Catch (catches) and F (fishing mortality). It should be noted that catches in GSA07 are very low.

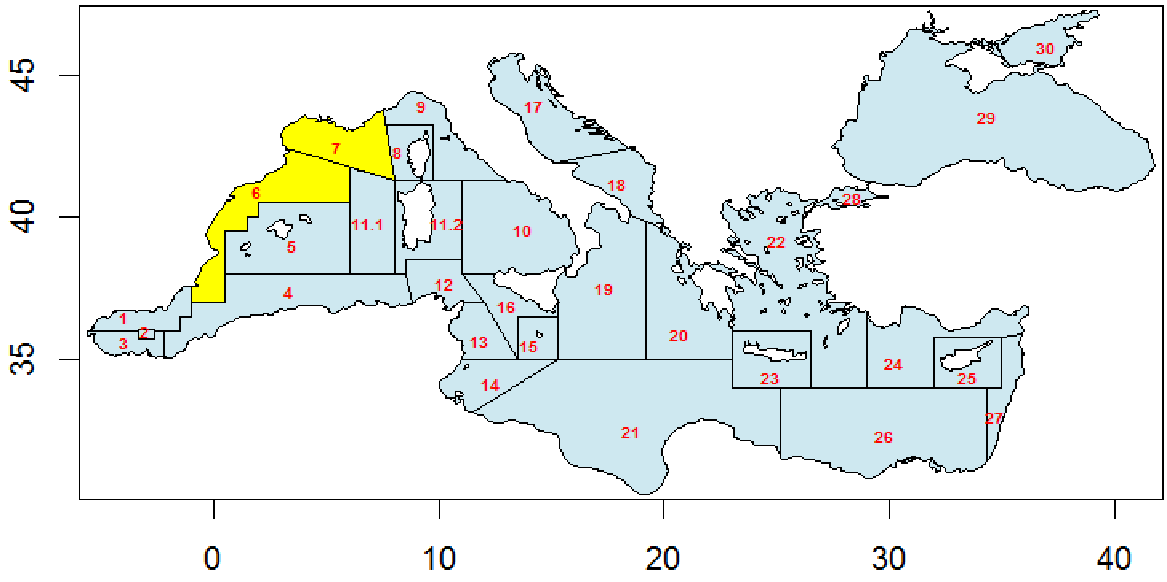

Figure 6.5.3.1: Blue and red shrimp in GSA 6&7. Geographical location of the stock.

The chart shows relatively low values for recruitment, SSB and catches in the first years of the series (below 500 t annually) which led us to suspect inconsistencies in the catch data series used in this assessment compared with the catch data series used in previous assessments of this stock. As illustration Figure 6.5.3.3 shows the catches reported in STECF 2015-11, the official landings in Catalonia (which produces around 70% of the total landings in GSAs 06 and 07) and the catches used in the EWG21-11 assessment. Due to the strong discrepancy for the first two years, the data series for SSB/R model estimations was subset to the period 2004-2020 (Figure 6.5.3.4).

Fishing mortality is high: current F for ages 1-2 was estimated at 1.23 in the last three years (2018-2020) and corresponds to 4.23 times the target fishing mortality F_{01}, estimated at 0.29.

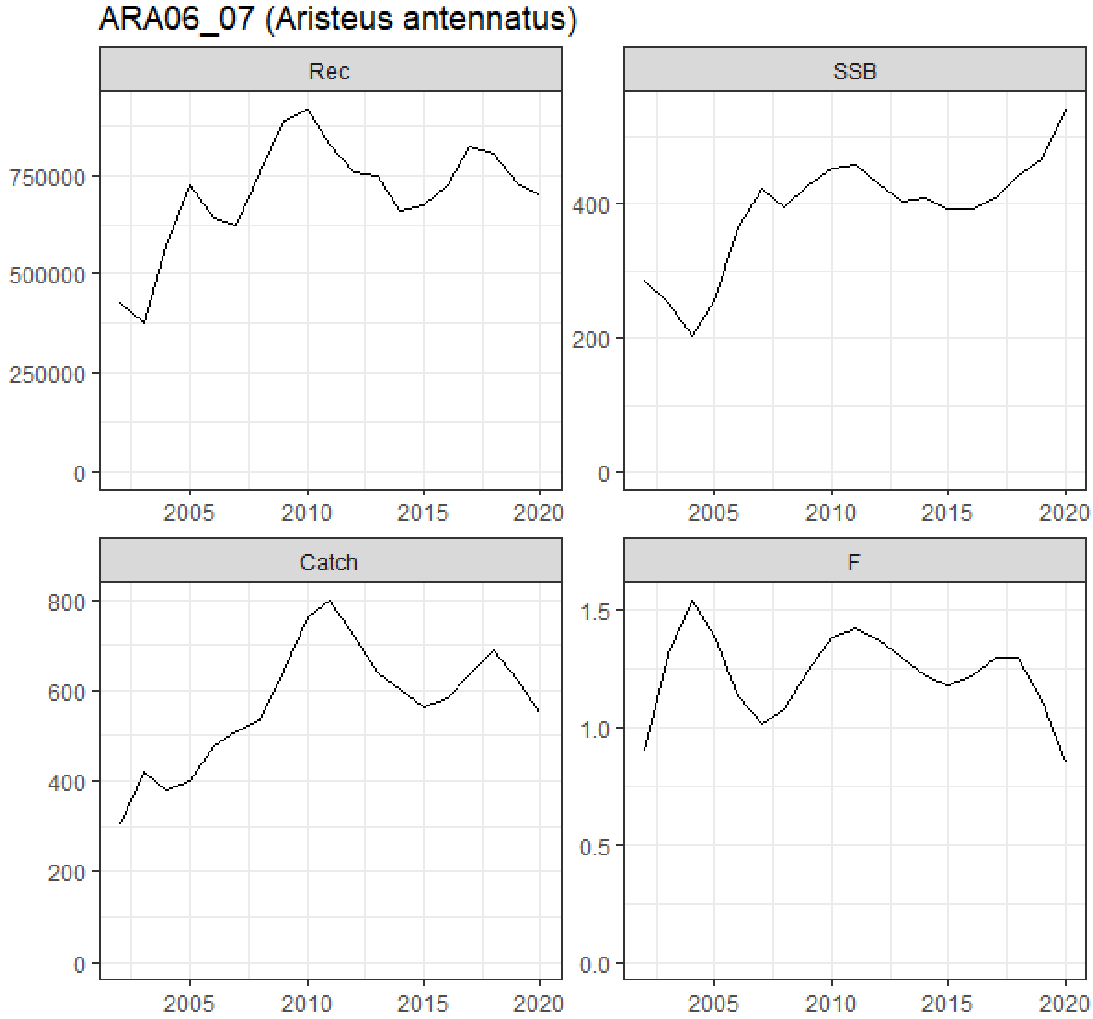

Figure 6.5.3.2: Blue and red shrimp (Aristeus antennatus “ARA”) in GSA01. Stock summary from the final a4a model produced in STECF EWG 21-11.

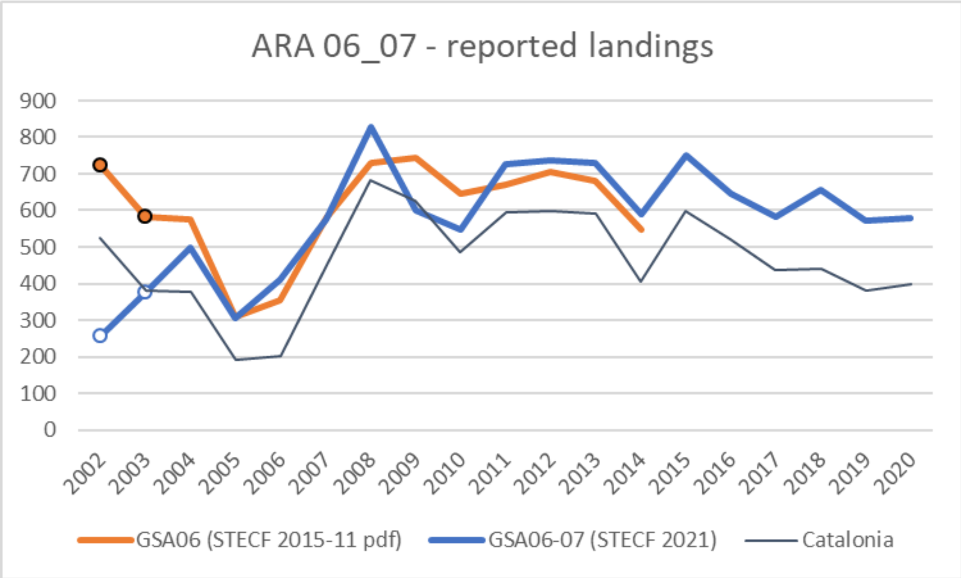

Figure 6.5.3.3: Blue and red shrimp in GSA0607. Comparison of landings reported in STECF 2015-11 (orange), STECF 2021 EWG 21-11 (blue) and in Catalonia (thin dark blue). The data series available to the STECF follow closely the landings for Catalonia, which represent

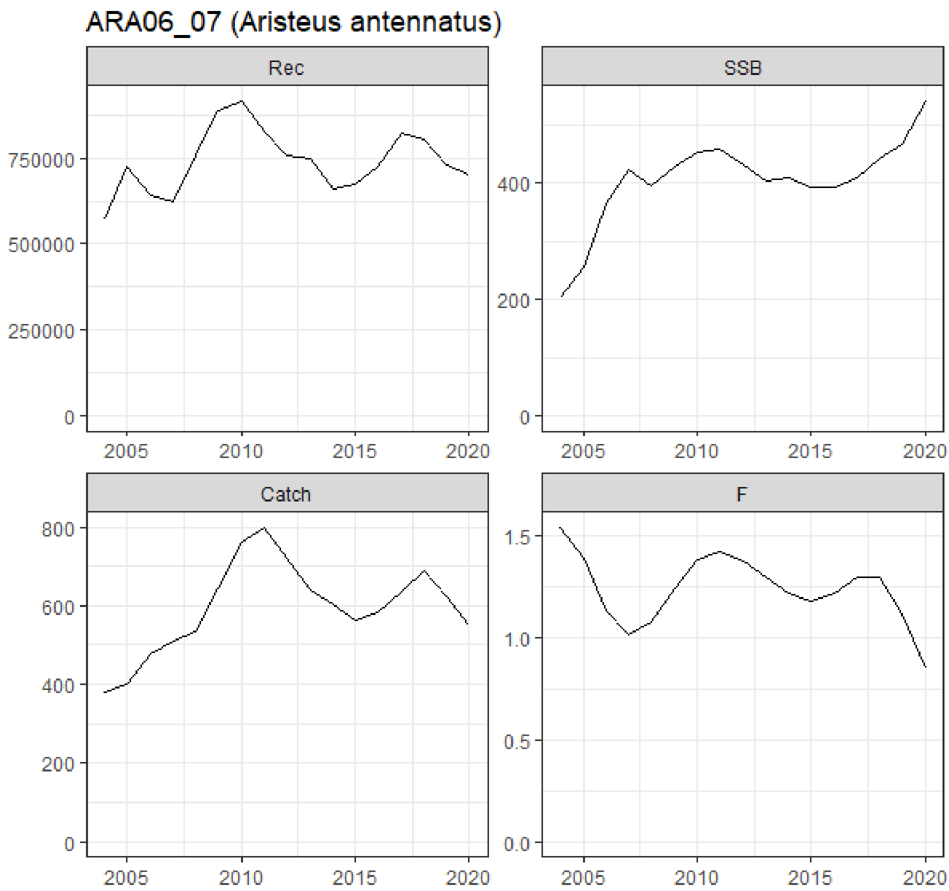

Figure 6.5.3.4: Blue and red shrimp (Aristeus antennatus "ARA") in GSA0607. Stock summary from the final a4a model produced in STECF EWG 21-11 excluding the years 2002 and 2003.

An overview of the biological data used in the assessment is shown in Figure 6.5.3.5-Figure 6.5.3.7. The charts show that the stock is composed of 6 age classes (the oldest age class being +), but most of the vulnerable population would be in ages 1 to 32. According to the biology of the species, age 1 would already contribute to SSB, with a maturity rate estimated at 0.75. Full selection to the fishery is estimated to take place from age 3 onwards.

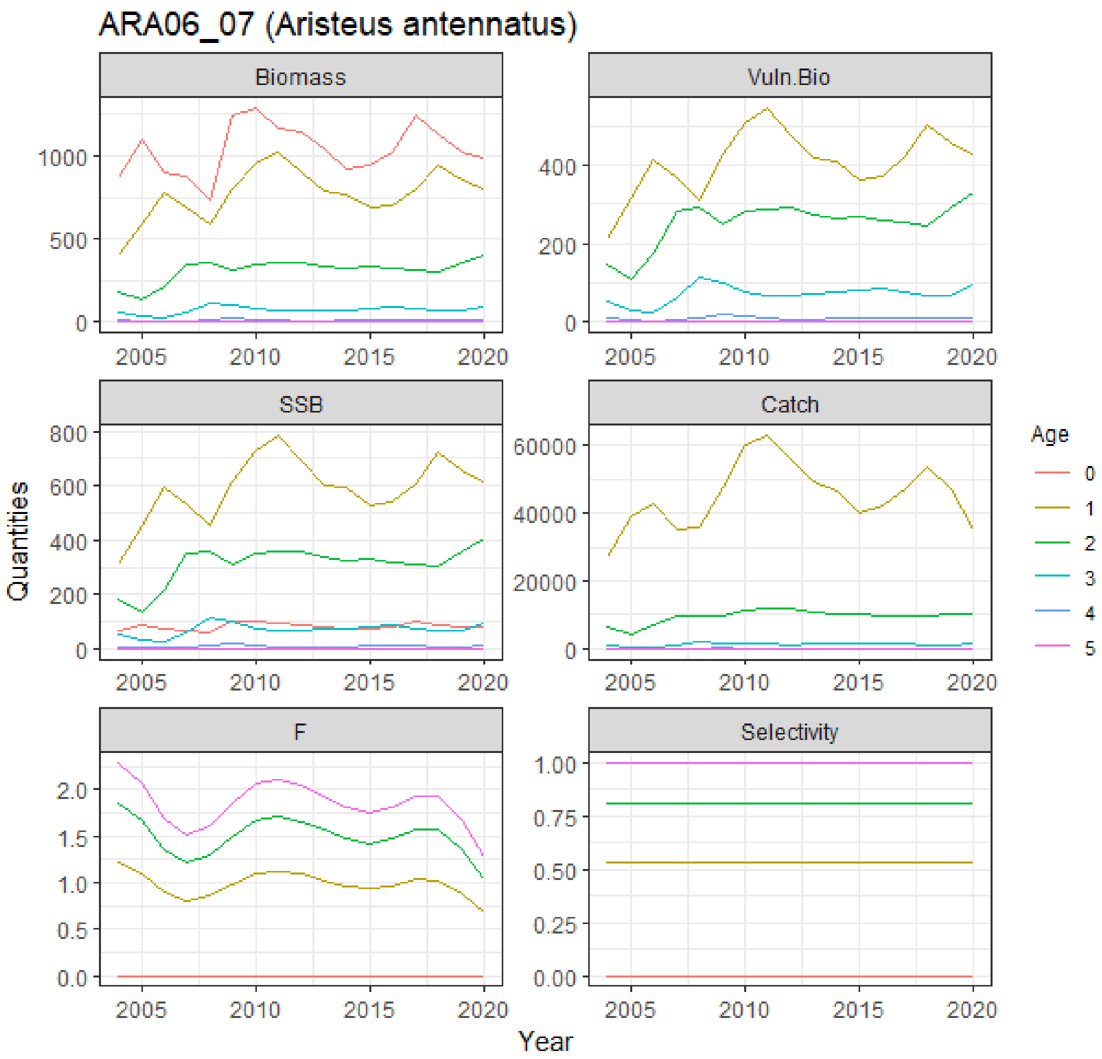

Figure 6.5.3.5: Blue and red shrimp in GSA0607. Stock assessment output trajectories of biological and exploitation indicators (continued).

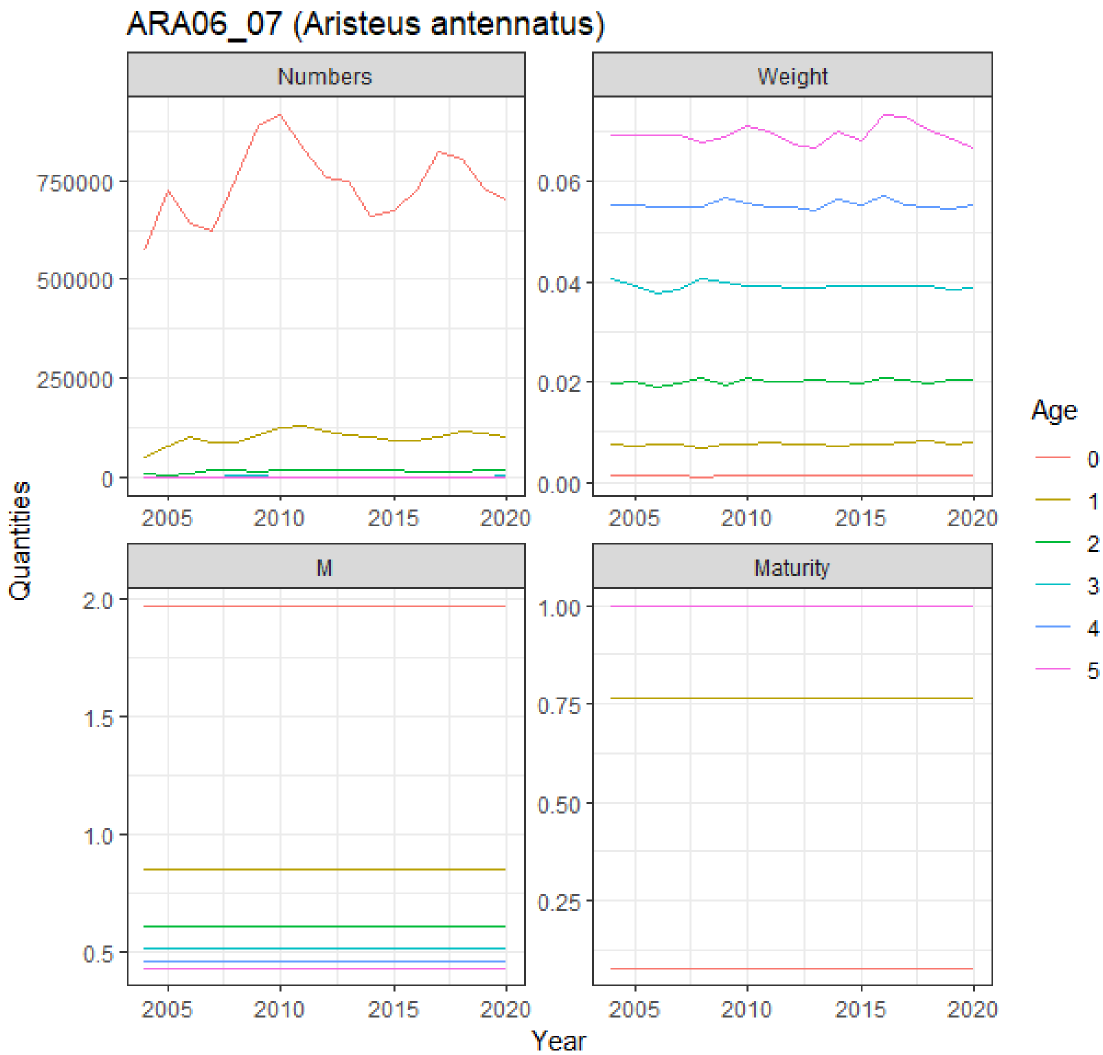

Figure 6.5.3.6: Blue and red shrimp in GSA0607. Stock assessment trajectories of biological and exploitation indicators. Numbers from the fitted assessment the other values from input data to the assessments.

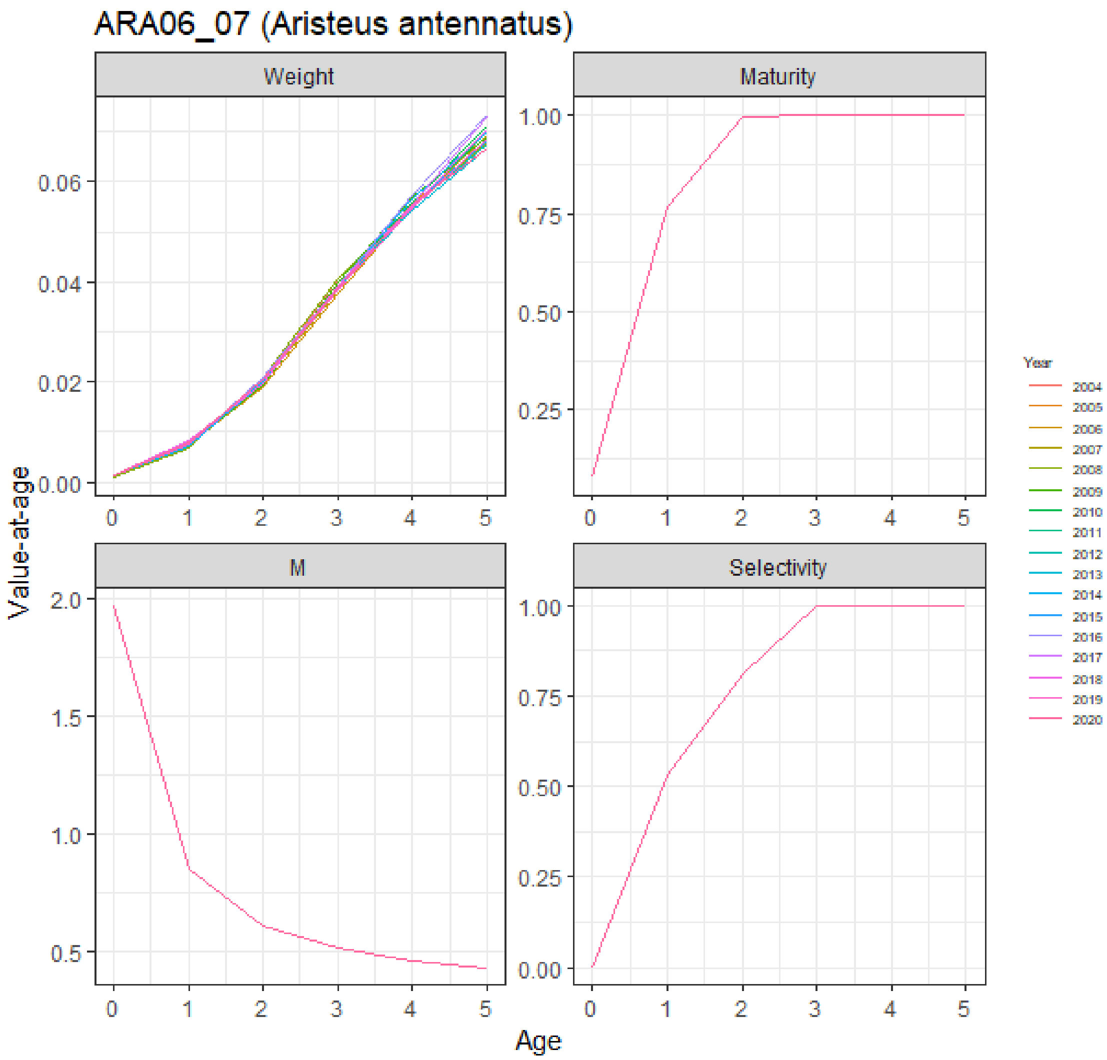

Figure 6.5.3.7: Blue and red shrimp in GSA0607. Stock quantities at age (constant in time for maturity, natural mortality M and Selectivity). Individual weights at age, fraction mature at age, natural mortality at age are input data and selectivity at age in the fishe

6.5.3.2 Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 with the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object excluding the first two years and are summarized in Table 6.5.3.2 and Figure 6.5.3.8. Note that current and all F since 2004 are near F_{lim} and that SSB is very low all along the data series and below B_{Lim} in the earlier years (Figure 6.5.3.9). The contribution by age class to spawning potential ratio (SPR) shows that the current population is heavily depleted for ages 2 and higher compared to an un-fished population (Figure 6.5.3.10).

Table 6.5.3.1: Blue and red shrimp in GSA0607.
Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.285805	0.002065	0.000519	1.373516	0.000778	0.005257

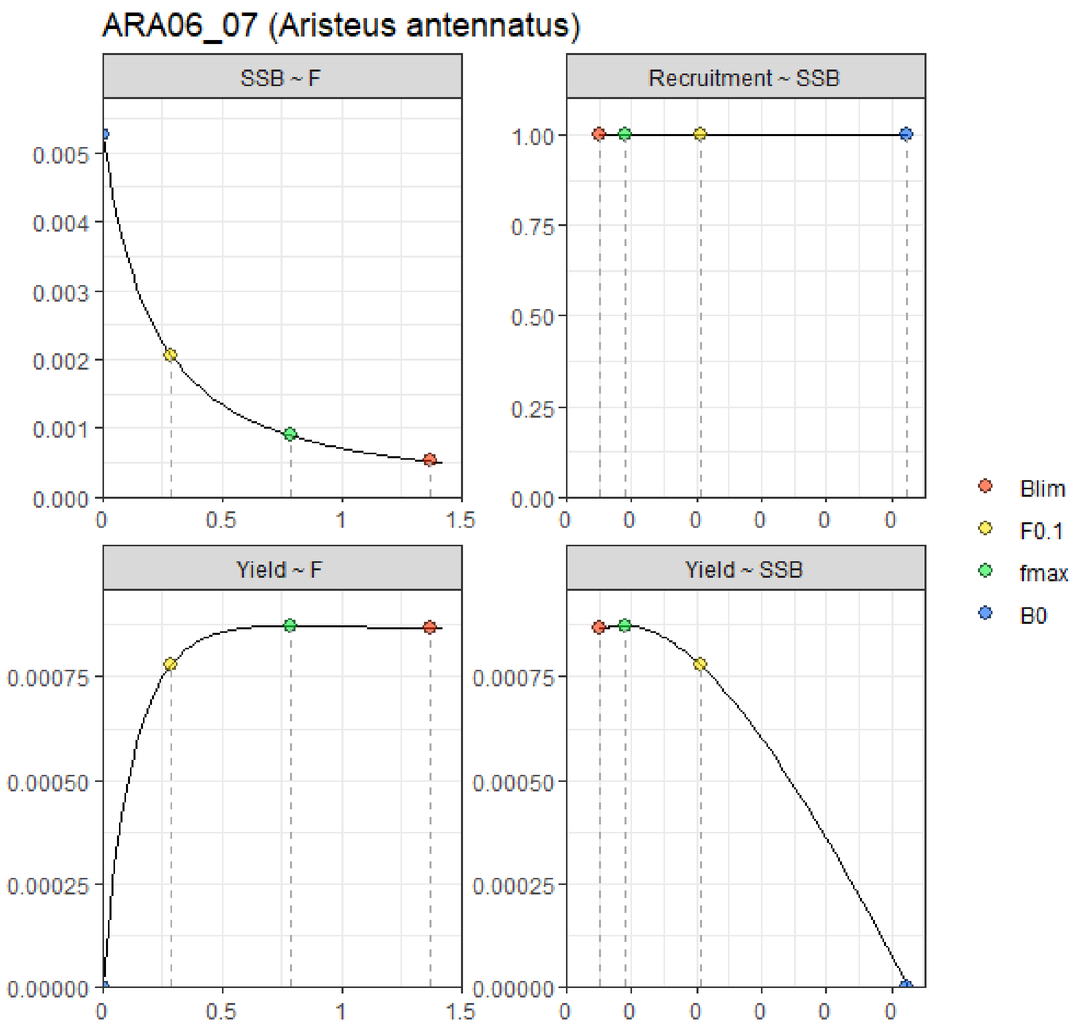

Figure 6.5.3.8: Blue and red shrimp in GSA00607. Per-recruit analysis.

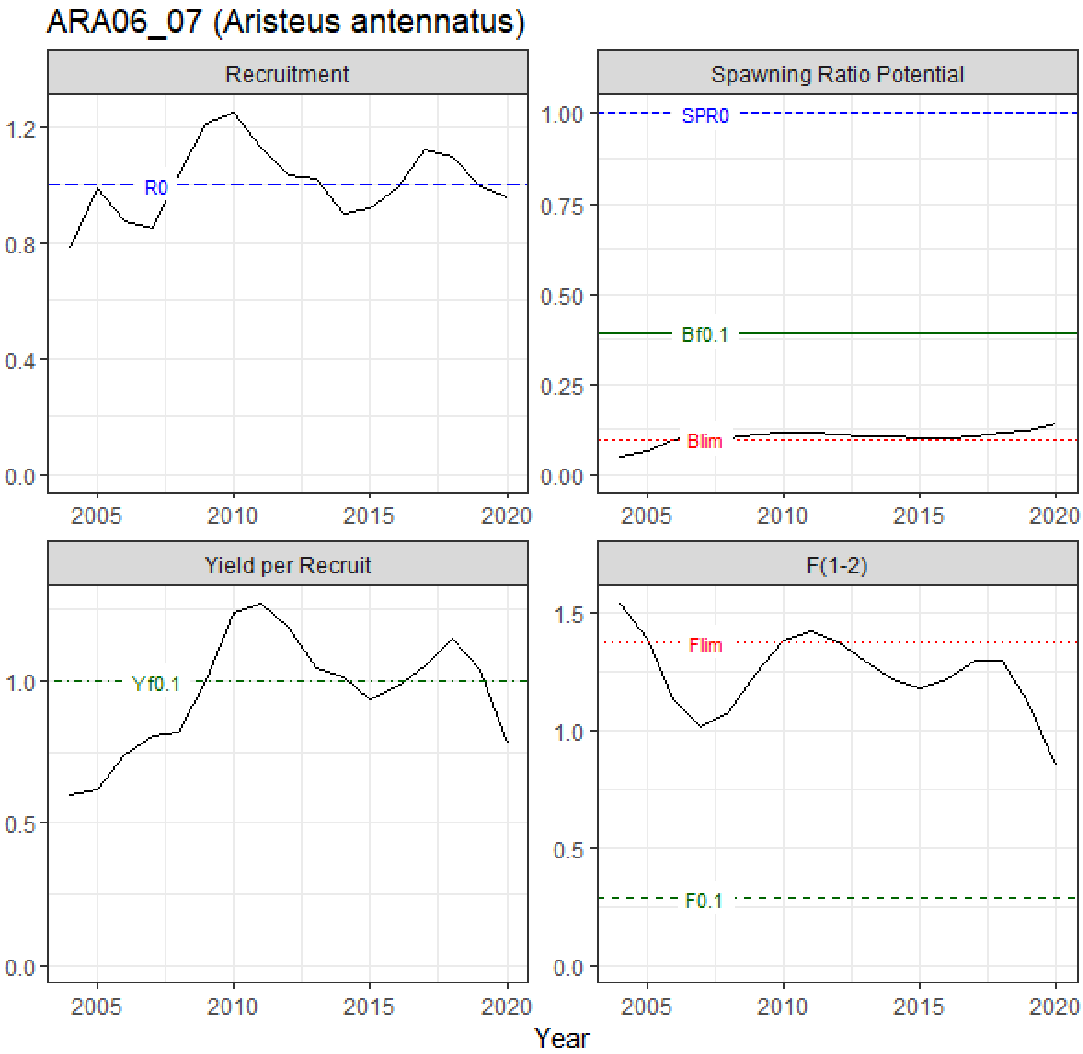

Figure 6.5.3.9: Blue and red shrimp in GSA0607. Indicators from the results of the a4a stock assessment in STECF EWG 21-11 compared with the per-recruit reference points.

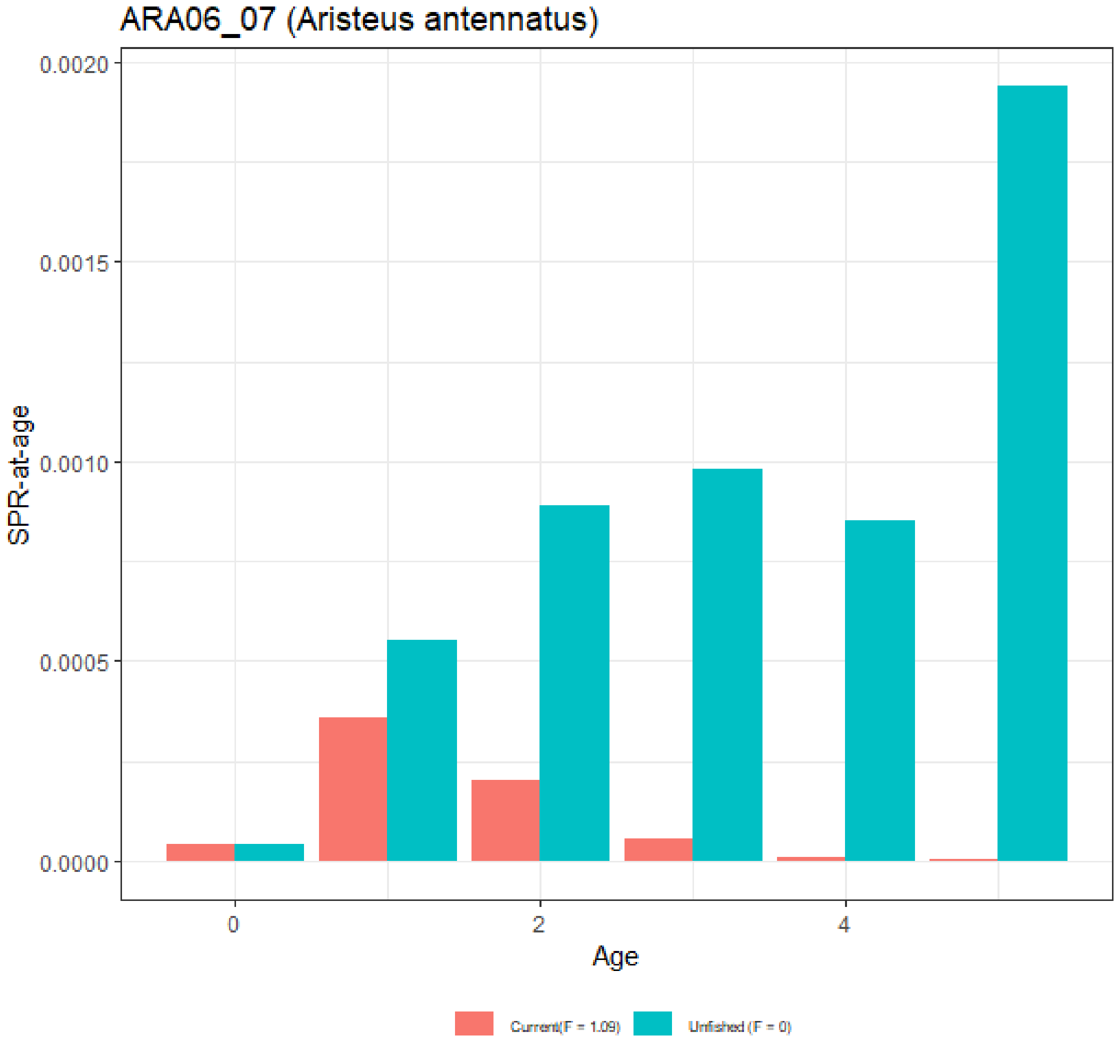

Figure 6.5.3.10: Blue and red shrimp in GSA0607. Spawning potential ratio by age class for the current (red bars) and a virgin population (blue bars).

Four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. GM: Geometric Mean (model=geomean)

2. HS: Hockey-Stick or segmented regression (model=segreg), estimated using lplim = 0.001 and uplim = 0.25, after several trials to test for sensitivity of the results to the specification of uplim (where *uplim* is the upper bound to the ratio SPR / SP R_0).

3. BH: Beverton-Holt (model=bevholtSV), with unconstrained estimation of steepness (s).

4. RI: Ricker (model=ricker), with unconstrained estimation of steepness (s).

Table 6.5.3.2: Blue and red shrimp in GSA0607. Summary of four S/R candidate models.

	s	sigmaR	R_0	rho	B_0
gm2@SV		0.1246	733,698	0.5485	3856.8
hs2@SV		0.1039	746,490	0.5776	3924.1
bh2@SV	0.9156	0.1049	930,968	0.4069	4893.8
ri2@SV	1.6441	0.1401	573,899	0.4489	3016.8

The estimates of the four candidate models did not differ strongly for R_0 and B_0. The value of R_0 for the HS model was found to be slightly higher than the geometric mean recruitment, and the breakpoint fits within the data. Inclusion of the first two years with uncertain catch gives very similar results in terms of biomass, but the breakpoint in the HS is slightly higher at 360 tonnes compared to 263 with the first two points omitted. The estimate of R_0 produced by the BH model was 40% higher than the value obtained with the GM or HS models. The steepness estimated for this BH model was 0.92, leading to the highest estimates of R_0 and B_0. BH models with lower s values were also explored (next section). The RI model was not further considered because i) it is unlikely, on biological grounds, that blue and red shrimp stocks show density-dependence of R at high values of SSB, ii) the series of SSB and R available allow to examine only the initial part of the SSB/R relationship for this stock, with no information on the right side of the curve (Figure 6.5.3.11).

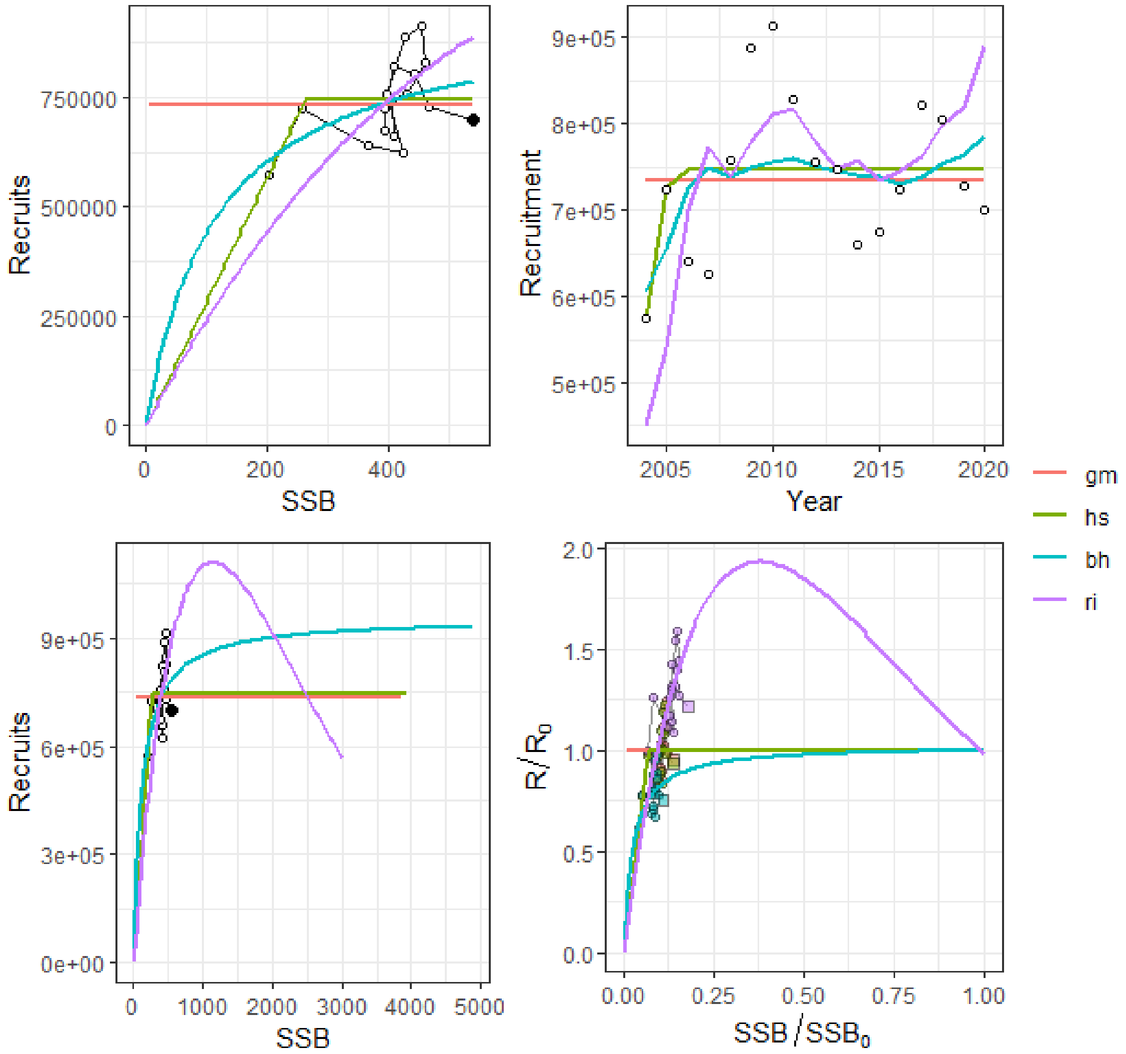

Figure 6.5.3.11: Blue and red shrimp in GSA0607. Summary of four candidate S/R models, gm: geometric mean; hs: hockey-stick; bh: Beverton and Holt; ri: Ricker.

Figure 6.5.3.12 shows the results of the sensitivity analysis of the BH model to a range of steepness values from s=0.8 to s=0.95. These results show that increasing s helps bring down R_0 and B_0 to levels compatible with the HS model estimates. Considering the highest values of R ever observed in the study period (ca. 900 000 thousand recruits) a BH model with s= 0.90 would be a good alternative to the HS model (recall that the unconstrained estimate of s was 0.92). However, it is not possible to obtain consistent values of steepness from the given the available data.

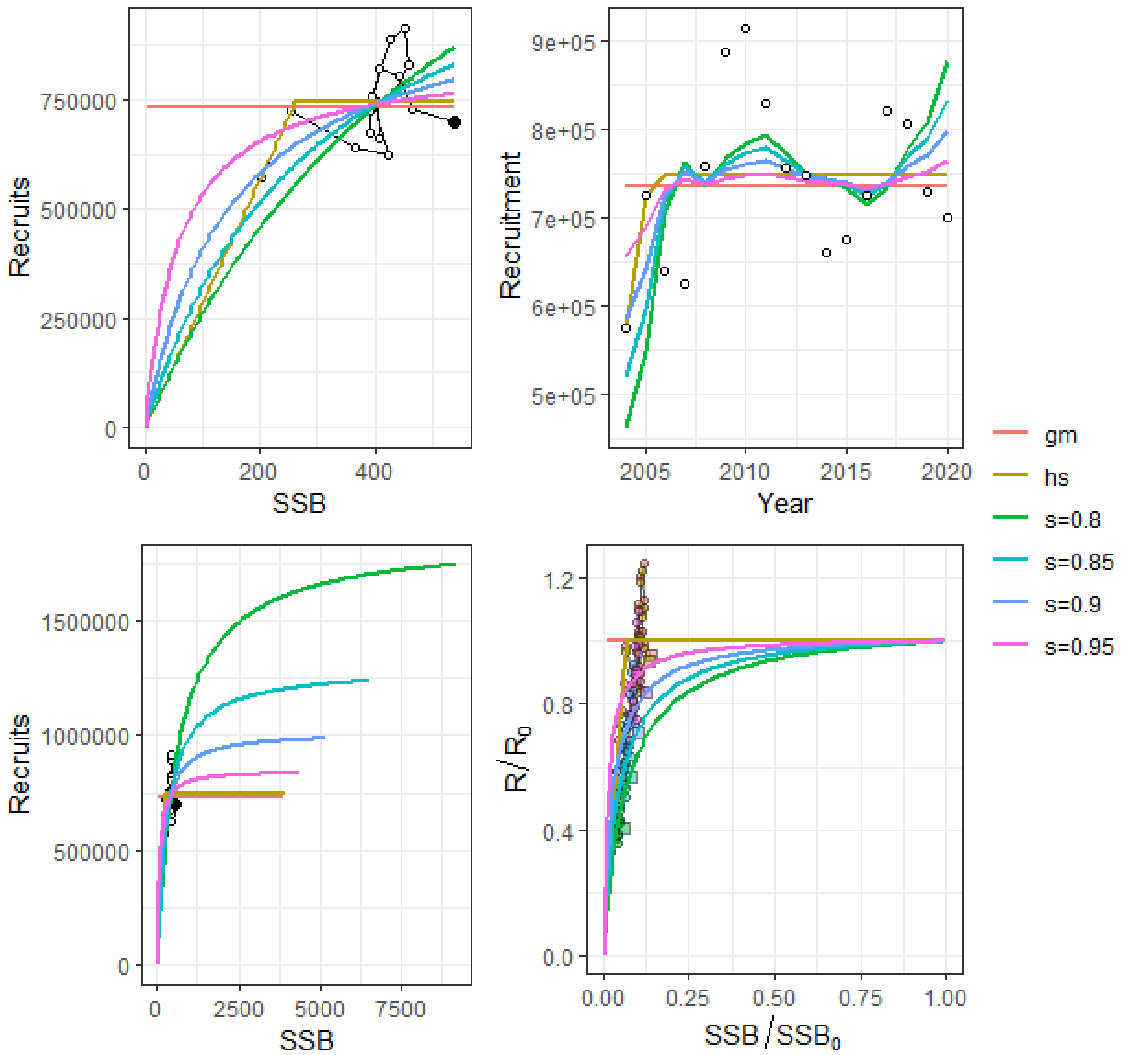

Figure 6.5.3.12: Blue and red shrimp in GSA0607. Summary of candidate models based on BH model at four levels of steepness, with the GM and HS models of Fig. 6.5.3.10 for comparison.

6.5.3.3 Results

From the considerations made in the previous section, as the break point lies within the data the HS model was selected to provide reference points for the blue and red shrimp in GSA0607 (Table 6.5.3.3). B_{pa} was set to 2*B_{Lim} (See Section 4.2). Figure 6.5.3.13 shows the advice plot from the per-recruit analysis of blue and red shrimp in GSA0607, with the equivalent Kobe plot in Figure 6.5.3.14. The figures show that according to the HS model the stock, except for the years 2004-2005, has been above B_{Lim} and between Flim and F01 for the study period.

Table 6.5.3.3: Blue and red shrimp in GSA0607. Reference points for a Hockey-Stick model fitted to the STECF EWG 21-11 assessment results for the period 2004-2020 with B_{pa} based on 2 B_{Lim}.

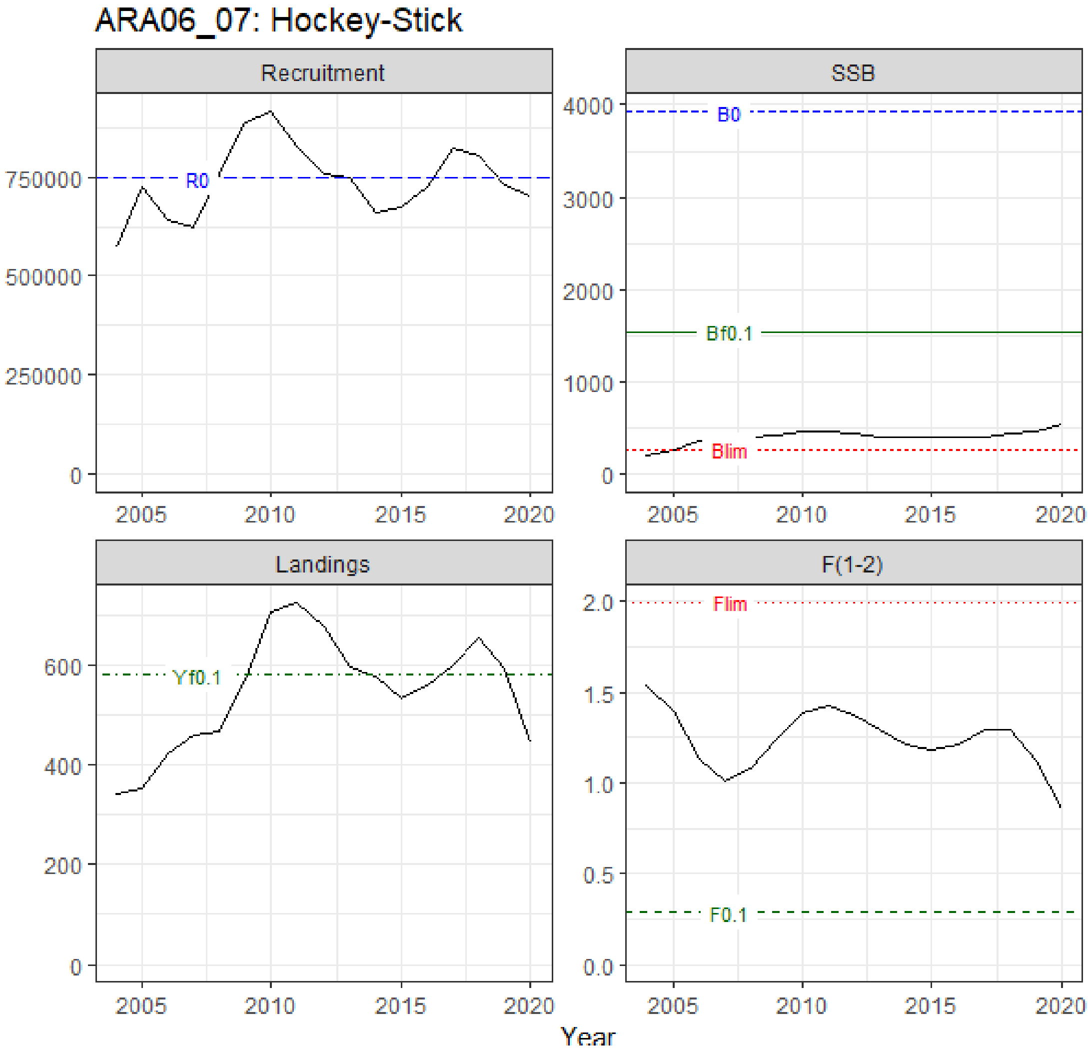

Figure 6.5.3.13: Blue and red shrimp in GSA01. Advice plot showing the trajectory of four stock assessment indicators along with the reference points estimated from a hockey-stick model.

F0.1	BLim	Bpa	BF0.1	B0	Fpa
0.29	263	526	1540	3924	1.01

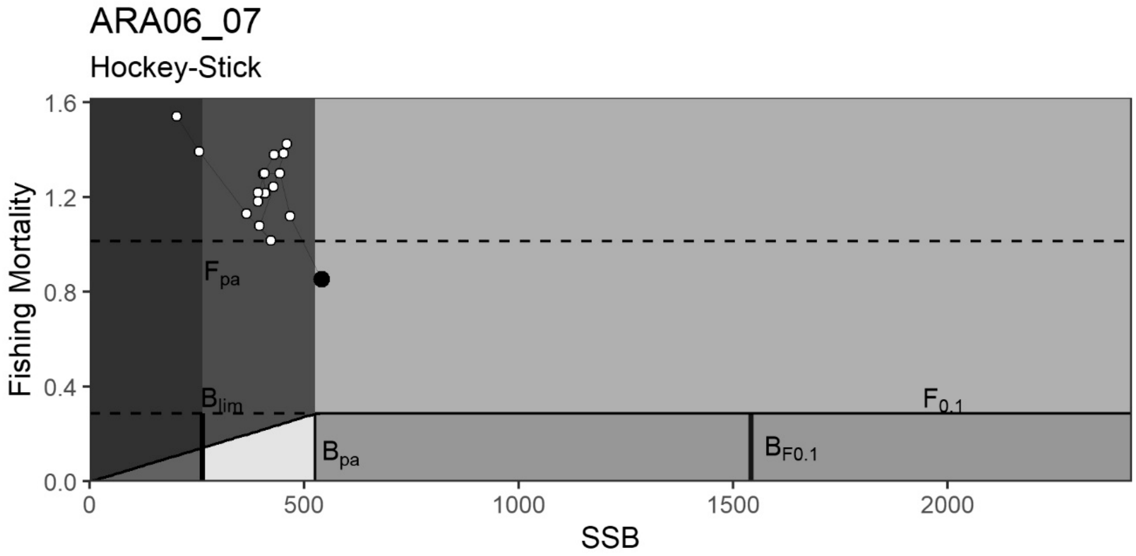

Figure 6.5.3.14: Blue and red shrimp in GSA0607. Advice Rule plot: HS model with B_{Lim} fitted to the data and B_{pa} = 2*B_{Lim}

6.5.3.4 Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling the future behaviour of the stock. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above are illustrated in Figure 6.5.3.12. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.90 (Figure 6.5.3.15).

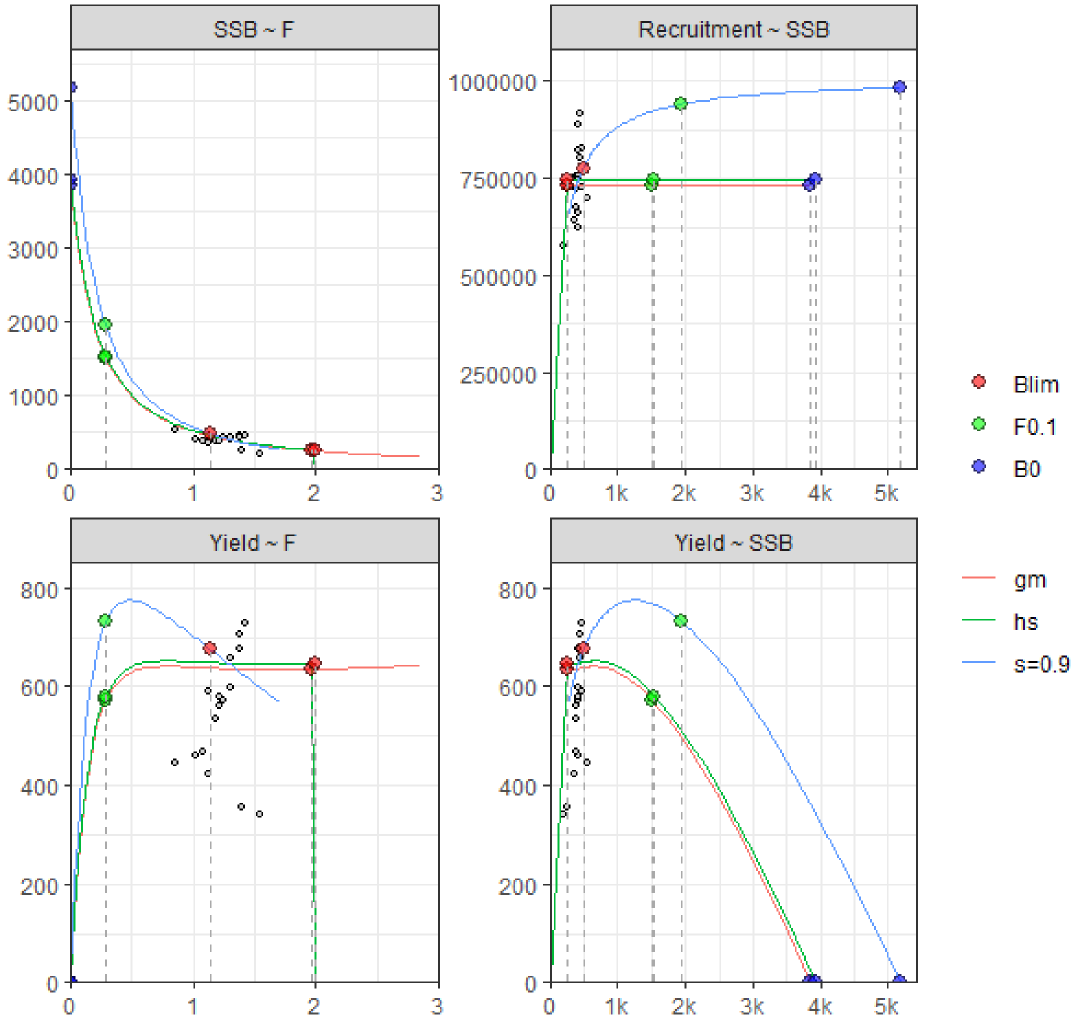

Figure 6.5.3.15: Blue and red shrimp in GSA0607. Comparison of Equilibrium yield results produced with different models (gm: geometric mean, hs: hockey-stick, s=0.90: Beverton-Holt with steepness 0.85).

6.5.4 Blue and red shrimp *(ARA)* in *GSA05*

The stock assessment of Blue and red shrimp in GSA05 was attempted in STECF EWG 21-11 but did not yield satisfactory results. This section is an exercise to evaluate whether data series from the assessed stocks ARA01 and ARA0607, together with the local MEDITS index for the stock, can be an alternative to provide information comparable to reference points for this unassessed stock.

The landings data series for the three stocks are shown in Figure 6.5.4.1. The behaviour of the landings of the three stocks is quite different, although higher landings in GSA01 and GSA05 are appreciated before 2010 in their respective areas, while the GSA0607 stock became more productive after 2010-

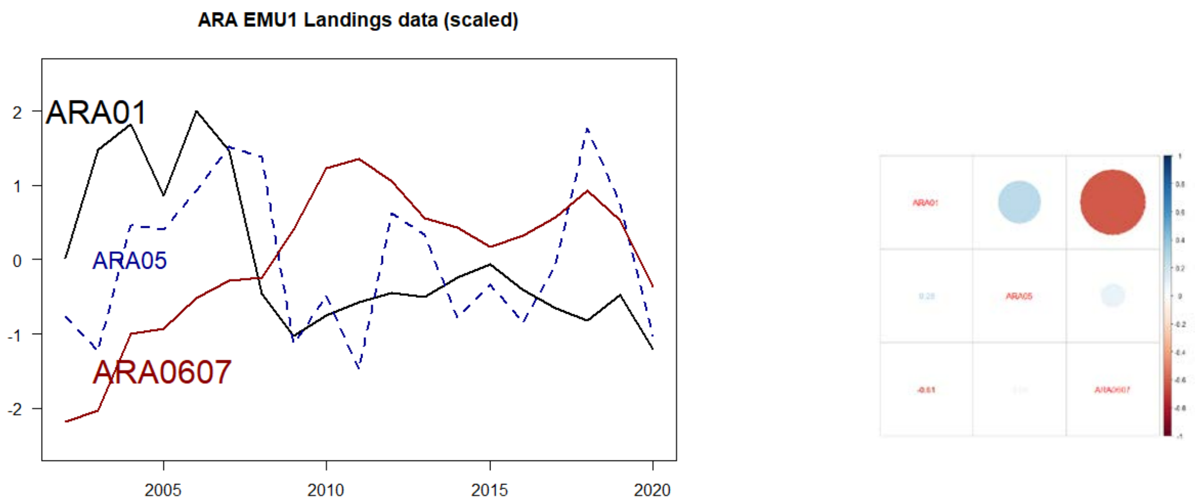

Figure 6.5.4.1: Blue and red shrimp in GSA05. Landings of the GSA05 stock (dashed blue lines) compared to the landings of the GSA01 (black) and GA0607 (red) stocks (scaled data). Right panel: pairwise correlation coefficient between the three series. Note high and negative correlation.

The evolution of the MEDITS indices is shown in Figure 6.5.4.2. The series for stocks GSA01 and GSA0607 show relatively higher values before 2010, typically between 1 and 3 kg/km2 (with a very high value of 12 kg/km2 in 2000 for the GSA01 stock). After 2010 the indices for the GSA01 and GSA0607 never exceed 2 kg/km2. The MEDITS index data series started in 2007 for the GSA05 stock and oscillated from values of 2 to 5 kg/km2 in the period, always higher than in the GSA01 and GSA0607 stocks.

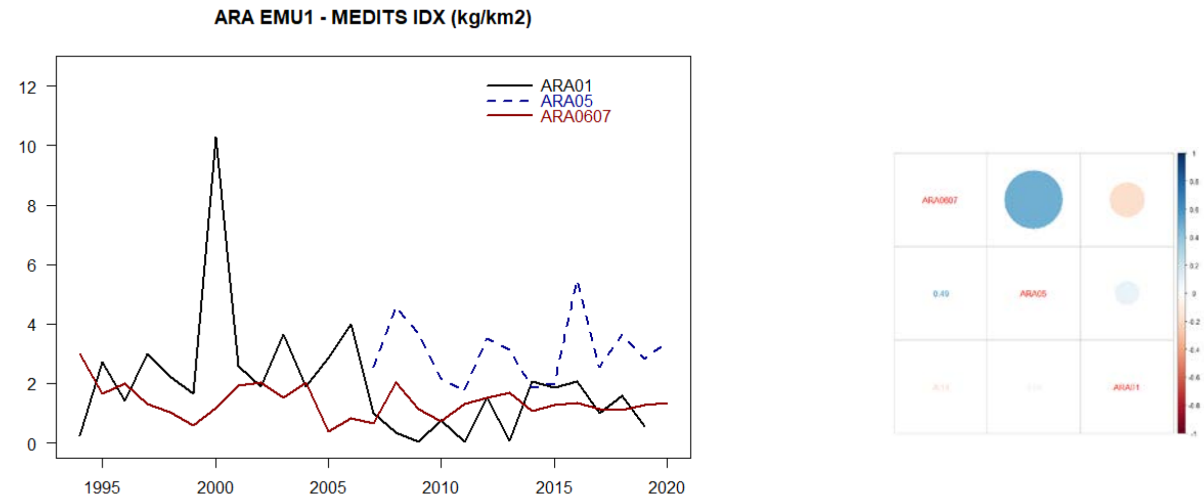

Figure 6.5.4.2: Blue and red shrimp in GSA05. MEDITS index for the GSA05 stock (dashed blue lines, starting in 2007) compared with the indices for the GSA01 (black) and GA0607 (red) stocks (kg/km2). Right panel: pairwise correlation coefficient between the three series

The ratio of Catches to biomass index, taken as "harvest rate", shows fluctuating values for all three GSAs without clear trend. In GSA01 note 3 very high and unlikely values for the years 2009, 2011 and 2013 due to the very low biomass index values in those years. On the other hand, the values for GSA01 and GSA05 vary from year to year around 50 to 100, typically, while in GSA06-07 they are about 10 times higher.

Table 6.5.4.1: Catches and biomass index for the three blue and red shrimp stocks considered to derive the ratio "harvest rate".

	CATCHES (t)			MEDITS INDEX (kg/km2)			"harvest rate"		
	GSA01	GSA05	GSA06-07	GSA01	GSA05	GSA06-07	GSA01	GSA05	GSA06-07
2002	145	142	723	1.89		2.03	76.96		355.78
2003	228	122	583	3.66		1.52	62.25		383.07
2004	247	194	577	1.89		2.04	130.77		282.33
2005	192	192	306	2.87		0.39	66.99		790.42
2006	257	214	412	3.98		0.81	64.52		506.49
2007	226	239	575	1.00	2.54	0.65	226.70	94.04	891.37
2008	118	233	827	0.34	4.57	2.02	348.41	50.95	409.69
2009	86	126	600	0.04	3.67	1.14	2436.04	34.38	524.78
2010	102	153	547	0.77	2.18	0.72	132.92	70.33	763.43
2011	112	111	726	0.03	1.76	1.30	3368.47	63.09	556.86
2012	119	201	736	1.52	3.52	1.51	78.00	57.13	486.42
2013	116	189	731	0.06	3.12	1.69	2047.50	60.38	432.89
2014	130	141	591	2.08	1.87	1.06	62.73	75.41	555.41
2015	141	160	750	1.85	2.00	1.29	75.96	80.04	581.22
2016	121	138	647	2.05	5.49	1.34	59.14	25.18	480.87
2017	107	171	581	1.01	2.56	1.13	105.83	67.02	512.06
2018	98	250	656	1.59	3.64	1.11	61.63	68.68	590.67
2019	118	206	571	0.56	2.82	1.29	211.26	72.96	442.35
2020	76	131	577		3.40	1.34		38.49	431.36

It is unclear what can be concluded from this evaluation, although biomass from MEDITS for GSA 5 is higher and harvest rate proxy from GSA 5 is lower than those for GSA 1 and GSA 6-7 which might be considered an indication that biomass was higher and exploitation lower, the comparison of these variables with the assessments and state of stock given above in Section 6.3.2 and 6.3.4 questions the utility of these values in determining the status of blue and red shrimp in GSA 5. Overall it seems likely more work is required, see Section 3.

6.6 Giant Red Shrimp

6.6.1 Giant red shrimp (ARS) in GSA091011

6.6.1.1 Stock assessment

The assessment of giant red shrimp, *Aristaeomorpha foliacea*, carried out during the STECF EWG 21-11 considered the stock shared by the GSAs 9, 10 and 11. No information from GSA 8 was included in the assessment (Figure 6.6.1.1).

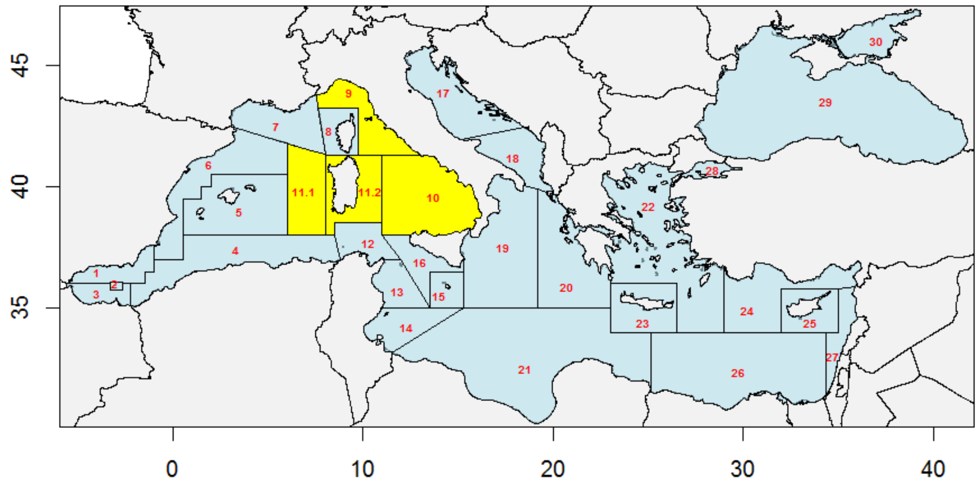

Figure 6.6.1.1: Giant red shrimp in GSAs 9, 10 and 11. Limit of Geographical Sub-Areas (GSAs) 9, 10, 11.

The assessment was performed using catch-at-age data from commercial fisheries in the period 2005-2020, tuned with the index-at-age data from the MEDITS survey in GSAs 9, 10 and 11 (2005-2020). The assessment was performed with SCAA using a4a. The outputs of the assessment done at EWG 21-11 are summarized in Figure 6.6.1.2.

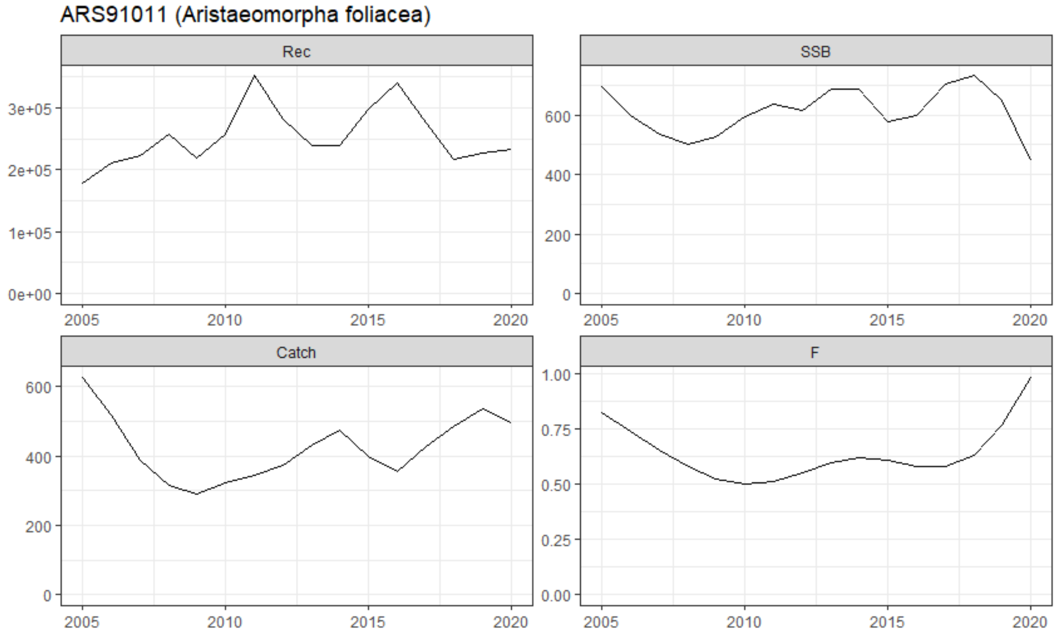

Figure 6.6.1.2: Giant red shrimp in GSAs 9, 10 and 11. Stock summary from the final a4a model.

An overview of the input data used in the assessment and outcomes is provided in Figure 6.6.1.3 - Figure 6.6.1.5

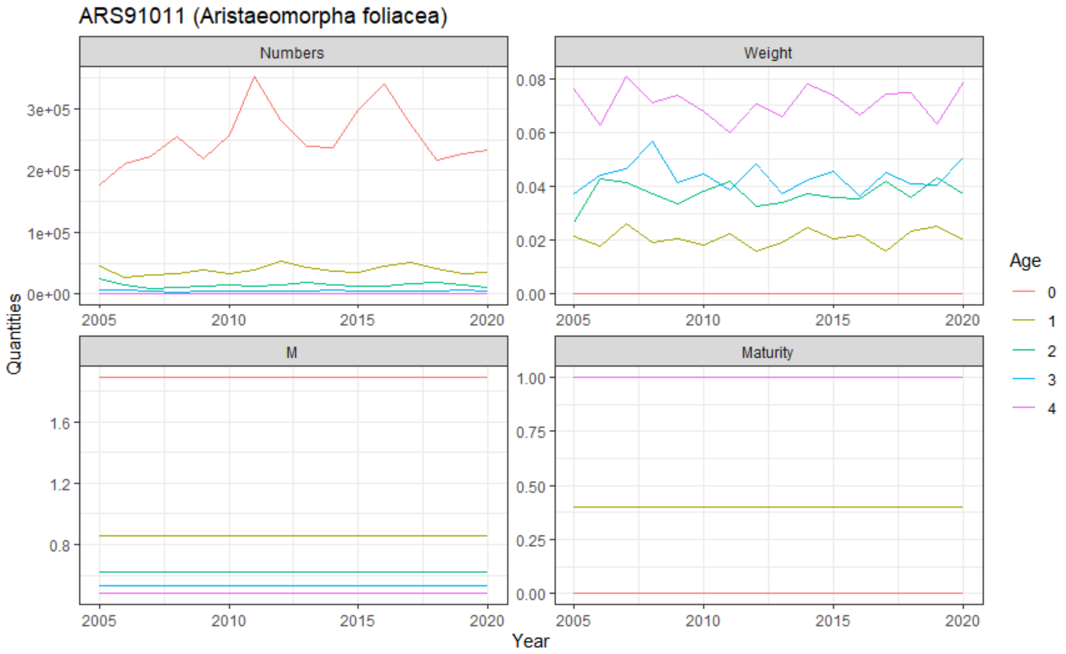

Figure 6.6.1.3: Giant red shrimp in GSAs 9, 10 and 11. Stock biology trajectories at age. Numbers from the fitted assessment the other values from input data to the assessment.

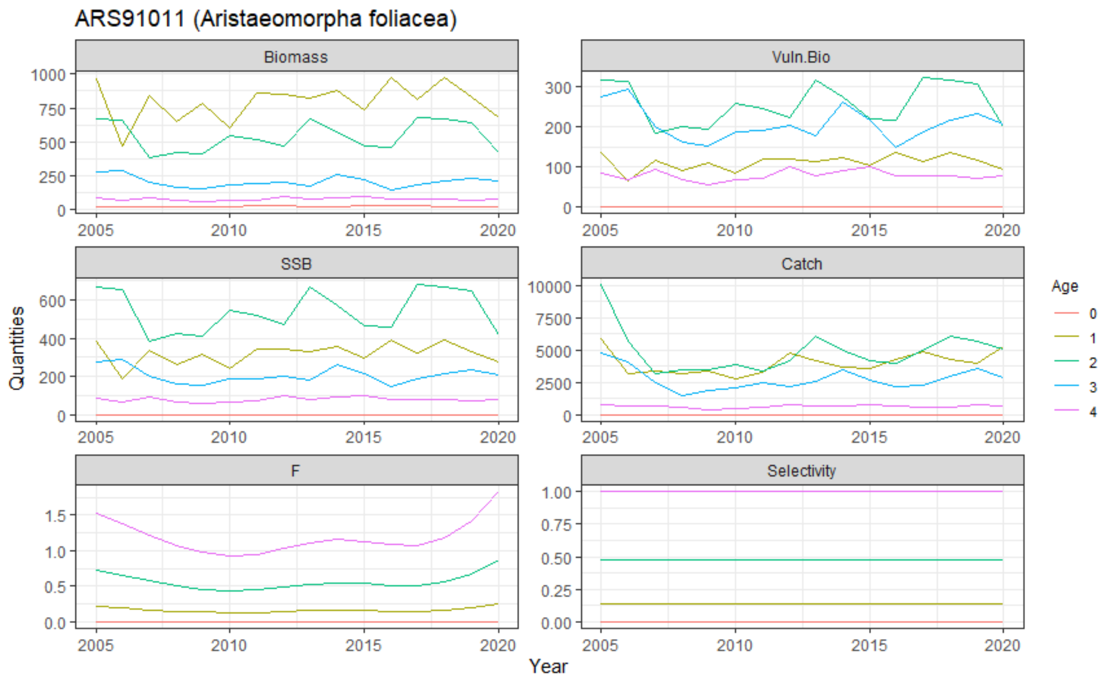

Figure 6.6.1.4: Giant red shrimp in GSAs 9, 10 and 11. Stock assessment trajectories at age estimates from the model.

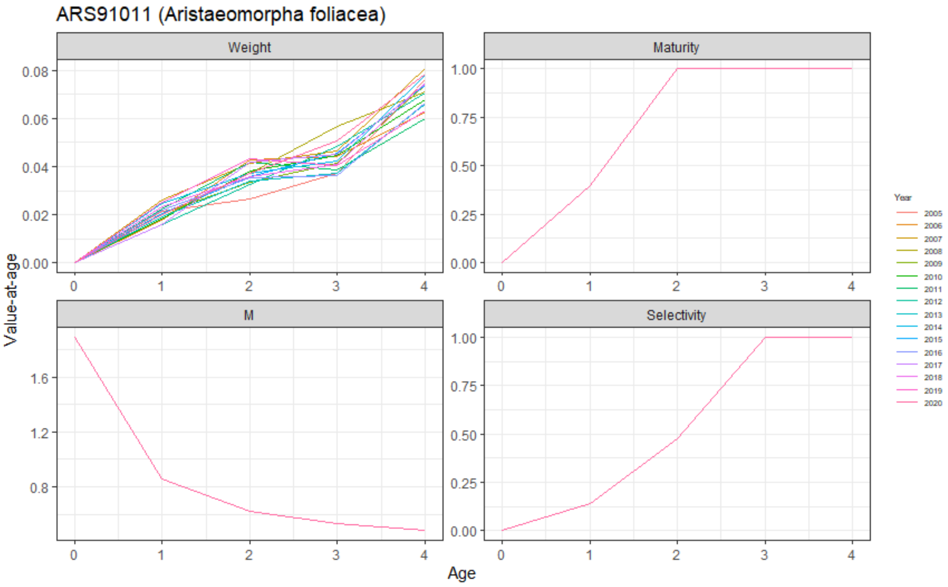

Figure 6.6.1.5: Giant red shrimp in GSAs 9, 10 and 11. Annual stock quantities at age; Individual weights at age, fraction mature at age, natural mortality at age are input data, and selectivity at age in the fishery is estimated in the model.

Exploratory analysis

An exploratory per-recruit analysis was performed using the stock object produced by EWG 21-11 containing the results of the a4a assessment. The per-recruit reference points of interest were computed from the stock object and are summarized in Table 6.6.1.1 and Figure 6.6.1.6.

Table 6.6.1.1: Giant red shrimp in GSAs 9, 10 and 11. Per-recruit reference points.

$F_{0.1}$	$B_{F0.1}$	B_{Lim}	Flim	Yeq	B_0
0.46	0.00286	0.00104	2.30	0.00147	0.00689

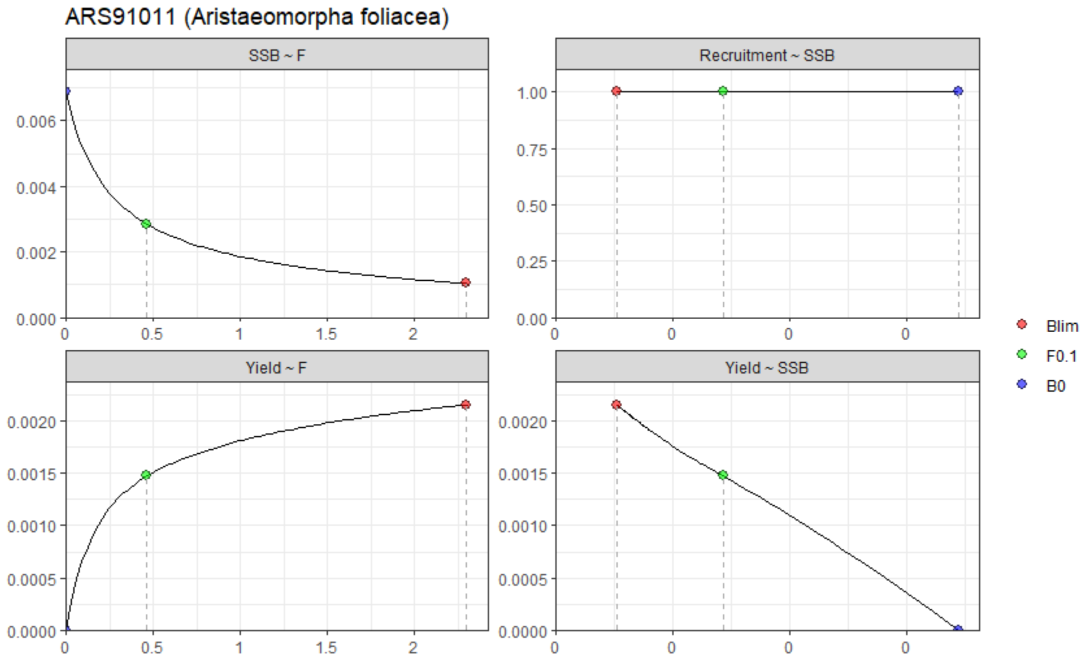

Figure 6.6.1.6: Giant red shrimp in GSAs 9, 10 and 11. Per-recruit analysis.

Figure 6.6.1.8 is showing the trajectories of the assessment outputs against the per-recruit reference points. SSB has been fluctuating slightly below the biomass at $F_{0.1}$ ($B_{F0.1}$) and well above B_{Lim}, with a sharper decrease in the last years. At the same time, F has been slightly above $F_{0.1}$, though increasing in the last years.

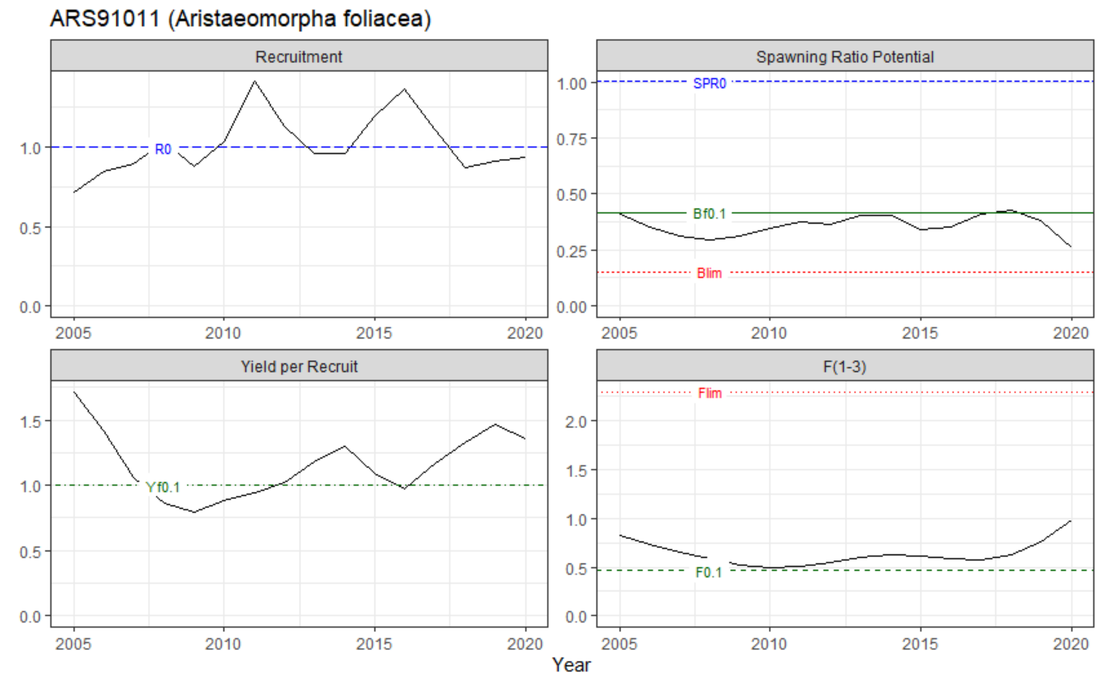

Figure 6.6.1.8: Giant red shrimp in GSAs 9, 10 and 11. Per-recruit analysis: outcomes of the a4a assessment compared against the per-recruit reference points.

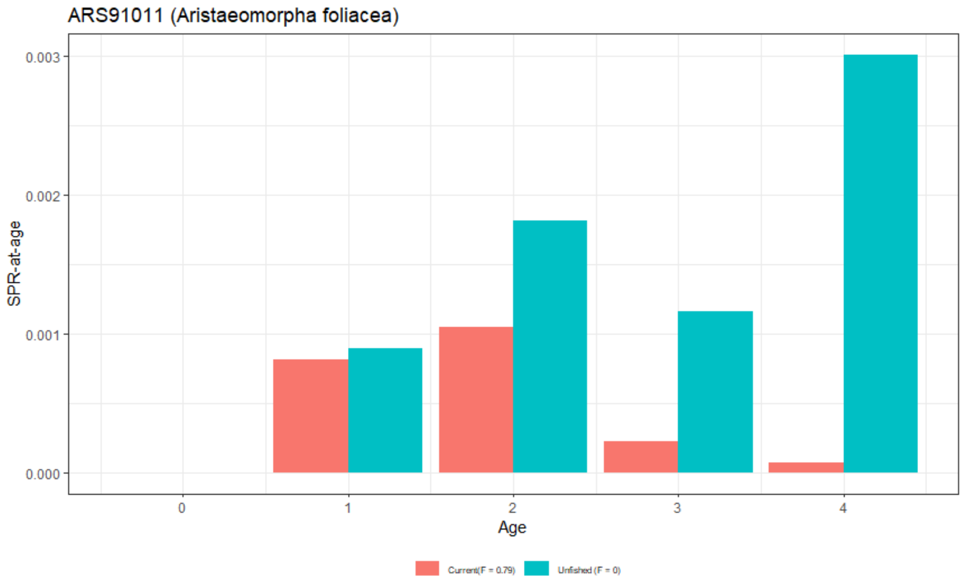

Figure 6.6.1.7: Giant red shrimp in GSAs 9, 10 and 11. Comparison of the spawning biomass per recruit SPRF at current F (average of last 3 years) and SPR0 with F = 0.

Figure 6.6.1.7 shows the contribution in terms of spawning biomass per recruit (SPR) by age class in the current situation (red bars) compared to an un-fished scenario.

Initially four recruitment functions were explored, using the function ssrTMB in the package FLSRTMB:

1. Geometric Mean (model=geomean)
2. Hockey-Stick (model=segreg)
3. Beverton-Holt (model=bevholtSV)
4. Ricker (model=ricker)

The Hockey-Stick was constrained to search for solutions of the break-point so that it falls within a lower bound (lplim) and upper bound (uplim) of spawning ration potential SRPlim = SPRlim/SPR_0. The initial bounds were chosen to be fairly unconstrained for a range of SRPlim = SRP0.1−20% by setting lplim=0.001 and uplim=0.2. In the initial fits of the Beverton-Holt and Ricker models steepness s and R_0 were estimated given the input SPR_0y. The Beverton-Holt model was run on the stock object with the full time series (2005-2020), and with reduced time series (BH1 up to 2019, and BH2 up to 2018) to check for consistency in the steepness.Available length frequencies of chub mackerel (MAS) landings are shown in Figure 5.8.1.4

Table 6.6.1.2: Giant red shrimp in GSAs 9, 10 and 11. Summary of the four SR models.

	s	sigmaR	R_0	rho	B_0
Geometric mean	NA	0.1789557	248799.2	0.4725757	1713.155
Hockey-stick	NA	0.1732731	248799.1	0.4725757	1713.155
Beverton-Holt	0.935	0.1731233	256828.1	0.4599154	1768.44
BH1 (data up to 2019)	0.976	0.1781299	252624.5	0.4567107	1716.563
BH2 (data up to 2018)	0.971	0.1824464	255026.3	0.4274348	1692.496
Ricker	0.903	0.1832236	205333.5	0.4094069	1413.863

The observed SR data are sitting on the right part of the R-SSB plot, and the breakpoint estimated by the HS model is lower that the observed values.

The results show that the recruitment variation fairly low, e.g. $\sigma r = 0.25$ for the Beverton-Holt model, associated with a steepness of s = 0.935. The predicted recruitment by Hockey-Stick, Beverton-Holt and Ricker models follow the observed recruitment pattern over time, however, the three models differ largely in scale of their R_0 and B_0 estimates. Information on the slope to the origin is not found within the observed SSB Recruitment results from the assessment.

The break-point of the Hockey-Stick is estimated at b = 178 t, and the corresponding R_0 is equal to the one estimated by the geometric mean recruitment. The breakpoint from the Hockey-Stick comes from the control setting 25% $B_{F0.1}$ and is not informed by the data.

Figure 6.6.1.10 shows the results of the sensitivity analysis to alternative fixed steepness values of s = 0.55 – 0.95 for the Beverton-Holt model explored. The results show that increasing steepness to 0.9-0.95 substantially decreases the R_0 and B_0 estimates to a scale that is comparable to the Hockey-Stick estimates. It is not possible to obtain consistent values of steepness from the given available data.

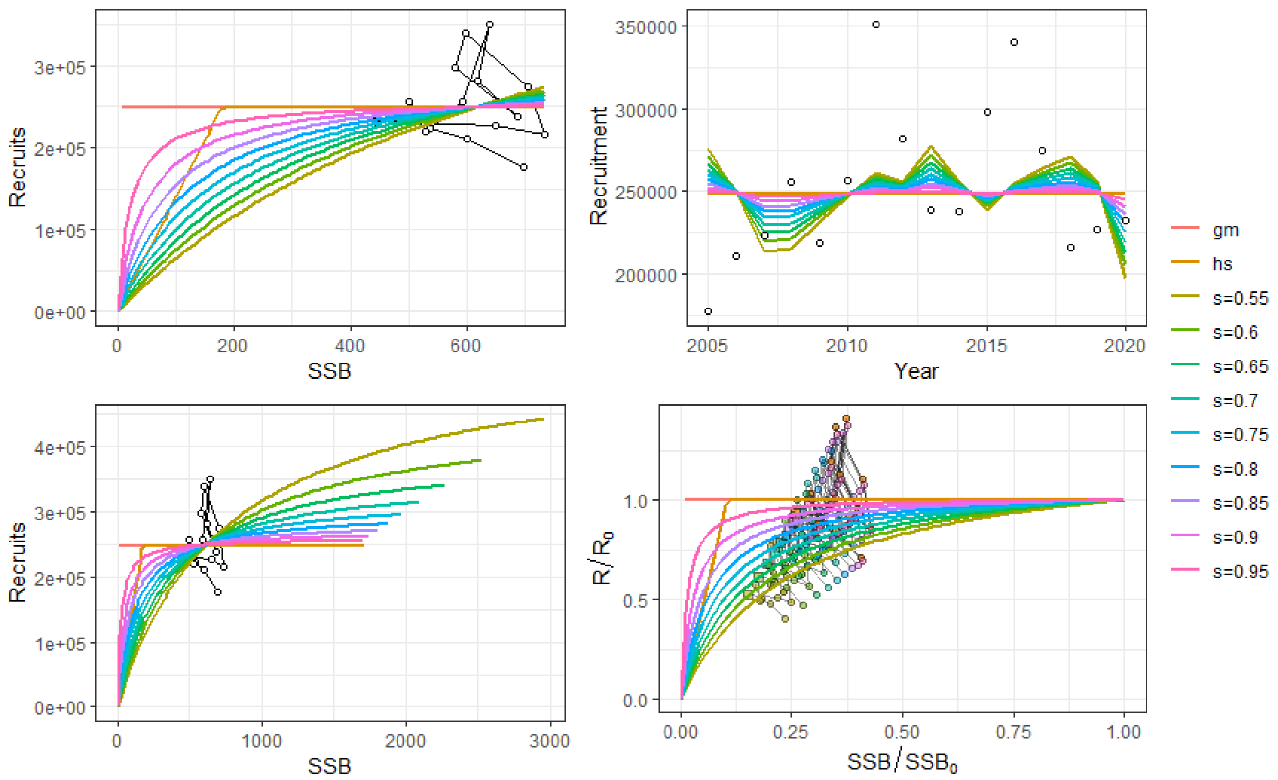

Figure 6.6.1.10: Giant red shrimp in GSAs 9, 10 and 11. Equilibrium yield with GM, HS and BH models with different slope (s, steepness) scenarios for the BH model.

An investigation of the available historical landings was performed to evaluate whether the results of stock recruit models are in compatible with the past production of the stock. The historical landings were gathered from the Italian national official statistics (ISTAT) as collected and stored in the RECFISH project (Ligas, 2019). Landings for red shrimps (combining both giant red shrimp and blue and red shrimp) were available from 1972 to 1999. Historical landings (by GSA and total) are summarized in Figure 6.6.1.11 and are compared to the EU DCF time series of landings of giant red shrimps in GSAs 9-10-11 (ARS) and blue and red shrimp in GSA 9-10-11 (ARA).

With the exception of some odd peaks in 1987 and early 90s, with production above 2500 t, the landings of the two species are around 1000 t per year. If we consider about 500-600 t of giant red shrimp (according to the proportion with blue and red shrimp in recent EU DCF landings) this is in line with the results of the SR analysis.

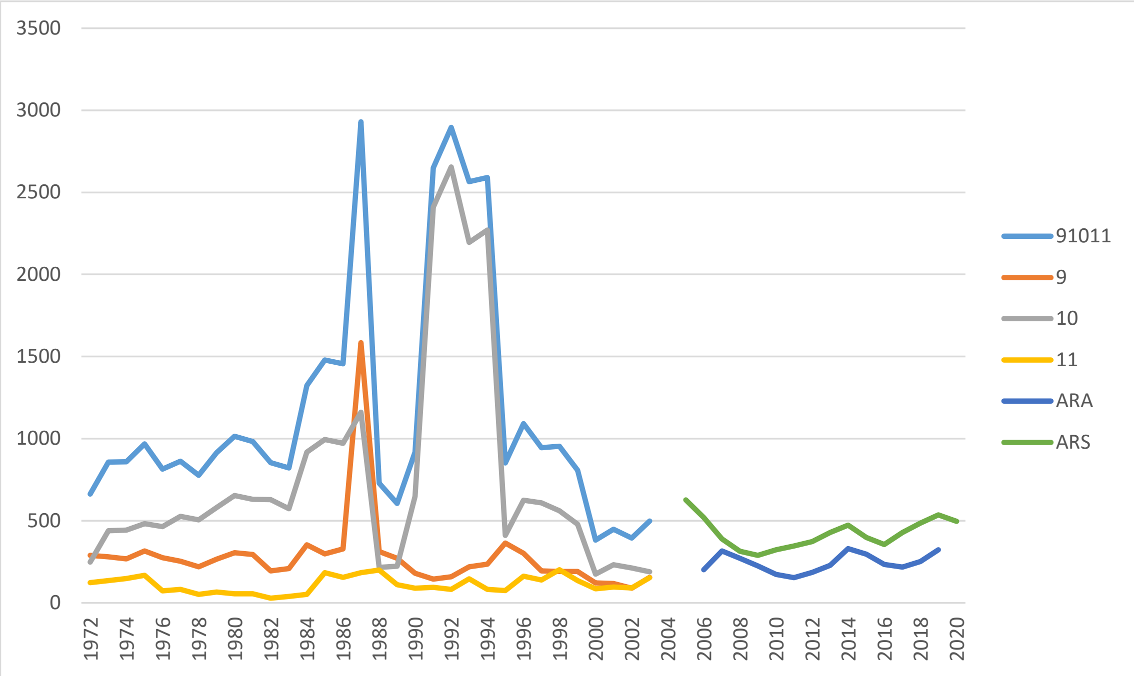

Figure 6.6.1.11: Giant red shrimp in GSAs 9, 10, 11. Historical landings (tonnes) by GSA and total landings, and EU DCF landings of giant red shrimp (ARS) and blue and red shrimp (ARA) in GSAs 9-10-11.

Results

In the light of the outcomes of the exploratory analysis, it was decided to consider the Geometric Mean approach as the most suitable to estimate the biomass reference points for the stock of giant red shrimp in GSAs 9, 10 & 11. This being also equivalent to the asymptote of the HS.. Table 6.6.1.3 summaries the reference point values based on the default value of 25% of $B_{F0.1}$ for B_{Lim} and Geometric Mean fitted to the data for R_0. B_{pa} is set to 2* B_{Lim} (See Section 4.2). The implied dynamics, based on a Hockey-stick model with R_0 from GM recruitment and the HS breakpoint at 25%$B_{F0.1}$, are illustrated in Figure 6.6.1.12, and the historic assessment information is shown in this context in Figure 6.6.1.13 and Figure 6.6.1.14. In conclusion the stock is considered to be between B_{pa} and $B_{F0.1}$ in 2020.

Table: 6.6.1.3 Giant red shrimp in GSAs 9, 10 & 11 . Final reference points based on Geometric mean stock recruit model fitted to the data and the default $\mathbf{B_{Lim}}$ = $\mathbf{B_{F0.1}}$/4.

$F_{0.1}$	B_{Lim}	B_{pa}	$B_{F0.1}$	B_0	F_{pa}
0.462	178	356	711	1713	1.50

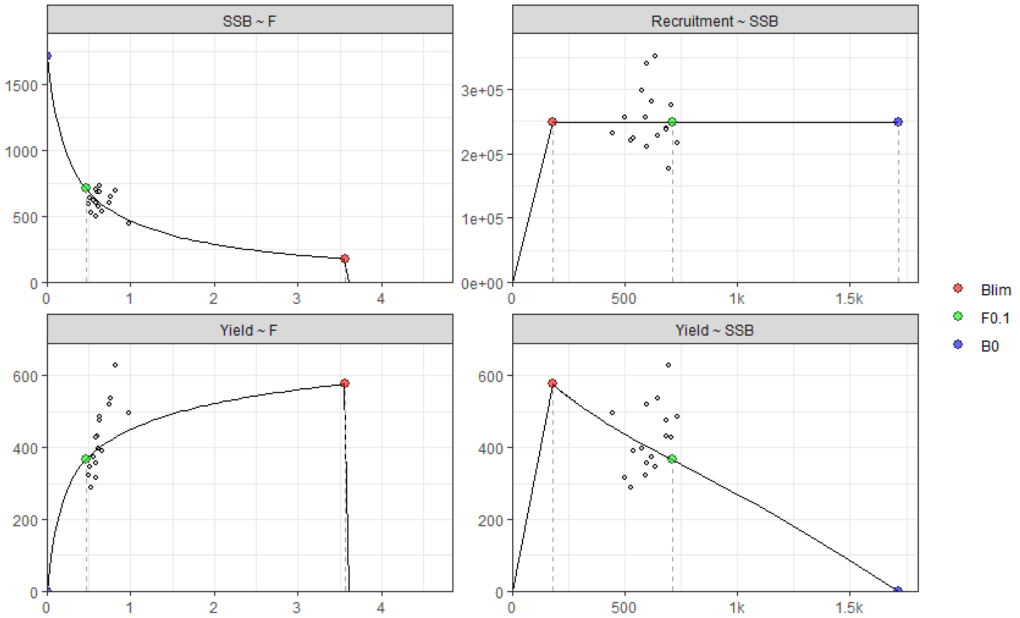

Figure 6.6.1.12: Giant red shrimp in GSAs 9, 10 and 11. Equilibrium yield with the Hockey-Stick model.

Figure 6.6.1.13 show the reference points estimated for the Hockey-Stick model for giant red shrimp in GSAs 9, 10 and 11.

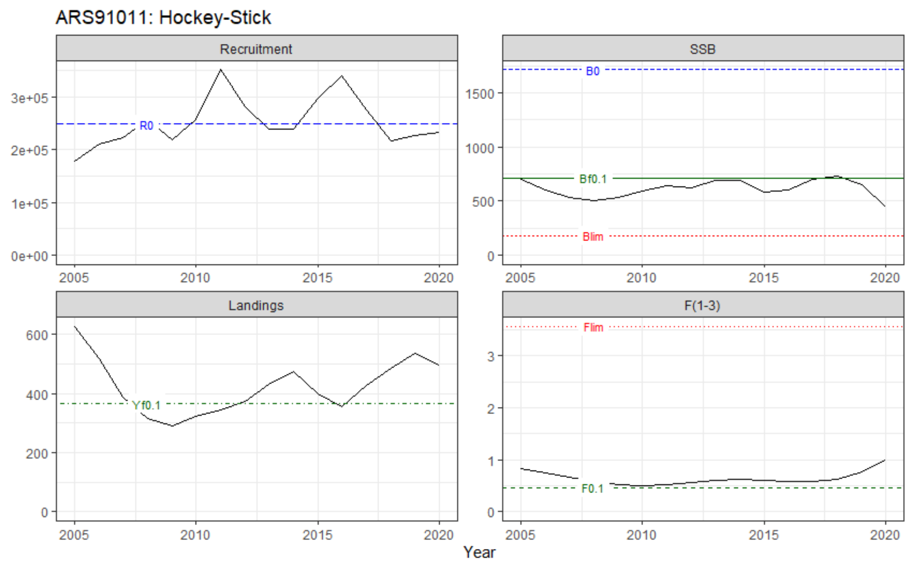

Figure 6.6.1.13: Giant red shrimp in GSAs 9, 10 and 11. Status Advice plot showing stock trajectories of Recruitment, SSB, F, Landings and Yield compared to the estimated reference points, based on a Hockey-Stick stock-recruitment relationship.

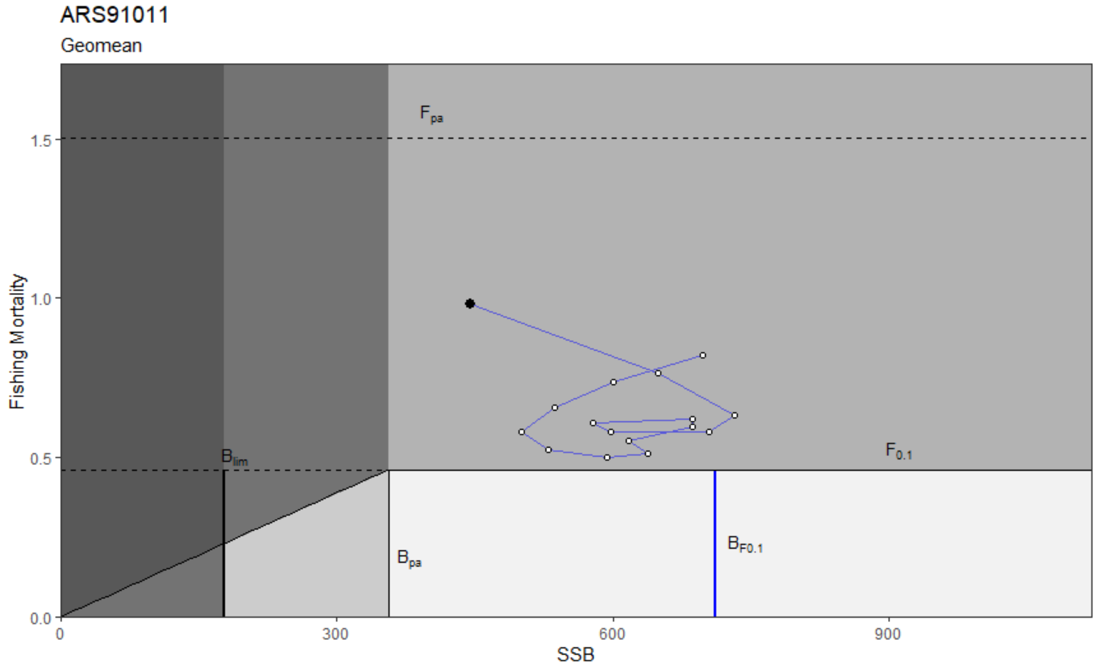

Figure 6.6.1.14: Giant red shrimp in GSAs 9, 10 and 11. Advice Rule plot for the Hockey-Stick model, with default B_{Lim} = 0.25 $B_{F0.1}$

Modelling options

The HS model defined above is considered as the best option for defining reference points for this stock, but it may not be the most suitable for modelling. A Beverton-Holt model may be helpful to as a modelling option. The steepness options considered above and illustrated in Figure 6.6.1.10. The steepness option that most closely mimics in terms of deviation from slope and asymptote the HS chosen is thought to be steepness = 0.90 (Figure 6.6.1.15).

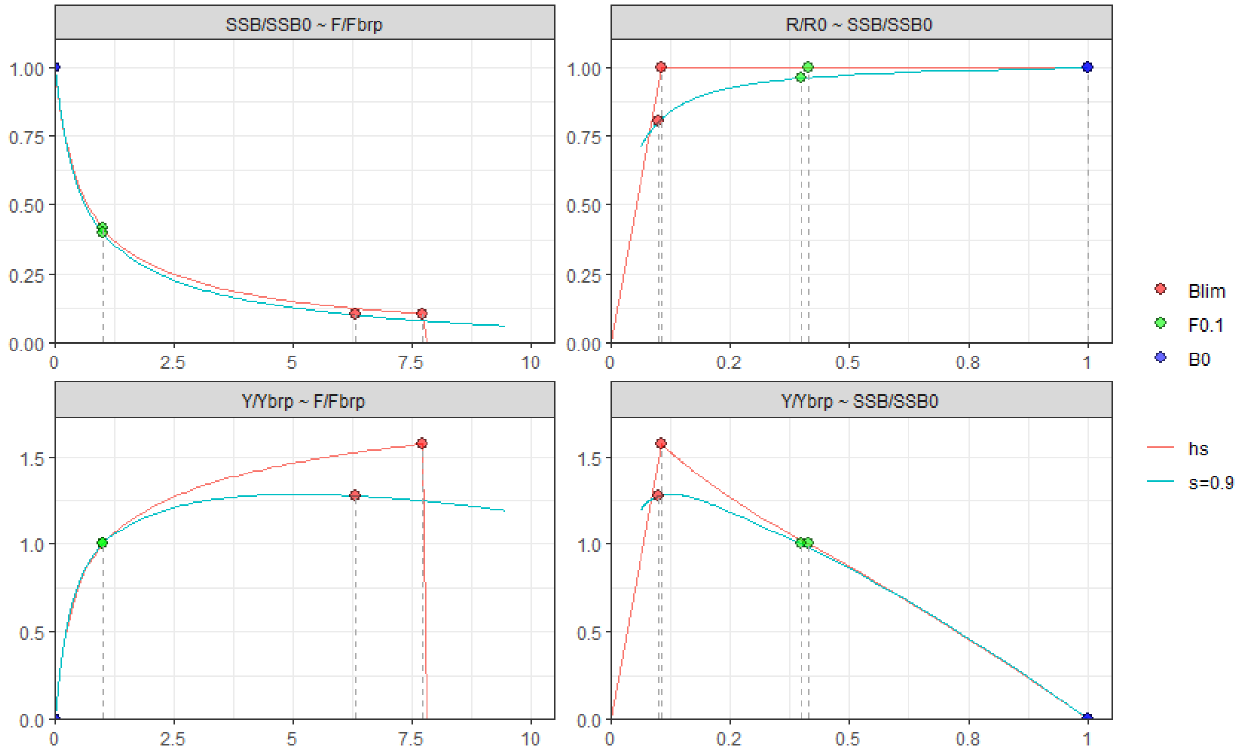

Figure 6.6.1.15: Giant red shrimp in GSAs 9, 10 and 11. Equilibrium yield: relative reference points for HS and BH (steepness 0.9) models.

6.7 Striped Red Mullet

6.7.1 Striped Red Mullet (MUR) in GSA 5

No STECF assessment is available for this stock, and there is no other stock of this species assessed by STECF in the Western Mediterranean. In the absence of an assessment and without other stocks of the same species for comparison there is currently no agreed procedure for setting reference points. Further evaluation of the other stocks without assessments is required and it may be that these evaluations will allow an approach to be developed.

6.8 Reference Point Analysis Summary

Throughout the sections above, the analyses have concentrated on the use of fitted Hockey-stick to define the dynamics, and estimated B_{Lim} or use of Geometric mean recruitment and a default value of 25% of $B_{F0.1}$ for B_{Lim} . The EWG considers that the choices made are the best option. However, it is noted in Section 2 and 3 that there are other options for individual stocks, such the two hake stocks and red mullet in GSA 1, and a different basis for the default B_{Lim} (i.e. 10% B_0). For convenience a table of values for both HS and GM for each stock is given below (Table 6.8.1). The table can be used to compare the different approach or as a source of values to recommend different options.

Table 6.8.1 Summary comparison of fitted Hockey-stick with estimated B_{Lim} and Geometric mean recruitment and a default value of 25% of $B_{F0.1}$ for B_{Lim} by stock. SR: the basis (HS or GM) for the entry. Choice: TRUE line used, FALSE line not used. $F_{0.1}$: Fishing mortality $F_{0.1}$. $B_{F0.1}$: equilibrium SSB at $F_{0.1}$. B_0: SSB with F=0 (un-fished). B_{Lim} : Limit reference point estimated using the method in SR column (HS fitted if breakpoint < 20% B_0 or default 25% $B_{F0.1}$). B_{pa} based on 2* B_{Lim}

stock	SR	choice	$F_{0.1}$	$B_{f0.1}$	B_0	B_{Lim}	B_{pa}
ARA01	hs	TRUE	0.292	528.9	1373.5	120.3	240.6
ARA01	gm	FALSE	0.292	324.8	843.6	81.2	162.4
ARA06_07	hs	TRUE	0.286	1541.8	3924.1	262.5	525
ARA06_07	gm	FALSE	0.286	1515.4	3856.8	378.9	757.7
ARA09_10_11	hs	FALSE	0.294	649.2	1532.4	138.6	277.3
ARA09_10_11	gm	TRUE	0.294	649.2	1532.4	162.3	324.6
ARS09_10_11	hs	FALSE	0.462	711.3	1713.2	155.1	310.2
ARS09_10_11	gm	TRUE	0.462	711.3	1713.2	177.8	355.6
DPS09_10_11	hs	FALSE	1.287	899.5	3549.7	321.4	642.8
DPS09_10_11	gm	TRUE	1.287	899.5	3549.7	224.9	449.8
HKE01_05_06_07	hs	TRUE	0.444	59561.3	223391.1	4138.2	8276.5
HKE01_05_06_07	gm	FALSE	0.444	39015.1	146330.5	9753.8	19507.6
HKE08_09_10_11	hs	TRUE	0.168	43255.4	103665.8	4316.3	8632.5
HKE08_09_10_11	gm	FALSE	0.168	38170.7	91479.7	9542.7	19085.3
MUT01	hs	TRUE	0.607	419.4	1293.6	205.1	410.3
MUT01	gm	FALSE	0.607	338.1	1042.9	84.5	169
MUT06	hs	FALSE	0.317	3306.5	7811.3	707.2	1414.4
MUT06	gm	TRUE	0.317	3306.5	7811.3	826.6	1653.2
MUT07	hs	TRUE	0.456	454.5	1415.5	128.2	256.3
MUT07	gm	FALSE	0.456	454.5	1415.5	113.6	227.3
MUT09	hs	FALSE	0.52	1811.8	4384.8	397	794
MUT09	gm	TRUE	0.52	1811.8	4384.8	452.9	905.9
MUT10	hs	FALSE	0.401	954.4	2493.3	225.7	451.5
MUT10	gm	TRUE	0.401	954.4	2493.3	238.6	477.2
NEP06	hs	FALSE	0.228	10312.3	33289.6	2660.8	5321.6
NEP06	gm	TRUE	0.228	2013.4	6499.5	503.3	1006.7
NEP09	hs	FALSE	0.297	811.7	2893.4	254	507.9
NEP09	gm	TRUE	0.297	811.7	2893.4	202.9	405.9

7 REFERENCES

Barrowman, N.J., Myers, R.A., 2000. Still more spawner–recruitment curves: the hockey stick and its generalizations. Can. J. Fish. Aquat. Sci. 57, 665–676.

Carruthers, T., Kell, L., Palma, C., 2017. Accounting for uncertainty due to data processing in virtual population analysis using Bayesian multiple imputation. Can. J. Fish. Aquat. Sci. 75, 883–896. https://doi.org/10.1139/cjfas-2017-0165

Clark, W.G., 1991. Groundfish exploitation rates based on life history parameters. Can. J. Fish. Aquat. Sci. 48, 734–750.

DFO, 2009. A fishery decision-making framework incorporating the precautionary approach.

FAO, 1995. Code of Conduct for Responsible Fisheries. FAO Tech. Guidel. Responsible Fish. 4 (Suppl., 1–112.

Goodyear, C.P., 1993. Spawning stock biomass per recruit in fisheries management: foundation and current use., in: Smith, S.J., Hunt, J.J., Rivard, D. (Eds.), Risk Evaluation and Biological Reference Points for Fisheries Management. Canadian Special Publication of Fisheries and Aquatic Sciences 120, pp. 67–81.

Goodyear, C.P., 1977. Assessing the Impact of Power Plant Mortality on the Compensatory Reserve of Fish Populations, in: Van Winkle, W.B.T.-P. of the C. on A. the E. of P.-P.-I.M. on F.P. (Ed.), . Pergamon, pp. 186–195. https://doi.org/https://doi.org/10.1016/B978-0-08-021950-9.50021-1

ICES, 2022. Workshop on ICES reference points (WKREF1). ICES Sci. Reports 4, 1–70.

ICES, 2021a. Workshop on guidelines and methods for the evaluation of rebuilding plans (WKREBUILD). ICES Sci. Reports 2, 1–79. https://doi.org/https://doi.org/10.17895/ices.pub.6085

ICES, 2021b. Workshop of Fisheries Management Reference Points in a Changing Environment (WKRPChange). ICES Sci. Reports 3, 39. https://doi.org/https://doi.org/10.17895/ices.pub.7660

ICES, 2020. The third Workshop on Guidelines for Management Strategy Evaluations (WKGMSE3). ICES Sci. Reports 2, 1–112. https://doi.org/http://doi.org/10.17895/ices.pub.7627

Jardim, E., Millar, C.P., Mosqueira, I., Scott, F., Osio, G.C., Ferretti, M., Alzorriz, N., Orio, A., 2015. What if stock assessment is as simple as a linear model? The a4a initiative. ICES J. Mar. Sci. 72, 232–236.

Kell, L.T., Mosqueira, I., Grosjean, P., Fromentin, J., Garcia, D., Hillary, R., Jardim, E., Mardle, S., Pastoors, M.A., Poos, J.J., Scott, F., Scott, R.D., 2007. FLR : an open-source framework for the evaluation and development of management strategies 640–646.

Kristensen, K., Nielsen, A., Berg, C.W., Skaug, H., 2015. Template Model Builder TMB. J. Stat. Softw. 70, 1–21.

Ligas A., 2019. Recovery of fisheries historical time series for the Mediterranean and Black Sea stock assessment (RECFISH). EASME/EMFF/2016/032. Final Report, 95 pp. + Annexes

Mace, P.M., Doonan, I.J., 1988. A generalized bioeconomic simulation model for fish population dynamics, New Zealand Fishery Assessment.

Mace, P.M., Sissenwine, M.P., 1993. How much spawning per recruit is enough?, in: Smith, S.J., Hunt, J.J., Rivard, D. (Eds.), Risk Evaluation and Biological Reference Points for Fisheries Management. Canadian Special Publication of Fisheries and Aquatic Sciences, pp. 101–118.

Methot, R.D., Wetzel, C.R., 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fish. Res. 142, 86–99. https://doi.org/10.1016/j.fishres.2012.10.012

New Zealand Ministry of Fisheries, 2008. Harvest Strategy Standard for New Zealand Fisheries.

Patterson, K., Cook, R., Darby, C., Gavaris, S., Kell, L., Lewy, P., Mesnil, B., Punt, A., Restrepo, V., Skagen, D.W., Stefánsson, G., 2001. Estimating uncertainty in fish stock assessment and forecasting. Fish Fish. 2, 125–157.

Ralston, S., Punt, A.E., Hamel, O.S., Devore, J.D., Conser, R.J., 2011. A meta-analytic approach to quantifying scientific uncertainty in stock assessments. Fish. Bull. 109, 217–231.

Rosenberg, A.A., Fogarty, M.J., Sissenwine, M.P., Beddington, J.R., Shepherd, J.G, 1993. Achieving sustainable use of renewable resources. Science (80-.). 262, 828–829.

Thorson, J.T., 2020. Predicting recruitment density dependence and intrinsic growth rate for all fishes worldwide using a data-integrated life-history model. Fish Fish. 21, 237–251. https://doi.org/https://doi.org/10.1111/faf.12427

UN, 1995. United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. New York.

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9 LIST OF ANNEXES

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List of electronic annexes documents:

EWG-22-03 – Annex 1 – Data checking

EWG-22-03 – Annex 2 – FLRef user guidelines

EWG-22-03 – Annex 3 – Reference points reproducible R code and results based worked example for Mediterranean stocks

EWG-22-03 – Annex 4 – .Working document: Temporal stability of reference points

10 LIST OF BACKGROUND DOCUMENTS

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List of background documents:

EWG-22-03 – Doc 1 - Declarations of invited and JRC experts (see also section 8 of this report – List of participants)

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