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# Scientific Technical and Economic Committee for Fisheries (STECF) - Evaluation of fishing effort and catch regime for demersal fisheries in the western Mediterranean Sea (Part XI) (STECF-23-11)

Pinto, C., Doering, R., Pierucci, A.

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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 is the 11th of a suite of STECF EWG reports dedicated to the evaluation of the implementation of the Western Mediterranean Sea Multi-Annual management Plan (hereafter, MAP), following EWG reports 18-09, 18-13, 19-01, 19-14, 20-13, 21-01, 21-13, 22-01, 22-11 and 23-01.

The group was requested to update the graphical representation of fishing effort time series evolution by MS, GSA, vessel length and gear with the latest data obtained from the FDI datacall (TOR 1). Together with the fishing effort time series the group was requested to update the F-E analysis by stock and gear using the outputs from STECF EWG 23-09 (TOR 2). The group was also requested to collect qualitative information on the fuel related situation to potentially estimate cost changes in 2022-2023 (TOR2).

Finally, the group was requested to implement mixed fisheries bio-economic models to run a number of different scenarios up to 2030 to test a combination of measures taking into account all the effort reductions, closure areas and maximum catch limits (MCLs) introduced in the western Mediterranean MAP since 2020 (TOR 3-4). Within the scenarios a combination of effort reductions and MSLs were tested, together with the introduction of spatio-temporal closures and selectivity restrictions to obtain compensation mechanisms by MSs. A total number of 13 scenarios were requested, 6 of which were considered priority scenarios.

For TOR 1 time series of fishing effort in fishing days, days at sea, hours at sea, GT x fishing days, and kW x fishing days by Country (Spain, France, Italy), EMU (1 and 2), GSA (1, 5, 6, 7, 8, 9, 10, 11), gear (OTB, OTT, GNS, GTR, LLS, other), and fleet segment (<12m, 12-18m, 18-24m, >24m) were produced. Graphs for fishing days are reported in the report while the rest of the data are submitted in Annex I as an Excel table. The comparison of fishing days for trawlers (OTB, OTM, OTT, PTB, PTM and TBB as per EU regulation 2019/2236) declared in the FDI official datacall and reported in the 2020, 2021, 2022 and 2023 regulations were reported this year as well. Across fleet segments, the fishing effort from the regulation is greater, for most segments, than that estimated through the FDI database. This could be due to the regulation values being calculated considering the maximum fishing days possible for the year and also difficult to estimate the possible transfer among fleet segments.

An additional analysis (section 2.3) was added to provide a broad context of the state and evolution of the fishery in EMU-1 (encompassing GSAs 1,5,6,7), through the detailed examination of weights, values and prices landed by stocks and fleet segments using the FDI data submitted to the group. It was observed that during the implementation of the MAP, all fleet segments have not evolved in the same way. If all demersal trawlers seem to face a substantial contraction of their landed values, deep-water trawlers are increasing their landed value, most likely thanks to an increased ARA price. Still, for many other fleets, the transition rates before and during the plan remains similar.

For TOR 2 the F-E analysis was updated and as in previous years a linear relationship consistent across GSAs and stocks was not found for any gear. Those stocks were there seem to be a linear relationship, such as HKE, ARA, DPS (except for DPS 1), it was shown that there is an effect of the GSA level which should be accounted for in future modelling exercises potentially using mixed effect models. Concerning fuel prices the group noted that marine fuel prices are significantly influenced by global oil prices which are driven by factors like international agreements, supply disruptions, or changes in demand. Geopolitical tensions and conflicts, sanctions or embargoes on certain countries can affect the availability and cost of marine fuels. Technology and efficiency improvements can

impact fuel efficiency and investments in energy-efficient vessels and propulsion systems can lead to cost savings. Also, environmental concerns, such as reducing carbon emissions and promoting sustainable fishing practices, are affecting fuel usage and prices.

It's also important to consider that marine fuel prices can vary significantly by region and port, depending on local factors, taxes, subsidies, transportation costs and regulations. In particular, governments may provide subsidies or financial incentives to the fishing industry to mitigate the impact of high fuel prices or promote environmentally friendly practices. Within the group the EUMOFA and AER data are used to parameterize the models. On these data the group highlighted two issues for a correct interpretation of the model results:

1. The financial situation which the bio-economic models present for the year 2022 and beyond depend a lot on the assumptions regarding the development of fuel prices but include no mitigation measures for the fishing companies (like de minimis payments to cover parts of the increase in fuel costs 2022). STECF plenary (22-03) agreed not to include those support payments to allow distinguishing between the impacts of the MAP from external economic shocks.

2. STECF PLEN (22-03) observed that the nowcast for 2023 (that are now used as input data for the models) should be interpreted with caution due to the fact that the development in the second half of the year (energy and fish prices, inflation, interest rates etc.) is unknown and highly uncertain.

FOR TOR 3 results for EMU 1 are obtained from the IAM and the ISIS-Fish models: from the IAM model only scenarios adjusting trawler fishing effort to reach Fmsy of Hake (i.e. scenarios A and D) foresee exploitation levels in line with the objectives of the plan, i.e. all stocks at Fmsy in 2025. With the two other simulated scenarios, in which only maximum catch limit on ARA was applied, with or without selectivity measures on deep water trawls, i.e. scenarios Status Quo and L, respectively, the stocks of Hake in GSA1567, red mullet in GSA1, red mullet in GSA6, Nephrops in GSA 6, and Blue and red shrimp in GSA 5 do not reach the objective of Fmsy in 2025. Scenarios allowing to reach Fmsy for all stocks foresee some significant negative socio-economic impacts for French and Spanish trawlers in the short and medium term, with a reduction in their Gross Value Added, Gross Profit, employment in terms of Full Time Equivalent (FTE), and average wages.

From the ISIS-Fish model results showed that the SQ scenario did not achieve the objective of the plan regarding HKE, as fishing mortality stays way above Fmsy and the SSB below Blim. The four other scenarios, A, B, C and E, on the contrary succeeded in reaching Fmsy at the latest in 2028 and Hake SSB was above Blim but below Bpa starting in 2029. The determinant factor was the adjustment of effort to reach Fmsy, which implied reductions in effort level of more than 60% compared to 2022 FDI values. Economic indicators for ISIS-Fish could not be reported.

In EMU 2 results are obtained from models BEMTOOL and SMART: from the BEMTOOL model for ARS, MUT9 and DPS the Fmsy level is reached by 2025 for all the scenarios explored. For DPS an increase in F is expected in 2024 for scenario L, due to the reallocation of the effort induced by the catch limit, but in 2025 the value is below Fmsy. For HKE and NEP9 only scenarios A, C and D (which are forced to reach Fmsy by 2025) allow to reach Fmsy in 2025, while SQ and L have F well above the reference point. It should be noticed that the change in selectivity implemented in scenario L show a slight improvement in respect to the SQ scenario for HKE, but it does not allow to reach Fmsy in 2025. As a general consideration, the scenarios most impacting on the effort highlight the risk of underutilization of the stocks that currently already are close or in line with the reference point. Results for the stock of MUT 10 and ARA in 9-10-11 should be taken with caution as no analytical assessment was available for these two stocks in the last two years. The results of the economic indicators showed that in the short term for all the alternative scenarios is expected a decrease, which generally is followed by an increase in the medium-long term.

For the SMART model for four of the five stocks (ARS, DPS, HKE, and MUT) the scenarios associated with the best effect on the stock are A, C, D, E and L. For NEP, the situation seems to be much more complex and only scenario A allows you to get close to the BPA (Precautionary Biomass Level) value. However, all the simulated scenarios show a substantial reduction in Gross profit margin.

Results suggest that in EMU 1 and 2 Fmsy in 2025 is reached for all stocks only when effort is decreased as much as 60% to 85% depending on the fleet segment observed, with bigger segments suffering a higher reduction. Scenarios accounting for an MCL on ARA and ARS do not allow to reach Fmsy for all stocks including HKE. In EMU 2, the ARS, MUT and DPS stocks are already close or at Fmsy becoming underutilized due to the reductions to bring HKE and NEP at Fmsy.

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**STECF advice:**

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**EWG-23-11 report:**

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**SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Evaluation of fishing effort and catch regime for demersal fisheries in the western Mediterranean Sea (PART XI) (STECF-23-11)**

**Request to the STECF**
STECF is requested to review the report of the STECF Expert Working Group meeting, focusing on the following:

STECF is requested to evaluate the findings of the STECF Expert Working Group meeting and make any appropriate comments and recommendations. Specifically, STECF is requested to consider the results and conclusions of the EWG 23-11 showing the socio-economic performance of the fleets, based on a number of modelling assumptions and limitations, which results in a variable economic performance of numerous fleets under EMU 1 and in particular EMU2. STECF is requested to advise on the potential limitations of such indicators and indicate the modelling scenario that better balances the biological improvement of the stocks towards MSY and the socio-economic impacts on the fleets both by fleet segments and at Member State level. Additionally, given the enduring state of the hake stocks in both EMU 1&2 being assessed as below Blim, STECF is requested to advise on potential management measures that could complement the effort regime to ensure a faster recovery of these stocks.

**STECF comments**
EWG 23-11 met online from 25th September to 29th September 2023. EWG 23-11 was the eleventh such STECF EWG dedicated to the evaluation of the implementation of the Western Mediterranean Sea Multi-Annual Management Plan (West Med MAP). This plan refers to the Western Mediterranean geographical subareas (GSA) adjacent to Spain, France and Italy in GSAs 1, 2, 5, 6, 7, 8, 9, 10 and 11, grouped into two spatial EMU (Effort Management Units) - EMU1 for GSAs 1 to 7 and EMU2 for GSAs 8 to 11.

STECF observes that the EWG adequately addressed the TORs and has the following specific comments on the five ToRs addressed by EWG 23-11.

*ToR 1 compile and provide complete sets of annual data on fishing effort from 2015 to 2022.*

STECF notes that the EWG has compiled and provided a time series of fishing effort data reported in fishing days, days at sea, hours at sea, Gross Tonnes (GT) x fishing days, and Kilowatts (kW) x fishing days by:

- Country (i.e., Spain, France, Italy)
- EMU 1 and 2
- GSA (1, 5, 6, 7, 8, 9, 10, 11)
- Gear (OTB, OTT, GNS, GTR, LLS, other); and
- Fleet segments (i.e., <12m, 12-18m, 18-24m, >24m).

STECF notes that effort reported in the FDI data call were compared with effort thresholds contained in EU regulation (2019/2032) for trawlers (OTB, OTM, OTT, PTB, PTM and TBB). Across fleet segments, fishing effort thresholds set out in the Regulation are greater than those reported in the FDI database. This discrepancy may be explained by the fact that a maximum fishing days baseline rather than actual fishing effort baseline was used when calculating the Regulation thresholds. Further, possible difficulties in monitoring transfers of effort between fleets may also cause discrepancies between the data sets.

STECF notes that, in this context, the maximum fishing days included in the Regulation might not be as limiting as intended, as the overall quota per year has been consistently underutilised, although not by all fleet segments.

STECF observes that the effort analysis was complemented by a detailed examination of volumes, values and price data for landings by stocks and fleet segments using FDI data. This preliminary analysis aimed to provide a broad context of the state and evolution of the fisheries in EMU-1 (encompassing GSAs 1,5,6,7). Due to time constraints, it was not possible to run it for EMU 2 as well.

While the trends were heterogeneous among fleets, the EWG observed that Spanish and French demersal trawlers seem to face a substantial contraction of their landed values, while deep-water trawlers showed an increasing trend for their landed values, most likely due to an increase in price for red shrimp (ARA). STECF notes that for many other fleets, the trends rates before and during the plan remain similar, (i.e., trends before and after the implementation of the MAP are broadly the same).

*ToR 2 Update the F-E analyses for Effort Management Units 1 and 2 - Collect qualitative information on the situation and estimate, if possible, the consequences of fuel and other costs changes*

STECF observed that the EWG has updated the fishing mortality – fishing effort (F-E) plots per species and fleets. As last year, in most cases, there is no obvious linear relationship between F-E. For some stocks, a linear relationship was visible (e.g., hake (HKE), red shrimp (ARA), deep-water rose shrimp (DPS) except for DPS in GSA 1) but is driven by varying situations (fishing effort and fishing mortality) among GSAs.

STECF notes it would be worthwhile to include a GSA effect next year in the modelling to ascertain whether there is a linear relationship at the GSA level. Based on the latest stock assessments (EWG 23-09), the EWG also updated temporal trends in partial mortality per species due to the different fishing fleets in the different GSAs.

STECF notes that the EWG updated fuel price information using EUMOFA data and AER projections. The EUMOFA data indicated a rapid increase of the price from summer 2020 to summer 2022, followed by a decrease since then (and a new increase in the later months of 2022). However, EWG acknowledges that analysing the marine fuel price is complex since they are significantly influenced by many international and local factors.

While the EUMOFA and AER data were used to parameterise the bioeconomic models, EWG noted that:

1. The financial situation which the bio-economic models present for the year 2022 and beyond depend a lot on the assumptions regarding the development of fuel prices but include no mitigation measures provided to fishing companies (e.g., de minimis payments to cover parts of the increase in fuel costs 2022 and 2023). STECF plenary (22-03) agreed that the modelers should not include those support payments to allow distinguishing them from impacts of the MAP as opposed to other external economic shocks.
2. STECF PLEN (22-03) observed that the nowcast for 2023 (that are now used as input data for the models) should be interpreted with caution due to the fact that the development in the second half of the year (energy and fish prices, inflation, interest rates etc.) is unknown and highly uncertain.
3. The resolution of AER data raises some issues for EMU2 in which a disaggregation of costs per GSA was required. Moreover, it is also important to note that estimates of crew costs are considered unreliable, due to a lack of data and information, and uncertainty over the reliability of the AER data used to estimate the values of crew share by fleet segment. Consequently, crew costs are very likely to be underestimated in situations where the economic performance of a fleet segment is poor.

*ToR 3 and 4: Develop, as in previous years, effort and catch management scenarios for all demersal fishing gear - provide an overview of the measures needed to achieve MSY by 1 January 2025 and what are the socio-economic impact of these measures.*

STECF observes that the EWG updated the 4 bioeconomic models based on the latest stock assessments and tested different management scenarios (i.e., combinations of management measures, including effort reduction, including selectivity measures and introduction of MPAs) as proposed by the Commission. This included 13 scenarios, 6 of them being considered priorities. Scenarios include a combination of trawler effort reductions, selectivity improvements and closure areas, for which bonuses of fishing days were granted as a compensatory mechanism under the WestMed Map and combined red and blue shrimp (ARA-ARS) catch limits.

STECF reiterates that all bioeconomic simulation models have pros and cons to exploring the scenarios, with some bioeconomic models better handling the spatial aspects of the fisheries and others better accounting for socio-economic factors. STECF agrees with the EWG that the models were not specifically developed for the WestMed MAP and that they have been often used "at their limits" to test the requested scenarios. STECF observes that additional work is needed to improve and develop the models further (e.g., Specifications of stock-recruitment relationships, including more stocks in ISIS-Fish, implementing more scenarios in the different models). STECF observes that potentially moving towards a Management Strategy Evaluation (MSE) would be a positive step.

STECF observes due to the model constraints, it was not possible to test all the scenarios with all the models or to integrate all stocks in all models. STECF observes that efforts have been made to harmonise socio-economic indicator outputs across models following STECF EWG 23-01. STECF also notes that models vary in the way they address uncertainty/natural stochasticity, and regarding assumptions on the stock-recruitment relationship, a key process in any bioeconomic simulation model. STECF notes that modellers expended much effort to modify their models to handle the different scenarios and that more time and resources would be required to address the limitations of the different models. STECF observes that the lack of MEDITS data for 2022 may have increased the uncertainty of the stock assessment results, that fed the BEMTOOL model for the biological and pressure component in EMU2.

STECF notes that, for EMU1, IAM and ISIS-Fish models were applied, while BEMTOOL and SMART were applied in EMU2. STECF observes that, in both EMUs, Fmsy for all stocks was only achieved under scenarios involving a reduction in effort of a magnitude specifically set to achieve this objective. STECF notes that, in such scenario's, fishing effort was reduced by 60-85% in EMU 1 and up to 50% in EMU 2, leading to very significant negative impacts on the socio-economic performance of several fleets in the short (2025) and medium (2030) term. This decrease is mainly required to the situation of the hake stocks which are severly overexploited in both EMUs.

STECF notes that the other types of measures tested (e.g., selectivity, closures) have had limited effects on biological and socio-economic indicators on their own. STECF notes that the two scenarios that did not involve any reduction in fishing effort (SQ and L) had more limited socio-economic impacts, but do not allow the Fmsy level to be reached for overexploited stocks, as the visible effects are limited to a few stocks that are already close to the Fmsy level in the EMU2. STECF notes that the implementation of TACs in EMU1 had been tested by STECF EWG 21-13, and that while Fmsy could be reached, it would result in a strong fishing effort reduction, detrimental socio-economic impacts for many fleets, and hake acting as a choke species.

Table 1 and 2 present the main socio-economic indicators estimated by IAM in EMU1 and BEMTOOL estimated in EMU2. Those two tables were aggregated to be more consistent with the ToR requests. STECF observes that the results critically depend on the

assumptions regarding the development of fuel prices and do not include any measures such as subsidies that are likely to mitigate some of the negative socio-economic impacts.

**Table 1**. EMU1 (IAM model). Socio-economic outputs by Member State (MS) and fishing technique (DTS, DFN and HOK) and per scenarios such as : Gross Profit Margin in 2025, and in 2030, percentage of change in Gross Profit Margin between 2022 and 2025, and between 2022 and 2030, Full Time Equivalent (FTE) change between 2022 and 2024, between 2022 and 2025, and between 2022 and 2030 (in numbers of FTE), and percentage of change of FTE between 2022 and 2025 , and between 2022 and 2030. Red indicates a decrease, yellow a moderate increase (less than 10%) and green a high increase (>10%). Arrows indicate the change in trends between 2022-2030 compared to 2022-2025

| | Fleet segments | (Estimated level of profitability) Gross profit margin in 2025 | (Estimated level of profitability) Gross profit margin in 2030 | % Gross profit margin changes between 2022 - 2025 | % Gross profit margin changes between 2022 – 2030* | FTE evolution between 2022 and 2024 (in number of FTE per MS and fishing technique) | FTE evolution between 2022 and 2025 (in number of FTE per MS and fishing technique) | FTE evolution between 2022 and 2030 (in number of FTE per MS and fishing technique) | % of changes of FTE between 2022-2025 | % of changes of FTE between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| SQ | FR_DTS | | | | ↗ | | | | | |
| | FR_DFN | | | | → | | | | | |
| | FR_HOK | | | | ↘ | | | | | |
| | SP_DTS | | | | ↗ | | | | | |
| | SP_DFN | | | | ↗ | | | | | |
| | SP_HOK | | | | ↗ | | | | | |
| A | FR_DTS | | | | ↗ | | | | | |
| | FR_DFN | | | | ↗ | | | | | |
| | FR_HOK | | | | ↘ | | | | | |
| | SP_DTS | | | | ↗ | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP_DFN | | | | ↗ | | | | | |
| | SP_HOK | | | | ↗ | | | | | |
| D | FR_DTS | | | | ↗ | | | | | |
| | FR_DFN | | | | ↗ | | | | | |
| | FR_HOK | | | | ↘ | | | | | |
| | SP_DTS | | | | ↗ | | | | | |
| | SP_DFN | | | | ↗ | | | | | |
| | SP_HOK | | | | ↗ | | | | | |
| L | FR_DTS | | | | ↗ | | | | | |
| | FR_DFN | | | | → | | | | | |
| | FR_HOK | | | | ↘ | | | | | |
| | SP_DTS | | | | ↗ | | | | | |
| | SP_DFN | | | | → | | | | | |
| | SP_HOK | | | | ↗ | | | | | |

Legend:

**Indicator**

| |
|---|
| >10% - High |
| 0-10% - Reasonable |
| <0% - Weak |

**Table 2** EMU2 (BEMTOOL model). Socio-economic outputs by fishing technique for Italy (DTS, DFN and HOK) and per scenarios such as : Gross Profit Margin in 2025, and in 2030, percentage of change in Gross Profit Margin between 2020 and 2025, and between 2020 and 2030 (as a difference between, for ex., GPM in 2030 and 2020), Full Time Equivalent (FTE) change (difference) between 2020 and 2024, between 2020 and 2025, and between 2020 and 2030 (in numbers of FTE), and percentage of change of FTE between 2020 and 2025 , and between 2020 and 2030 (as for ex. (FTE(2025)-FTE(2020))/FTE(2020)). Red indicates a decrease, yellow a moderate increase (less than 10%) and green a high increase (>10%). Arrows indicate the change in trends between 2022-2030 compared to 2022-2025

| Scenarios | Fleet segments | (Estimated level of profitability) Gross profit margin in 2025 | (Estimated level of profitability) Gross profit margin in 2030 | % Gross profit margin change between 2020 - 2025 | % Gross profit margin changes between 2020 – 2030* | FTE evolution between 2020 and 2024 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2025 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2030 (in number of FTE per MS and fishing technique) | % of change of FTE between 2020-2025 | % of change of FTE between 2020-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| A | DTS_VL0612 | | | | ↗ | | | | | |
| | DTS_VL1218 | | | | ↗ | | | | | |
| | DTS_VL1824 | | | | ↗ | | | | | |
| | DTS_VL2440 | | | | ↗ | | | | | |
| | PGP_VL0012 | | | | → | | | | | |
| | PGP_VL1218 | | | | ↗ | | | | | |
| C | DTS_VL0612 | | | | ↗ | | | | | |
| | DTS_VL1218 | | | | ↗ | | | | | |
| | DTS_VL1824 | | | | ↗ | | | | | |

| Scenarios | Fleet segments | (Estimated level of profitability) Gross profit margin in 2025 | (Estimated level of profitability) Gross profit margin in 2030 | % Gross profit margin change between 2020 - 2025 | % Gross profit margin changes between 2020 – 2030* | FTE evolution between 2020 and 2024 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2025 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2030 (in number of FTE per MS and fishing technique) | % of change of FTE between 2020-2025 | % of change of FTE between 2020-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | DTS_VL2440 | | | | ↗ | | | | | |
| | PGP_VL0012 | | | | ↗ | | | | | |
| | PGP_VL1218 | | | | → | | | | | |
| D | DTS_VL0612 | | | | ↗ | | | | | |
| | DTS_VL1218 | | | | ↗ | | | | | |
| | DTS_VL1824 | | | | ↗ | | | | | |
| | DTS_VL2440 | | | | ↗ | | | | | |
| | PGP_VL0012 | | | | ↗ | | | | | |
| | PGP_VL1218 | | | | → | | | | | |
| L | DTS_VL0612 | | | | ↗ | | | | | |
| | DTS_VL1218 | | | | ↗ | | | | | |
| | DTS_VL1824 | | | | ↗ | | | | | |
| | DTS_VL2440 | | | | ↗ | | | | | |

| Scenarios | Fleet segments | (Estimated level of profitability) Gross profit margin in 2025 | (Estimated level of profitability) Gross profit margin in 2030 | % Gross profit margin change between 2020 - 2025 | % Gross profit margin changes between 2020 – 2030* | FTE evolution between 2020 and 2024 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2025 (in number of FTE per MS and fishing technique) | FTE evolution between 2020 and 2030 (in number of FTE per MS and fishing technique) | % of change of FTE between 2020-2025 | % of change of FTE between 2020-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | PGP_VL0012 | | | | ↗ | | | | | |
| | PGP_VL1218 | | | | → | | | | | |
| SQ | DTS_VL0612 | | | | → | | | | | |
| | DTS_VL1218 | | | | ↗ | | | | | |
| | DTS_VL1824 | | | | ↗ | | | | | |
| | DTS_VL2440 | | | | ↗ | | | | | |
| | PGP_VL0012 | | | | → | | | | | |
| | PGP_VL1218 | | | | → | | | | | |

Legend:

**Indicator**

>10% - High

0-10% - Reasonable

<0% - Weak

STECF notes that the implementation of the WestMed MAP is ongoing with the first measures only implemented in 2020, and that the data used to calibrate the bioeconomic models date is from 2022. Given the stochasticity of fish stocks, the effects of different crisis (COVID, conflict in Ukraine), it is unlikely that any significant postive effects on stocks dynamics could already be detected. STECF observes that in the case of the North Sea in the 2000s, the status of many species had appeared seemingly stable for many years, but it took several years before the effort reduction restrictions introduced had observable effects (Fernandes and Cook, 2013).

STECF notes that since hake mature at a relatively large size in the area (~36 cm – STECF PLEN 22-02) and at age 2 (Mellon-Duval et al. 2010) many years will be required to observe a rebuild of the stocks. Further, the recovery of the population given the currently depleted SSB (STECF EWG 23-09), and the low abundance of large individuals observed during the MEDITS survey (STECF EWG 23-09).

Notwithstanding this, STECF notes that recent observations suggest some positive effects of the MAP. In GSA7 (TOR 5.2b), where the largest closure areas have been implemented and where only coastal fisheries operate), the abundance of some species seems to be increasing following the implementation of the closure areas. Additionally, catches of juveniles of hake have decreased, while at the same time, the higher prices for octopus have increased its importance as a commercial species and to some extent, limited the negative socio-economic impacts (Certain and Billet 2023) of the MAP. EWG 23-01 has also reported positive changes in fishermen behaviour in reaction to the MAP.

*ToR 5: ensure that all unresolved data transmission issues encountered prior to and during the EWG meeting are reported online via the Data Transmission Monitoring Tool (DTMT)*

STECF notes that the EWG did not find any transmission issues to be reported in the DTMT.

**Other observations**

STECF notes that the EWG chairs met with MEDAC representatives and acknowledges their engagement. This meeting provided valuable information which the modelers can use to improve the assumptions in the model (e.g., on crew costs, where vessel owners must pay a minimum wage to be able to keep the crew, or reasons why fishing days were not fully utilised). MEDAC provided further documents which will be analysed to provide information for next year's EWG meetings.

STECF observers that this type of stakeholder engagement in cases where EWGs do not need to discuss specific issues represents a practical approach to gathering detailed fisheries information.

**STECF conclusions**

STECF concludes that reported fishing effort have effectively decreased from 2015 to 2022. In EMU1, this has led to a contraction of the landed values of some fleets, especially demersal trawlers.

STECF concludes that for most considered stocks and fleets, there was no simple relationship between fishing effort and fishing mortality. This suggests that the effectiveness of any fishing effort regulation aiming at achieving a given fishing mortality requires regular monitoring.

STECF concludes that because of the discrepancy between the fishing effort thresholds implemented in the Regulation and the number of fishing days declared in the FDI, further decrease of the thresholds might be required to achieve the desired effective reduction, noting they are contained in the Regulation and are difficult to change.

STECF concludes that among the tested scenarios, only scenarios including trawler effort specifically designed to achieve Fmsy were likely to ensure achieving Fmsy for all species, including for hake. However, they imply significant fishing effort reductions (60% to 80%) in one or two years depending on fleets and scenarios.

STECF concludes that scenarios SQ and L which did not include effort reduction were not predicted to have major effects on overexploited stocks: Fmsy was not reached for the overexploited stocks even in 2030, and effects were mainly visible for stocks already in good status in EMU2. While having more limited socio-economic impacts, the profitability was predicted to be negative for some fleets even under SQ.

STECF concludes that large fishing effort reductions would have severe stronger negative socio-economic impacts on the fishing fleets, especially in EMU1 where many stocks are in a depleted state.

STECF concludes that the models BEMTOOL and IAM predicted almost half of the considered fleets will have negative profitability in the short (2025) and medium term (2030), though BEMTOOL predicted an increase of economic indicators in the medium term after the initial decrease in EMU2. Moreover, a decrease of trawler fishing effort might produce negative impacts on the catches of other species that are already below Fmsy in EMU2 (ARS, MUT and DPS), leading to an underexploitation of those stocks.

STECF concludes that the need for fishing effort reductions is mostly driven by the critical status of hake stocks in both EMU1 and EMU2. STECF notes that no other management measure on their own, as applied in the scenarios, appear to be enough to ensure achieving Fmsy. Any actions on hake will have impacts on the catches of other species and on economic performances of fleets, and that the magnitude of those impacts will depend on the pace of further fishing effort reductions.

STECF concludes that many factors that have mitigated or still mitigate the negative impacts of the MAP were not accounted for in the models.

STECF concludes that bioeconomic simulations results are highly sensitive to economic factors that are difficult to predict. This includes fuel costs and prices. STECF concludes that medium term (2030) forecasts of socio-economic performance of fleets should be treated with caution.

STECF concludes that a dedicated project would be required to further develop the bioeconomic models. This could include the expansion of model(s) to cover the whole area and allow running only one model for the assessment of the MAP. This will facilitate comparisons between countries. This could also be the first step towards the implementation of a MSE, which STECF sees as a positive way forward.

STECF concludes that since the 2025 of Fmsy objectives are not likely to be reached, scenarios tested by the EWG next year should be clarified.

STECF concludes that the exchanges between the EWG and MEDAC are useful and should continue to inform the assessment of socio-economic impacts of the MAP.

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# REPORT TO THE STECF

# EXPERT WORKING GROUP ON THE EVALUATION OF FISHING EFFORT AND CATCH REGIME FOR DEMERSAL FISHERIES IN THE WESTERN MEDITERRANEAN SEA (PART XI) (EWG-23-11)

## Virtual meeting, 25-29 September 2023

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

This report is the 11th of a suite of STECF EWG reports dedicated to the evaluation of the fishing effort and catch limit regime in the Western Mediterranean Sea.

The first EWG in June 2018 (STECF 18-09) addressed a number of issues related to managing fisheries with fishing effort regimes. Building on a review of previous experiences worldwide, the report highlighted the main and well known concern that catchability estimates (relationship between fishing effort and fishing mortality) are imprecise and vary systematically since fishers will tend to increase their efficiency in order to maintain their historical catch and revenue levels in spite of effort reductions. This was corroborated by quantitative analyses of differences in catch efficiency between fishing trips using trip-based data from Italy and Spain, differences that are only little explained by features such as vessel size or fishing area. Also, a study was presented monitoring continuous increase in gear size (width, opening, twin trawl etc) in the Mediterranean, highlighting a potential for further increase in fishing efficiency that may counteract the expected effect of effort reduction. Finally, a comparison of the completeness and consistency of the various datasets on catch and effort by fleet segments available at the JRC was performed, highlighting a number of gaps.

The second EWG in October 2018 (STECF 18-14) built further on these results. The relationship between fishing effort and fishing mortality, aggregated at the level of fleet segment and year, was analysed for a number of the MAP stocks using the available time series of stock assessment. This relationship was shown to be never linear, and in most cases it cannot even be detected in the time series. This means that a reduction of fishing effort will not translate by a similar reduction of fishing mortality at least in the first years of implementation. Secondly, the trips analyses were extended to new data from France, showing similar results as for Italy and Spain. Finally, a first review of existing bioeconomic mixed fisheries models in the Western Med was conducted. Considering that many models were potentially available but that none of them was directly operational for the purpose of the MAP, a 2 years road map was agreed to improve the availability and use of such models.

Accordingly, the third EWG in March 2019 (STECF 19-01) focused uniquely on updating and improving mixed-fisheries models. Several models of various complexity were presented and tested for the two regions (EMU1 & and EMU2). Good progresses were achieved but the most important issue left was the need to develop a single combined model for EMU1 including data from both Spain and France together, instead of the existing models by GSA. In addition, the EWG listed numerous other issues and future questions regarding data and models' dimensions (e.g. stock definition, inclusion of other species than the MAP species etc).

The fourth EWG in October 2019 (STECF 19-14) was the continuation of this work, progressing further on these issues in order to have models and datasets fully operational for providing mixed-fisheries advice on the MAP. In particular, a first version of a combined IAM model for EMU1 was presented, including both Spanish and French fleets but including only hake data. Two models were run in parallel for EMU 2 (BEMTOOL and SMART), providing different insights on future development. During the EWG 19-14, specific focus was also given to how to simulate closed areas in the bio-economic models to evaluate their potential impact in the medium-term.

The fifth EWG in October 2020 (STECF 20-13) was largely an update of STECF 19-14 regarding models and scenarios (see ToRs). The models were updated with the most recent assessment data (from STECF EWG 20-09) and FDI effort data (from STECF 20-10) and extended to cover some of the gaps previously identified (mainly for EMU 1), and a number of scenarios were run. Additional issues were though considered. In 2020, the West Med MAP has been implemented since January 1st, through Regulation (EU) 2019/1022, with fishing opportunities in terms of maximum allowable fishing effort in fishing days fixed for 2020 in Council Regulation (EU) 2019/2236. The EWG compared the

reference levels used for fishing effort quotas and discussed the implications of the sometimes large discrepancies observed between scientific and policy data.

The sixth EWG in March 2021 (STECF EWG 21-01) explored the datasets on the trawl fleets exploiting demersal stocks to estimate the conversion factors between fleet segments to ensure that effort swaps will not lead to an undesirable increase in fishing mortality. The EWG highlighted the need to have data at fishing trip (VMS data) level when estimating conversion factors. The impact of recreational fishery on the stocks covered by the Western Mediterranean Multi-Annual Plan was found to be negligible. The EWG also assessed the proposals for additional closure areas for 2021 received from Spain, but had no time nor data to propose alternative closure areas for EMU 1 and 2.

The seventh EWG held the last week of September 2021 (STECF EWG 21-13) was partially an update of STECF 20-13 and partially an update of STECF 21-01. The models were updated with the most recent assessment data (from STECF EWG 21-11) and FDI effort data (from STECF 21-12) and extended (compared to last year) to run scenarios accounting for alternative selectivity and introduction of TACs. The EWG updated the F-E relationships and estimated conversion factors at metier and stock level. In 2021, the second year of the West Med MAP has been implemented since January 1st, through Regulation (EU) 2021/90, setting fishing opportunities in terms of maximum allowable fishing effort in fishing days for 2021. This year as well the EWG compared the reference levels used for fishing effort quotas and found large discrepancies between scientific and policy data, the implications were discussed during the EWG.

The eighth EWG held the first week of March 2022 (STECF EWG 22-01) was a technical exercise to improve the mixed-fisheries modelling frameworks in preparation of future EWGs. The EWG focused on the evaluation of two specific management measures considered in the western Mediterranean MAP: maximum catch limits (MCLs) and closure areas. In order to evaluate these measures in isolation from others considered in the western Mediterranean management plan, effort reductions applied in 2022 following Regulation (EU) 2022/110 were not considered during EWG 22-01. MCLs on ARA and ARS (following Regulation (EU) 2022/110) and on HKE and existing closure areas were evaluated. EWG 22-01 evaluated the possibility of defining additional closure areas with the available data and highlighted numerous limitations in the process.

The ninth EWG held the last week of September 2022 (STECF EWG 22-13) was partially an update of STECF 21-13. The models were updated with the most recent assessment data (from STECF EWG 22-09) and FDI effort data (from STECF 22-10) and extended (compared to last year) to run scenarios accounting for effort reductions of trawlers, longliners and netters at the same time. Additionally vessel number reduction was considered as well. No additional closure areas from the existing ones were considered and MCLs were accounted only for ARA and ARS stocks. An increase in selectivity was accounted for as well. All management scenarios were run twice under two different economic regimes during projections: the first with fuel price fixed as the average price estimated for 2022, the second one with fuel price increased by 120% from 2023 onwards. The EWG updated the F-E relationships and estimated F by GSA and by gear for all stocks. In 2022, the third year of the West Med MAP has been implemented since January 1st, through Regulation (EU) 2022/110, setting fishing opportunities in terms of maximum allowable fishing effort in fishing days and in 22 terms of the maximum catch limits (MCLs) for 2022. This year as well the EWG compared the reference levels used for fishing effort quotas and found large discrepancies between official and policy data, the implications were discussed during the EWG.

The 10$^{th}$ EWG held the last week of February 2023 (STECF EWG 23-01) was partially dedicated to continue the development of socio-economic indicators to be used in the evaluation of management measures for the West Med MAP in both West Med management units. Two roadmaps were discussed, a short term approach and a long term approach which would consider the expansion of all the mixed-fisheries bio-economic models to both management units. As a first step, the EWG focused on the proposal of harmonizing the

economic indicators across the models implemented in order to make projections comparable for the next EWG. The second half of the EWG was partially an update of the technical exercise held during EWG 22-01 on the evaluation of closure areas in EMU 1 and 2. New closure areas for 2023 were submitted solely by Spain. The EWG tested the effect of existing and additional closure areas in EMU 2 (GSA 9, 10, 11) and GSA 7 but not GSA 1, 5 and 6. Finally the EWG revised Article 8 of the 2023 fishing opportunities under the West Med MAP (COUNCIL REGULATION (EU) 2023/195), which lists the compensation mechanisms that MSs can implement within the West Med MAP to obtain additional fishing days in 2023.

This 11th EWG held the last week of September 2023 (STECF EWG 23-11) was partially an update of STECF 22-11. The models were updated with the most recent assessment data (from STECF EWG 23-09) and FDI effort data (from STECF 23-10). Within the scenarios the models accounted for all the effort reductions on trawlers since 2020, the MCLs on ARA and ARS and the closure areas implemented since 2020. Compensation mechanisms (increase of 3.5% of effort) obtained by MSs in 2023 were accounted for as well together with vessel capacity reduction due to decommissioning schemes. Scenarios tested the effect of compensation mechanisms in 2024 and the effort reduction needed to reach Fmsy for all stocks in 2025, only two scenarios, Status quo and L (selectivity improvement on the deep-water fleet) did not account for the Fmsy constraint. This year as well the EWG compared the reference levels used for fishing effort quotas and found discrepancies between official and policy data, the implications were discussed during the EWG.

### 1.1 Terms of Reference for EWG-23-11

In the objective of reaching MSY by 1 January 2025 at the latest for all Western Mediterranean demersal target stocks, EWG 23-11 is requested to:

**TOR 1**. Based on the work of the FDI EWG in September 2023, compile and provide complete sets of annual data on fishing effort from 2015 to 2022. This should be described in terms of fishing days, days at sea, GT*days, fishing hours and nominal effort by Member State, GSA, vessel lengths[1] (4 fleet segments: < 12m, 12m to 18m, 18m to 24m and > 24m) and, where possible, by fishing gear.

**TOR 2**. Update the F-E analyses for Effort Management Units 1 and 2 with the most recent socio-economic and biological data and the most recent stock assessments' results. Given the fuel-related situation in 2022-2023, collect qualitative information on the situation and estimate if possible the consequences of fuel and other costs changes in 2022-2023, if possible for the different types of vessel sizes and fishing gears, with the most updated available data and expert knowledge.

**TOR 3**. Develop, as in previous years, effort and catch management scenarios for all demersal fishing gear (e.g. bottom trawls, nets, longlines) in EMU1 and EMU2. All scenarios should account for the management measures adopted in 2020, 2021, 2022 and 2023. The scenarios aim at identifying and evaluating the best possible transition path towards MSY for all demersal stocks by 1 January 2025.

Examples of plausible management scenarios, including the compensation mechanism implemented in 2022 and 2023, are provided in Table 1 in Annex as well as the references to the legal texts adopted for the implementation of EU-level and national management measures in place since 2020.

[1] See ToR 6.5 in STECF PLEN 21-03 pages 120-121 and Annex pages 155-167.

**TOR 4.** Based on the advice structure developed in 2021 (EWG 21-13) and the template tables for outputs in Annex of the present ToR, provide a synoptic overview of: (i) the source of data and methods and; (ii) the management advice.

The intention is to provide an overview of the measures needed to achieve MSY by 1 January 2025 and what are the socio-economic impact of these measures. The measures in question are focused on a range of trawling effort and catch reductions. The evaluation of the socio-economic impact could use the latest work done by STECF and JRC for the Annual Economic Report.

**TOR 5**. To ensure that all unresolved data transmission issues encountered prior to and during the EWG meeting are reported on line via the Data Transmission Monitoring Tool (DTMT) available at https://datacollection.jrc.ec.europa.eu/web/dcf/dtmt. 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.

## Annexes

**References to legal texts:**

- Annex 1 of 2020[2], Annex 3 of 2021[3], Annex 3 of 2022[4] Fishing Opportunities[5] and Annex 3 of 2023 Fishing Opportunities[6].

- French Ministerial Decree for closures in adopted in 2020 (JORF 0299, text n°85);

- Spanish Ministerial Decree for closures in adopted in 2020 (ORDEN-APA-423-2020 and OM 1212-20), 2021 (ORDEN-APA-1341-21) and 2023 (ORDEN-APA-2023-2571);

- Italian Ministerial Decree for closures in adopted in 2020 (DECR.DIR.Zonechiusura_prot_9045689).

As well as GFCM recommendation on Gulf of Lion 44/2021/5

**Management scenarios**

For each scenario, the models have to be run with the management measures adopted at EU and national level in 2020, 2021, 2022 and 2023, which from 2022 onwards include both effort and catch management measures.

Namely, for trawlers: 10% reduction of effort applied in 2020, 7,5% reduction of effort applied in Spain and France in 2021 (resp. 10% reduction in Italy in 2021), 6% reduction of effort applied in all 3 Member States in 2022, except for French and Spanish vessels active in GSA 7 in France where the reduction is of 4% from the

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_10485_2020_INIT&qid=1655826077148&from=EN https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1485&qid=1655826077148&from=EN

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0090&qid=1655826077148&from=EN

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0110&qid=1655826077148&from=EN

[6] https://eur-lex.europa.eu/legal-content/AUTO/?uri=CELEX:32023R0195&qid=1688397098419&rid=1

compensation mechanism, and, in 2023, 7% for Italy while 3,5% for 90% of the fleet from France and Spain from the compensation mechanism.

***For the Fishing Opportunities for 2024, the MAP will be in the final year of the transition period and the legal obligation is to propose the remaining 9,5% effort reduction for trawlers as not all stocks are at MSY.***

There has not been reduction of effort for the other fishing gear than trawlers.

As in previous EWGs, the percentages of reduction of trawlers effort given in the scenarios are calculated in reference to the baseline period 2015-2017.

Scenarios should be run till 2030 in order to estimate the short and mid-term impact of the management measures from a stock as well as a socio-economic perspective. However, the interpretation of the model outputs should focus on achieving MSY by 1 January 2025 and identifying the best combination of measures to achieve this.

(1) * In all scenarios, to account for closure areas the catchability is adjusted to reflect the closure areas adopted in French, Italian and Spanish national legislations, see list above.

** All reductions are applied to the baseline (which corresponds to the average value of FDI fishing effort by fleet between 2015 and 2017).

| | Scenario (priority in grey*) | Trawler effort reduction in 2024** | Compensation mechanism for trawlers** | Post 2025 effort management | Combined catch limits (ARA and ARS) for 2024 | post 2025 for catch limits (ARA &ARS) |
|---|---|---|---|---|---|---|
| 1 | **Status Quo*** | roll over effort in 2023 | No Compensation mechanism | roll over effort in 2023 | roll over catch limit 2023 | roll over catch limit 2023 |
| 2 | **A*** | 2024: level of reduction that secures Fmsy by 1 January 2025 for all stocks | No Compensation mechanism | keep at Fmsy | roll over catch limit 2023 | roll over catch limit 2023 |
| 3 | B | 9.50% | No Compensation mechanism | Effort to be set at Fmsy from 2025 | -7% in 2024" | keep at Fmsy |
| 4 | **C*** | 9.50% | 4% [4 week closure] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: level of reduction that secures Fmsy by 1 January 2025 for all stocks | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 5 | **D*** | 9.50% | 4% [Selectivity improvement] 2024 (50% uptake in the fleet) & onwards | Effort to be set at Fmsy from 2025 | 2024: -5% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 6 | **E*** | 9.50% | 5% [large and over 6mo-temporary closures] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: -7% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 7 | F | 9.50% | 4% [4 week closure] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: -7% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 8 | G | 9.50% | 4% [Selectivity improvement] 2024 (50% uptake in the fleet) & onwards | Effort to be set at Fmsy from 2025 | 2024: level of reduction that secures Fmsy by 1 January 2025 for all stocks | level of reduction that secures Fmsy from 2025 onwards for all stocks |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | H | 9.50% | 5% [large and over 6mo-temporary closures] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: -5% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 10 | I | 9.50% | 4% [4 week closure] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: -5% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 11 | J | 9.50% | 4% [Selectivity improvement] 2024 (50% uptake in the fleet) & onwards | Effort to be set at Fmsy from 2025 | 2024: -7% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 12 | K | 9.50% | 5% [large and over 6mo-temporary closures] 2024 & onwards | Effort to be set at Fmsy from 2025 | 2024: level of reduction that secures Fmsy by 1 January 2025 for all stocks | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| 13 | **L*** | roll over effort in 2023 | 4% [Selectivity improvement] 2024 (50% uptake in the fleet) and onwards | roll over effort in 2023 and 100% of the fleet improving gear selectivity in 2025. | roll over catch limit 2023 | roll over catch limit 2023 |

***For the compensation mechanism for trawlers, scenarios could work with an estimated proportion (50%) of the fleet having implemented one of the criteria.***

***Please note that for each scenario the closure areas adopted in 2020-2021-2022 and 2023 should be taken into account.***

***In addition, for each scenario, the number of vessels should be, as per the latest estimations, 695 for Italian trawlers, 48 for French trawlers and 571 for Spanish trawlers.***

**2) Biological outputs for all West Med stocks**

Table 2.1: Total catches by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock catch advice for 2024 | Catches per scenario 2024 (in tons) | | | | | |
|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f |
| *One line per stock* | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Table 2.2: Fishing Mortality (F) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice F for 2024 | F(2024) resulting from scenario | | | | | |
|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f |
| *One line per stock* | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Legend:

| | |
|---|---|
| | F2024 < Fmsy |
| | Fmsy < F2024 < Fpa |
| | Fpa < F2024 < Flim |
| | F2024 > Flim |

Table 2.3: Spawning stock biomass (SSB) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice SSB for 2024 | SSB(2024) resulting from scenario | | | | | |
|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f |
| *One line per stock* | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Legend:

| | |
|---|---|
| | SSB2024 >Bpa |
| | SSB2024 > Blim Fpa |
| | Blim < SSB2024 < Bpa |
| | SSB2024 < Blim |

**3) Socio-economic outputs for all West Med stocks**

As in 2022, the scenarios' socio-economic outputs should be summarized in a table with estimates by 2025 (short-term) and by 2030 (mid-term), for each Member State the landings of the main stocks could be used to calculate the socio-economic indicators:

| Scenarios | MS | Estimated level of F for target species in 2024 | Estimated level of F for target species in 2025, resp. 2030 | Estimated % landings of target species change 2020-2024 | Estimated % landings of target species change 2020-2025, resp. 2030 | Estimated level of profitability (gross profit margin) in 2024 | Estimated level of profitability (gross profit margin) in 2025, resp. 2030 | Estimated loss of FTE on-board 2020-2024 | Estimated loss of FTE on-board 2020-2025, resp. 2030 | Estimated % Gross profit margin 2020-2025, resp. 2030 | Estimated % loss of FTE on-board 2020-2025, resp. 2030 | Estimated Number of fleet segments in red (which do not cover costs and may not |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | **be financially viable) in 2025, resp. 2030** |
| A | **ES** | | | | | | | | | | | |
| | **FR** | | | | | | | | | | | |
| | **IT** | | | | | | | | | | | |
| B | **ES** | | | | | | | | | | | |
| | **FR** | | | | | | | | | | | |
| | **IT** | | | | | | | | | | | |
| C | **ES** | | | | | | | | | | | |
| | **FR** | | | | | | | | | | | |
| | **IT** | | | | | | | | | | | |
| D | **ES** | | | | | | | | | | | |
| | **FR** | | | | | | | | | | | |
| | **IT** | | | | | | | | | | | |
| E | **ES** | | | | | | | | | | | |
| | **FR** | | | | | | | | | | | |
| | **IT** | | | | | | | | | | | |

**Time allowing, a similar table by fleet segment could also be developed.**

## 1.2 Main findings

**KEY FINDINGS FOR EMU1 (GSAs 1 2 5 6 7) (IAM model)**

In EMU 1, several stocks are currently strongly overexploited, including Hake (HKE) in GSAs 1-5-6-7, red mullet (MUT) in GSA 1 and in GSA 6, Nephrops (NEP) in GSA 6, and blue and red shrimp (ARA) in GSAs 1-2, GSA 5 and in GSAs 6-7. The four scenarios investigated with the IAM model simulated implementation of maximum catch limits (MCL) on blue and red shrimps, improvement of deep water trawl selectivity along with compensation mechanisms, and reduction of trawler fishing effort to reach Fmsy of Hake in 2025 and after. It is important to note that adjusting the fishing effort of French and Spanish trawlers to reach Fmsy of Hake in GSAs 1-5-6-7 makes it possible to secure the Fmsy for all stocks, with the exception of MUT in GSA 1 (in 2025 and after: its Fbar is lower than its Fupper, but slightly higher than its Fmsy).

Only the scenarios adjusting trawler fishing effort to reach Fmsy of Hake (i.e. scenarios A and D) foresee exploitation levels in line with the objectives of the plan, i.e. all stock at Fmsy in 2025. With the two other simulated scenarios, in which only maximum catch limit on ARA was applied, with or without selectivity measures on deep water trawls, i.e. scenarios Status Quo and L, respectively, the stocks of Hake in GSA1567, red mullet in GSA1, red mullet in GSA6, Nephrops in GSA 6, and blue and red shrimp in GSA 5 do not reach the objective of Fmsy in 2025.

Scenarios SQ and L (for which only catch limit on ARA is applied without implementation of Fmsy) forecast overall constant levels of exploited stock biomasses, except for ARA5 and ARA67, for which biomass increases, with a higher slope of increase for ARA67 than for ARA5. By 2030, fishing mortality for ARA stocks decreases towards Fupper for ARA5, and toward Fmsy for ARA67. It should be noted that the ARA5 stock is the most binding. Furthermore, the level of maximum catch limit set in 2023 allows moving towards Fmsy target for ARA in the long term, but not for other stocks, such as Hake, red mullet in GSA 1 and 6 and Nephrops in GSA6.

Scenarios A and D, in which efforts are adjusted to achieve Fmsy of Hake (and therefore of all stocks) in 2025 and after, predict important increases in the spawning stock biomasses (SSB) of the exploited stocks. However, both scenarios foresee some significant negative socio-economic impacts for French and Spanish trawlers in the short and medium term, with a reduction in their Gross Value Added, Gross Profit, employment in terms of Full Time Equivalent (FTE), and average wages. Their fishing effort is in fact extremely reduced in order to reach Fmsy, and even if operating costs are thus reduced, it appears that it does not cover the important decrease in income resulting from effort reductions. More specifically, if we consider the gross profit margin, an significant drop below zero is expected in the short term (i.e. between 2023 and 2024 for scenario A, and between 2024 and 2025 for scenario D) for French and Spanish trawlers above 12 meters, but after that it increases towards zero in the medium term (i.e. between 2025 and 2030). Spanish trawlers between 18 and 24 meters are expected to recover faster than other trawler fleet segments, with their gross profit margin close to or even slightly above (depending on recruitment simulations) zero in 2030.

Meanwhile, other fleet segments are expected to benefit economically from this reduction in trawler fishing effort. This is particularly the case for French and Spanish vessels using hooks (HOK) of 6-12 meters, Spanish vessels using hooks of 12-18 meters, French and Spanish netters of 6-12 meters, and Spanish netters of 12-18 meters. These fleets are benefiting from the increases in biomass of the exploited stocks due to the reduction in trawler efforts.

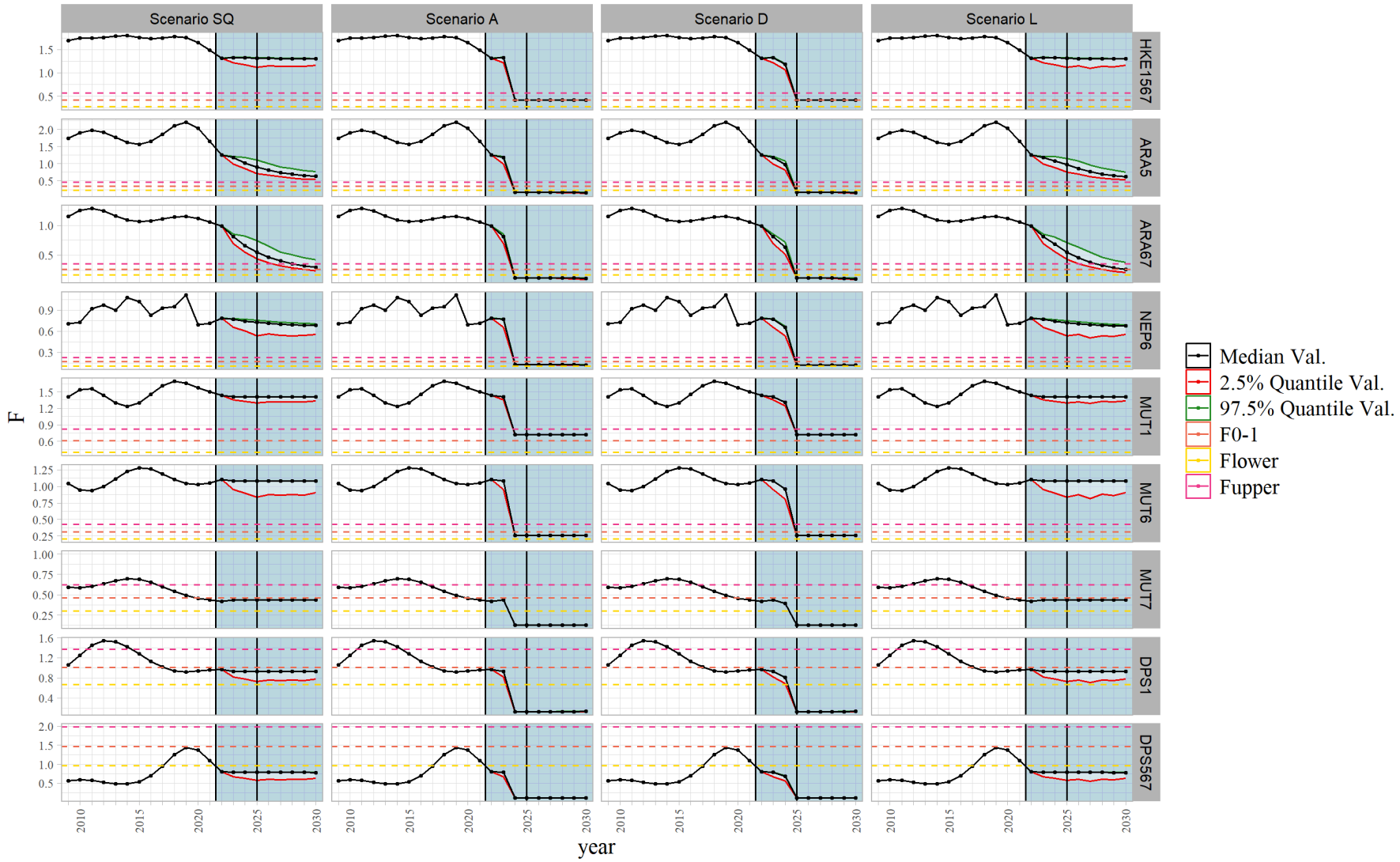



Figure 1.2.1. EMU 1 (IAM model). Predicted Fishing mortalities (Fbar) by modelled stock (in row) under alternative scenarios (in column). The stocks are as follow (from top to bottom): hake GSAs1-5-6-7 (HKE1567), blue and red shrimp GSA5 (ARA5), blue and red shrimp GSAs6-7 (ARA67), Norway lobster GSA6 (NEP6), red mullet GSA1 (MUT1), red mullet GSA6 (MUT6), red mullet GSA7 (MUT7), deep-water rose shrimp GSA1 (DPS1), and deep-water rose shrimp GSAs5-6-7 (DPS567). Historical values of Fbar are given in the white areas and simulated values in

the blue area. Estimated F 0-1, Flower and Fupper from EWG 23-09 stock assessments are represented. Simulations run until 2030 and vertical black lines indicate the year 2025.

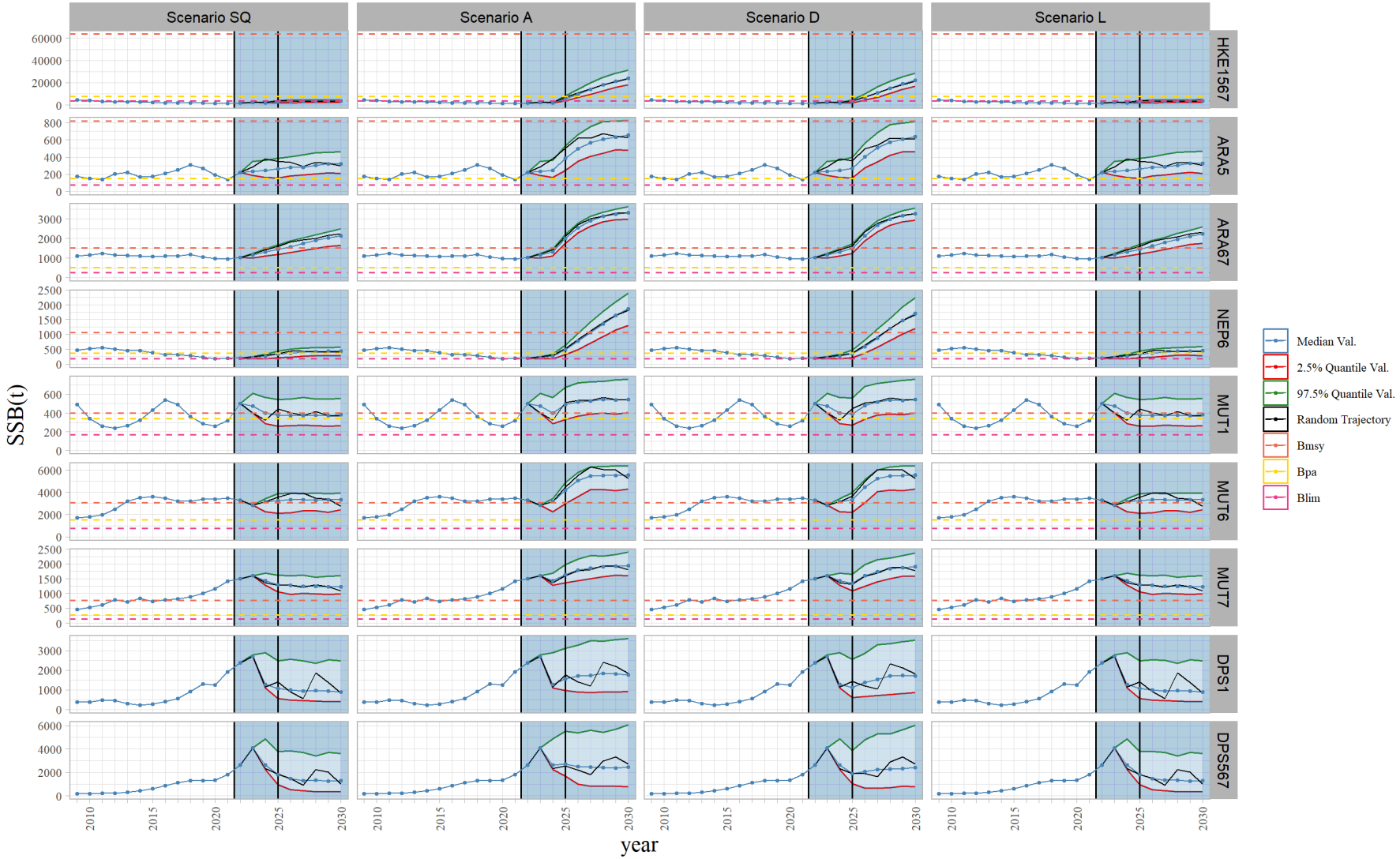


Figure 1.2.2. EMU 1 (IAM model). Predicted Spawning Stock Biomasses (SSB) by modelled stock (in row) under alternative scenarios (in column). Historical values of SSB are given in the white areas and simulated values in the blue area. Simulations run until 2030 and vertical black lines indicate the year 2025. The stocks are as follow (from top to bottom): hake GSAs1-5-6-7 (HKE1567), blue and red shrimp GSA5 (ARA5), blue and red shrimp GSAs6-7 (ARA67), Norway lobster GSA6 (NEP6), red mullet GSA1 (MUT1), red mullet GSA6 (MUT6), red mullet GSA7 (MUT7), deep-water rose shrimp GSA1 (DPS1), and deep-water rose shrimp GSAs5-6-7 (DPS567). Estimated Bmsy, Bpa and Blim from EWG 22-09 stock assessments are represented.

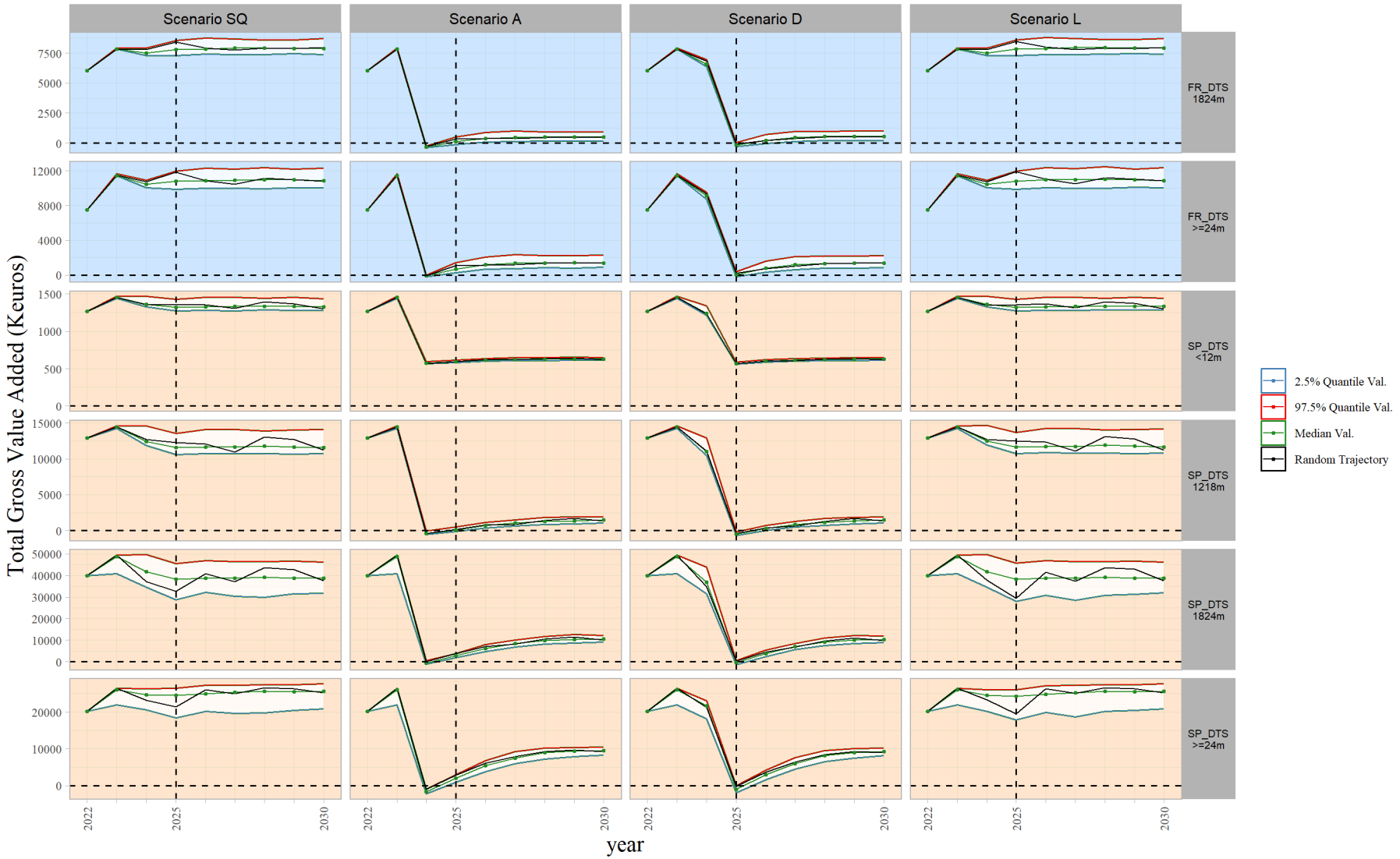



Figure 1.2.3. EMU 1 (IAM model). Evolution of the total Gross Value Added (GVA, i.e. proxy for the profit, in K euros) by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

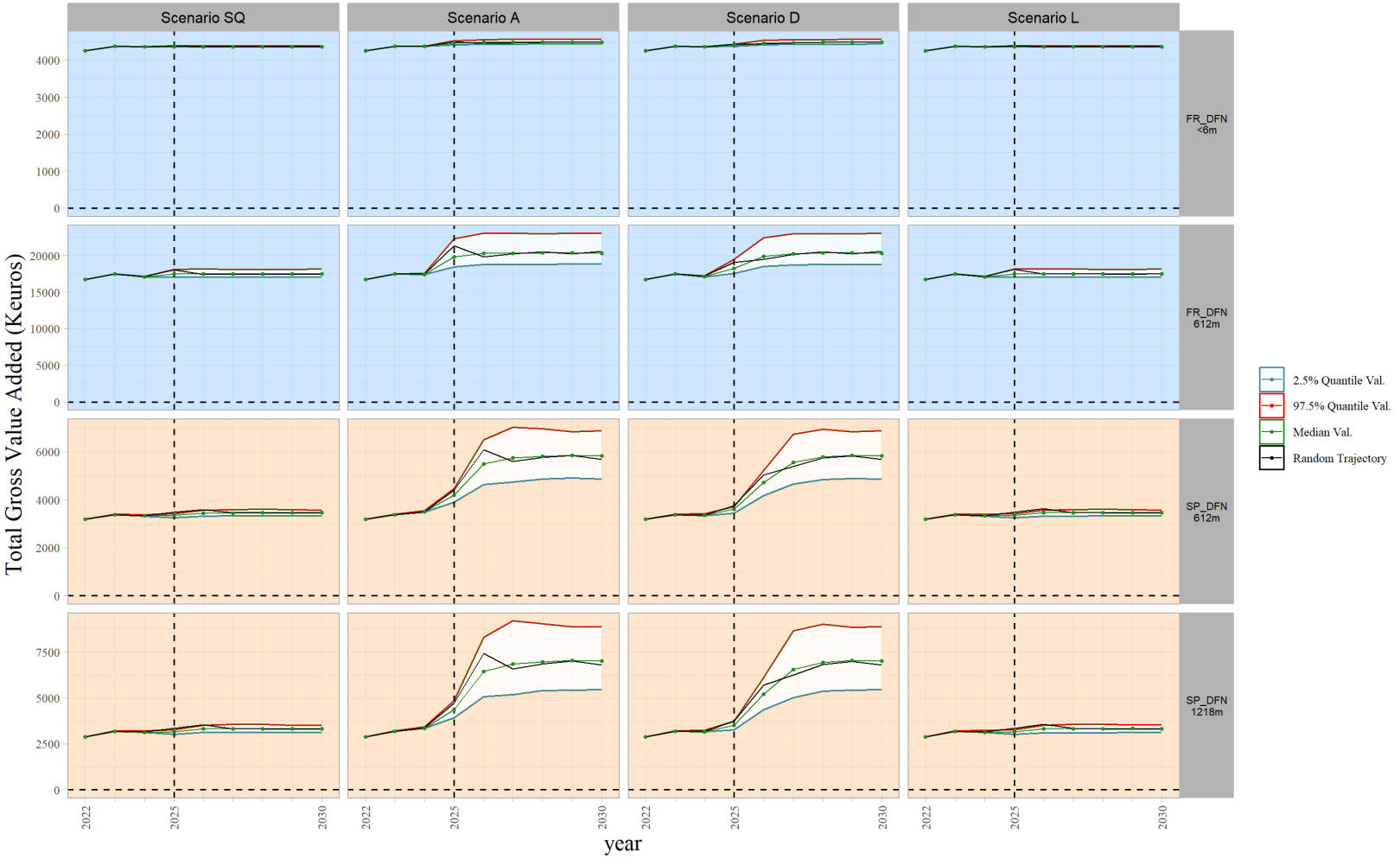



Figure 1.2.4. EMU 1 (IAM model). Evolution of the total Gross Value Added (GVA, i.e. proxy for the profit, in K euros) by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

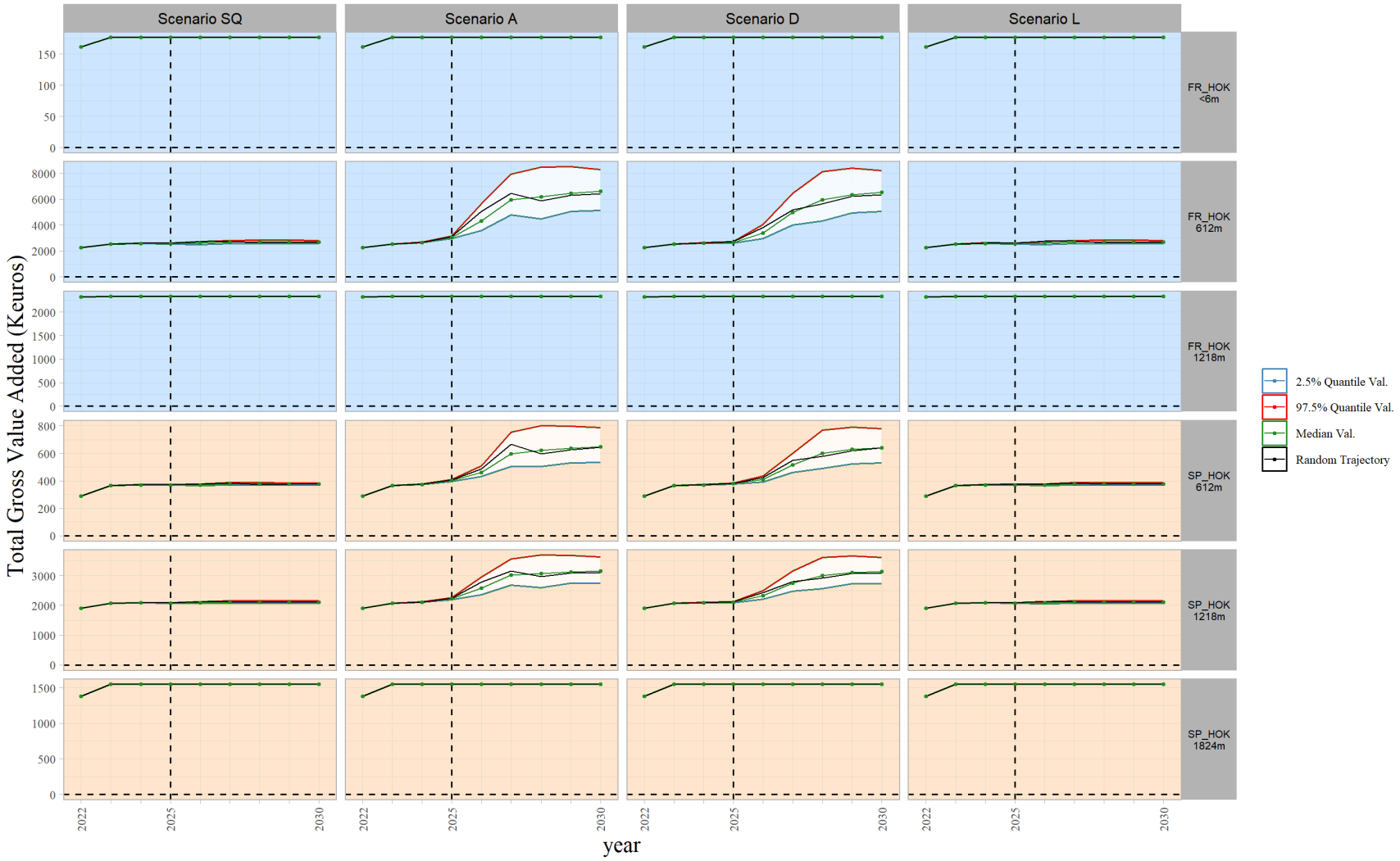



Figure 1.2.5. EMU 1 (IAM model). Evolution of the total Gross Value Added (GVA, i.e. proxy for the profit, in K euros) by vessels using hooks fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m.

## KEY FINDINGS FOR EMU1 (GSAs 1 2 5 6 7) (ISIS-Fish model)

ISIS-Fish implemented in EMU 1 simulated the effort reductions and spatio-seasonal closures described in scenarios SQ, A, B, C and E and their impact on hake dynamics and fleets' performances.

The SQ scenario did not achieve the objective of the plan regarding hake, as fishing mortality stays way above Fmsy and the SSB below Blim. The four other scenarios, A, B, C and E, on the contrary succeeded in reaching Fmsy at the latest in 2028 and Hake SSB was above Blim but below Bpa starting in 2029. Despite minor differences between the scenarios B, C and E, the determinant factor was the adjustment of effort to reach Fmsy, which implied reductions in effort level of more than 60% compared to 2022 FDI values. Scenario A where the constraint is applied as soon as 2024, reaches Fmsy in 2025.

Economic indicators for ISIS-Fish could not be reported due to a mistake in the computation that needs revision. The trends are reported in the Results section within the report but should be taken with caution.

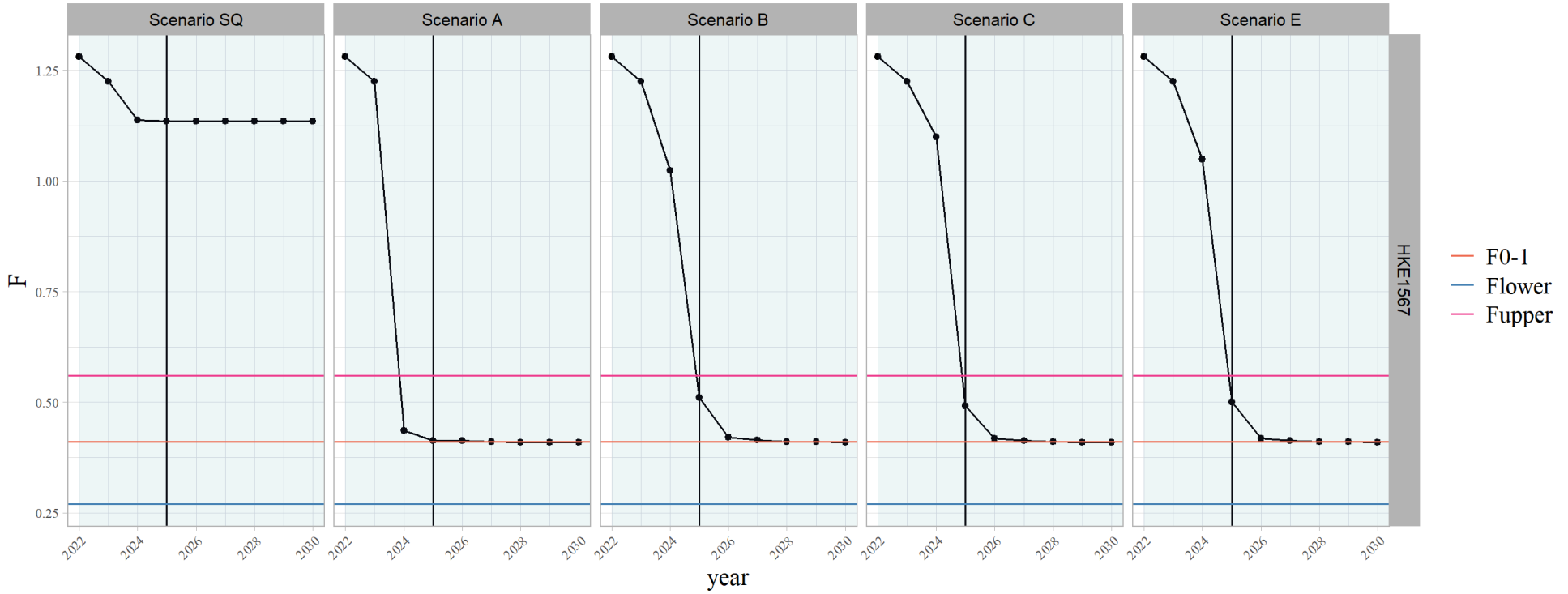



Figure 1.2.6. EMU 1 (ISIS-Fish model). Predicted Fishing mortalities (Fbar) of Hake1567 under alternative scenarios (in column). Estimated F 0-1, Flower and Fupper from EWG 23-09 stock assessments are represented. Simulations run until 2030 and vertical black lines indicate the year 2025.

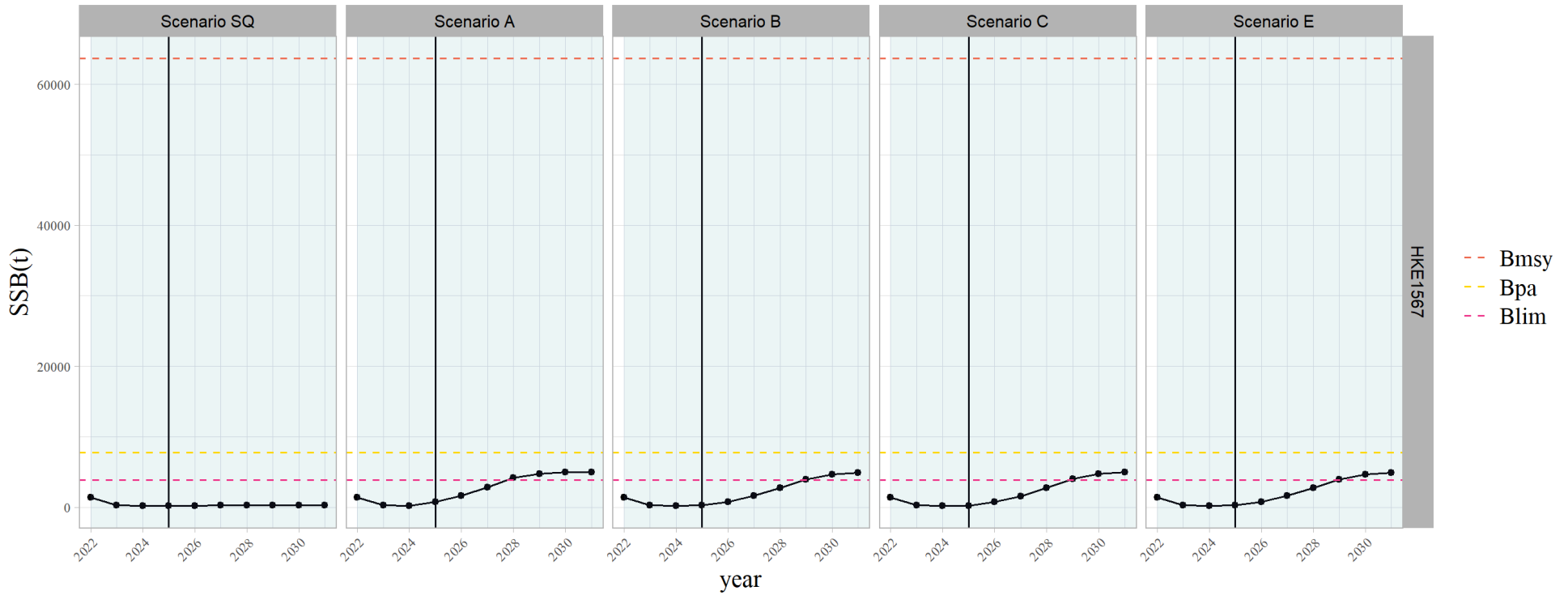



Figure 1.2.7. EMU 1 (ISIS-Fish model). Predicted Spawning Stock Biomasses (SSB) of Hake1567 under alternative scenarios (in column). Simulations run until 2030 and vertical black lines indicate the year 2025. Estimated Bmsy, Bpa and Blim from EWG 22-09 stock assessments are represented.

## KEY FINDINGS FOR EMU 2 (GSAs 8 9 10 11) (BEMTOOL model)

The most overexploited stocks in EMU 2 are hake (HKE 8-9-10-11) and giant red shrimp (ARS 8-9-10-11). The setting of a maximum catch limit foreseen in the EU Regulation 2022/110 would allow to approach $F_{MSY}$ for ARS, but not for HKE, even when in combination with other measures such as reduction of fishing days change in selectivity.

For ARS, MUT9 and DPS the Fmsy level is reached by 2025 for all the scenarios explored. For DPS an increase in F is expected in 2024 for scenario L, due to the reallocation of the effort induced by the catch limit, but in 2025 the value is below Fmsy. For HKE and NEP9 only scenarios A, C and D allow to reach Fmsy in 2025, while SQ and L have F well above the reference point. It should be noticed that the change in selectivity implemented in scenario L show a slight improvement respect to the SQ scenario for hake, but it does not allow to reach Fmsy in 2025. As a general consideration, the scenarios most impacting on the effort highlight the risk of underutilization of the stocks that currently already are close or in line with the reference point.

Using the biomass reference points of EWG 23-09, all the stocks show SSB levels above or very close the Bpa, highlighting the improvement associated to the measures previously implemented by the MAP and all alternative scenarios.

The results of the economic indicators showed that in the short term for all the alternative scenarios is expected a decrease, that generally is followed by an increase in the medium-long term. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target. The worst scenario for PGP is scenario A, severely impacting also on their effort already in 2024.

Concerning GVA, for GSA 9 the SQ is the best performing scenario for bigger DTS (1218, 1824 and 2440), while DTS0612 benefits more from scenario C and D. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target.
For GSA 10 the SQ is the best performing scenario for DTS 0612, 1218 and 1824, while DTS2440 benefits more from scenario C and D. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target. The worst scenario for PGP is scenario A, severely impacting also on their effort already in 2024.
For GSA 11 the best performing scenario for DTS 1218, 1824 and 2440 isD, followed by C. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target. A similar trend is shown by Gross Profit (GP).
Looking at the average salary, for all fleet segments in GSA 9, the scenarios return an average salary higher than the one observed in 2021; specifically, for DTS 0612 SQ scenario is the best performing, while for DTS 1218 and 1824 the C and D are the best performing. For PGP fleet segments, scenarios D return a value similar to SQ.

In GSA 10, for DTS 0612 SQ and D scenarios are the best performing, while for DTS 1218 and 2440 scenario A is the best performing. For DTS 1824 A is the best in short term, but D in medium and long. For PGP fleet segments, scenarios A return the highest average salary.

Also in GSA 11, for all fleet segments, the scenarios return an average salary higher than the one observed in 2021, except for DTS2440; specifically, for DTS 0612 SQ scenario is the best performing together with D, while for DTS 1218 and 1824 scenario D is the best performing, followed by C and SQ. For PGP fleet segments, scenarios D return a value similar to SQ.

It should be also noticed that the GP and the GPM do not take into account possible subsidies received by operators to face the recent fuel costs increase and the decrease in the number of effort quotas, because this information was not available. This may have impacted negatively on the economic indicators, projecting a worse situation respect to the actual one (underestimating the GPM).

Moreover, the lack of MEDITS data for 2022 could have increased the uncertainty of the stock assessment results, that feed BEMTOOL model for the biological and pressure component. This issue should be considered as an additional amount of uncertainty on the projections, although limited respect to the process error. Another important aspect is the missing stock assessment for MUT10 and ARA91011. The proxy used in the model for the projections, need to be soon replaced by quantitative updated stock assessment results in order to improve the accuracy of the results.

Finally, in the model, a linear relationship between FTE and total fishing days has been assumed for simplicity. Nevertheless, this assumption should be verified through a specific analysis on the historical data.

It is important to note that the scenarios here presented do not consider the adaptation of the catch limit to the status of the stock (e.g. $F_{MSY}$, SSB) that is expected to change during the application of management measures.

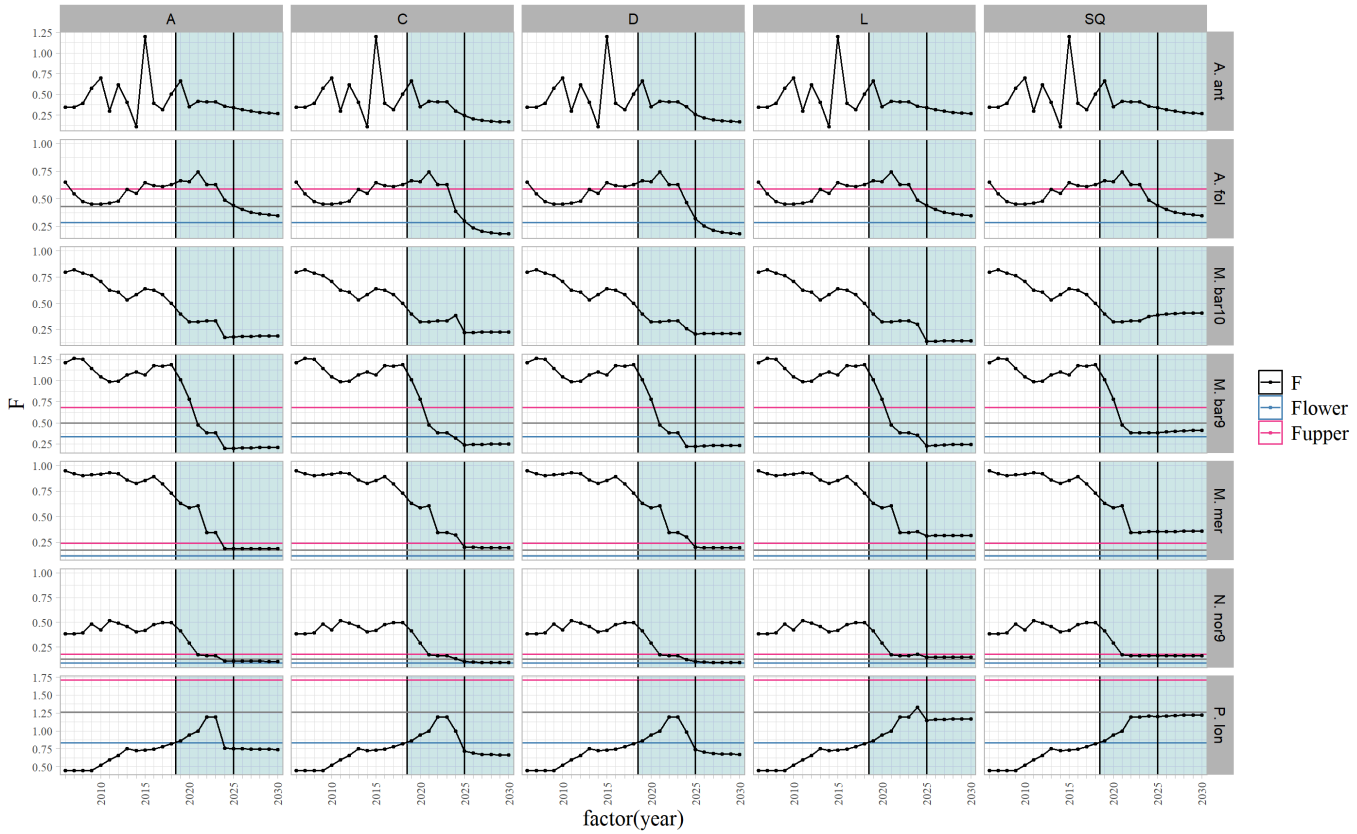



Figure 1.2.4. EMU 2 (BEMTOOL model). Predicted Fishing mortalities by modelled stock (in row) under the MAP scenario of effort reduction (in column). The stocks are as follow (from top to bottom): Hake GSAs8-9-10-11 (HKE), red mullet GSA10(MUT10), red mullet GSA9 (MUT9),deep-water rose shrimp GDSs9-10-11 (DPS), Giant red shrimp GSAs9-10-11(ARS), Norway lobster GSA9 (NEP9) and blue and red shrimp GSAs9-10-11 (ARA). Historical values of Fbar are given in the white areas and simulated values in the blue area. Estimated F 0-1, Flower and Fupper from EWG 23-09 stock assessments are represented, in orange, blue and red horizontal lines, respectively.

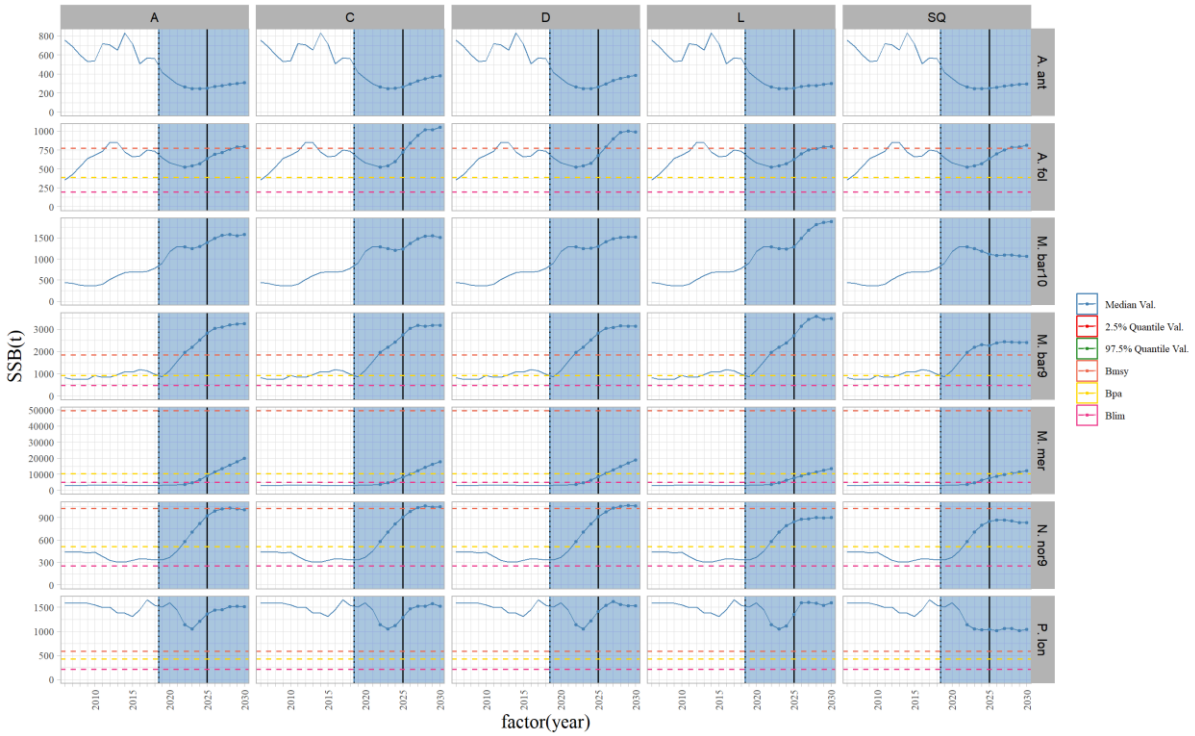



Figure 1.2.5 EMU 2 (BEMTOOL model). Predicted Spawning Stock Biomasses (in row) under the MAP scenario of effort reduction (in column). The stocks are as follow (from top to bottom): Hake GSAs8-9-10-11 (HKE), red mullet GSA10 (MUT10), red mullet GSA9 (MUT9), deep-water rose shrimp GSAs9-10-11 (DPS), Giant red shrimp GSAs9-10-11 (ARS), Norway lobster GSA9 (NEP9) and blue and red shrimp GSAs9-10-11 (ARA). Historical values of SSB are given in the white areas and simulated values in the blue area. Historical values of SSBs are given in the white areas and simulated values in the blue area. Simulations run until 2030 and vertical black lines indicate the year 2025.

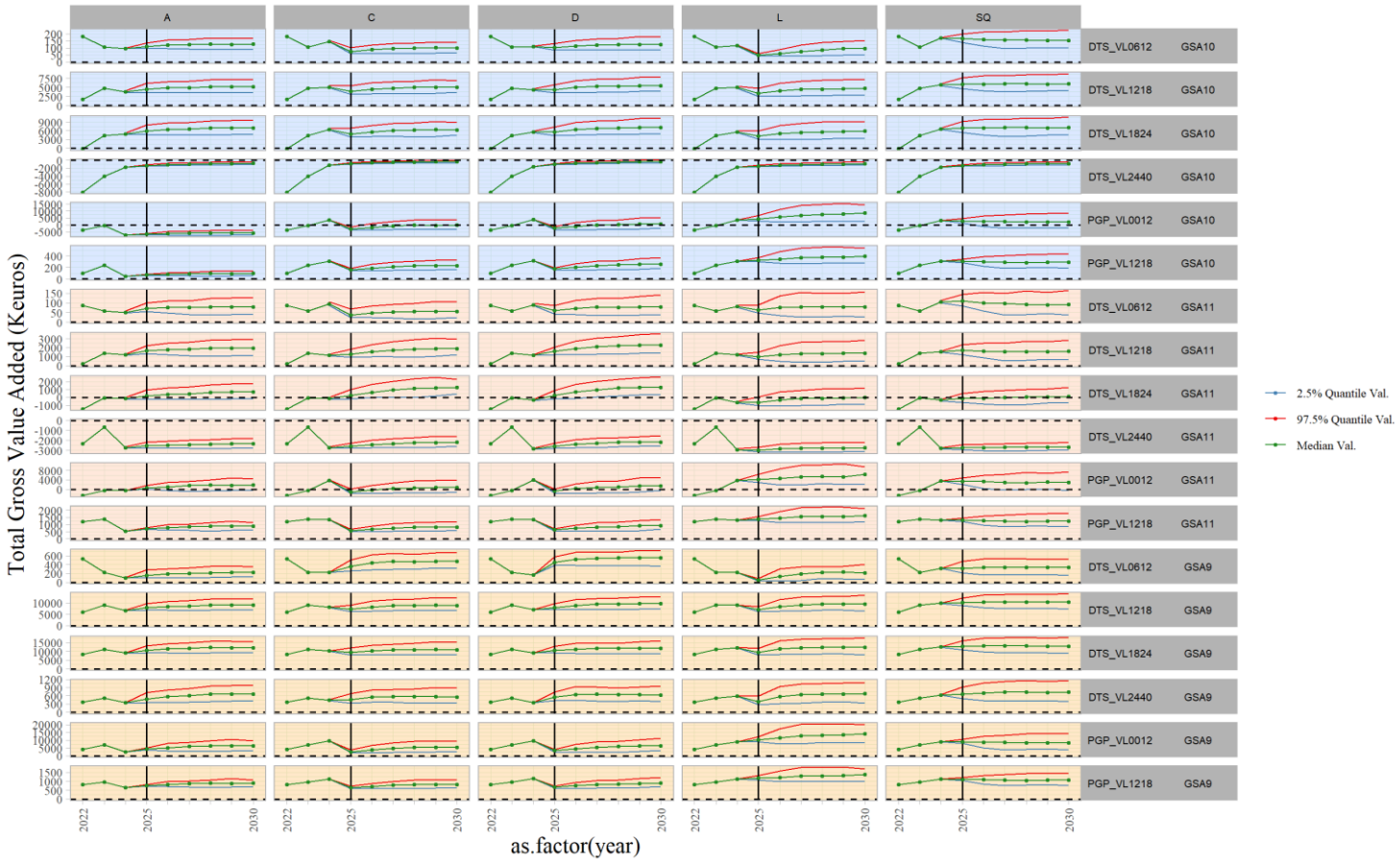



Figure 1.2.6. Evolution of the total Gross Value Added (GVA, i.e. proxy for the profit, in K euros) by fleet segment for each alternative scenario from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in r

## KEY FINDINGS FOR EMU2 (GSAs 9, 10, 11) (SMART model)

In the EMU 2, some stocks are currently overexploited, although for most of the stocks in the MAP the biomasses are increasing. Conceptually, the scenarios that were simulated during EWG 23-11 differed greatly from those that were examined in earlier iterations of the same working group. It's true that while some aspects of the new scenarios—like the presence of TACs on ARS and ARS catches or fishing effort—had already been modelled in earlier SMART applications, it was difficult to apply the model when a very strong constraint like fishing mortality—which is represented by the Post 2025 effort management column in all scenarios—was added.

The original workflow of SMART has to be modified to integrate the fishing mortality restriction shown in the columns "Trawler effort reduction in 2022" (for the Status quo, A, and L scenarios) and "Post 2025 effort management" in all scenarios, for the EWG23-11 scenarios. This adaptation was carried out as follows: for each scenario, the SMART optimizer was used to generate new potential fishing effort patterns that were then assessed against two criteria at each stage of the optimization process, following the introduction of all spatial, temporal, TAC, and selectivity constraints.

The predicted Spawning Stock Biomass (SSB) for the different scenarios shows important fluctuations, which are a typical characteristics of multi-species models such as SMART, in which trophic relationships between stocks are considered. For four of the five stocks (ARS, DPS, HKE, and MUT) the scenarios associated with the best effect on the stock are A, C, D, E and L. For NEP, the situation seems to be much more complex and only scenario A allows you to get close to the BPA (Precautionary Biomass Level) value. However, all the simulated scenarios show a substantial reduction in Gross profit margin. These reductions range between 22% (scenario A) and 8% (scenario L). It is interesting to note that this 'net' result is linked to large variations in expected costs and revenues. For example, in scenario A, there is a small reduction in costs (which generally results from the reduction in overall effort but also from the reduction in effort on fishing grounds far from the coast), while the corresponding loss of revenue is very large. In many other scenarios (e.g. J, K, L), on the contrary, the expected loss of revenue is smaller and sometimes associated with greater cost reductions. The combination of these two aspects results in a lower impact on the Gross Profit Margin.

Overall, the simulations run show that:

- The majority of the scenarios — many of which are also extremely close to one another from a management perspective — would affect stocks in terms of Fbar and SSB virtually identically.
- Scenarios A and L are the only notable outliers, being (Scenario A) the most impacting in terms of economic performance of the fleet and in terms of positive effects on the stocks and (Scenario L) the less impacting in terms of economic performance.
- The variations between all the scenarios are more noticeable from an economic perspective (at least in terms of the immediate impact on fleets). The scenarios with the most profit losses are A, B, C, and D, whereas the scenarios with the least amount of negative effects are G, L, and J.

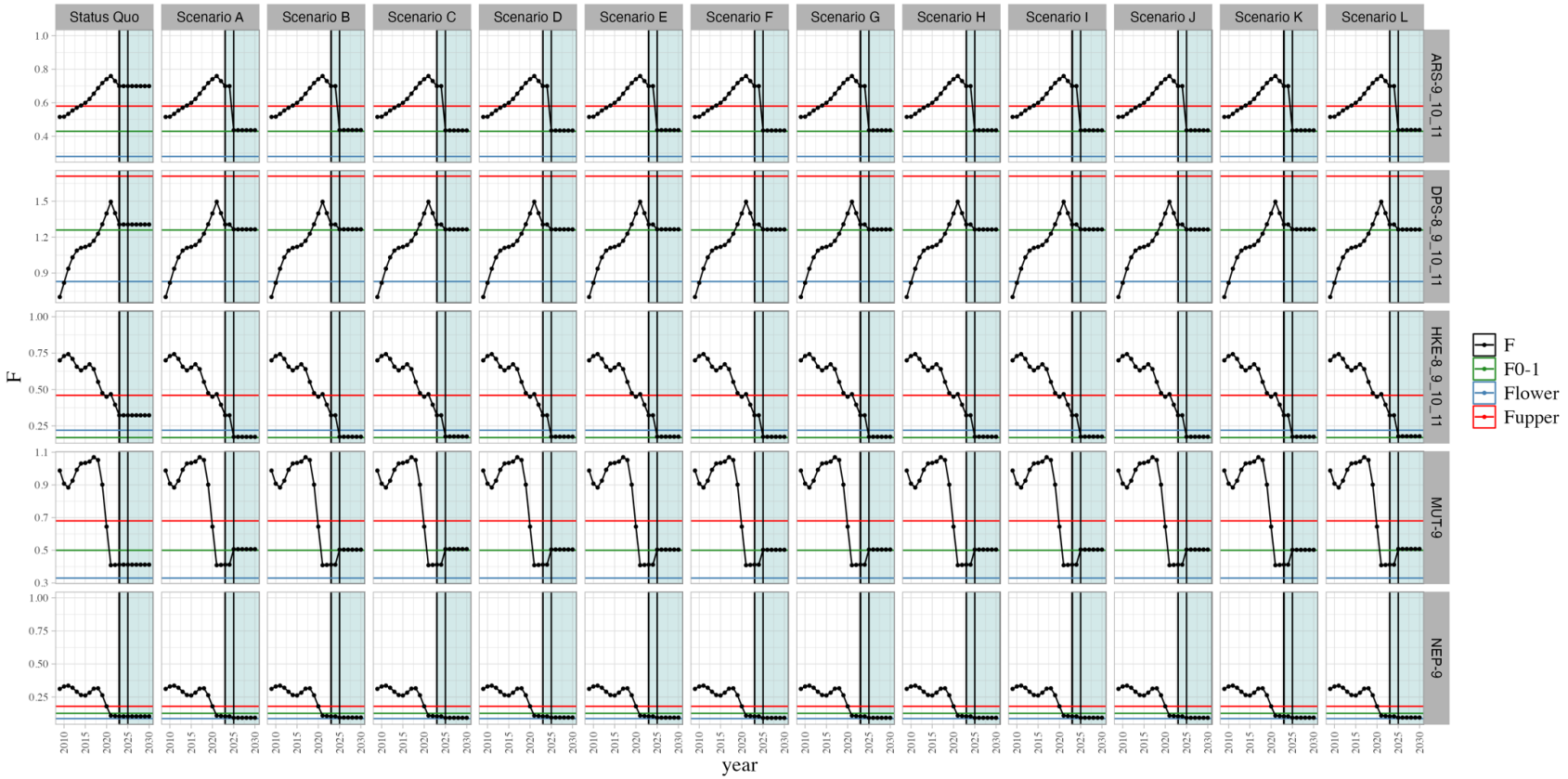



Figure 1.2.7. EMU 2 (SMART model). Predicted Fishing mortalities by modelled stock (in row) under the MAP scenario of effort reduction (in column). The stocks are as follow (from top to bottom): Giant red shrimp GSAs9-10-11(ARS), deep-water rose shrimp GDSs9-10-11 (DPS), Hake GSAs8-9-10-11 (HKE), red mullet GSA9 (MUT9),Norway lobster GSA9 (NEP9). Historical values of Fbar are given in the white areas and simulated values in the blue area. Estimated F 0-1, Flower and Fupper from EWG 23-09 stock assessments are represented, in green, blue and red horizontal lines, respectively.

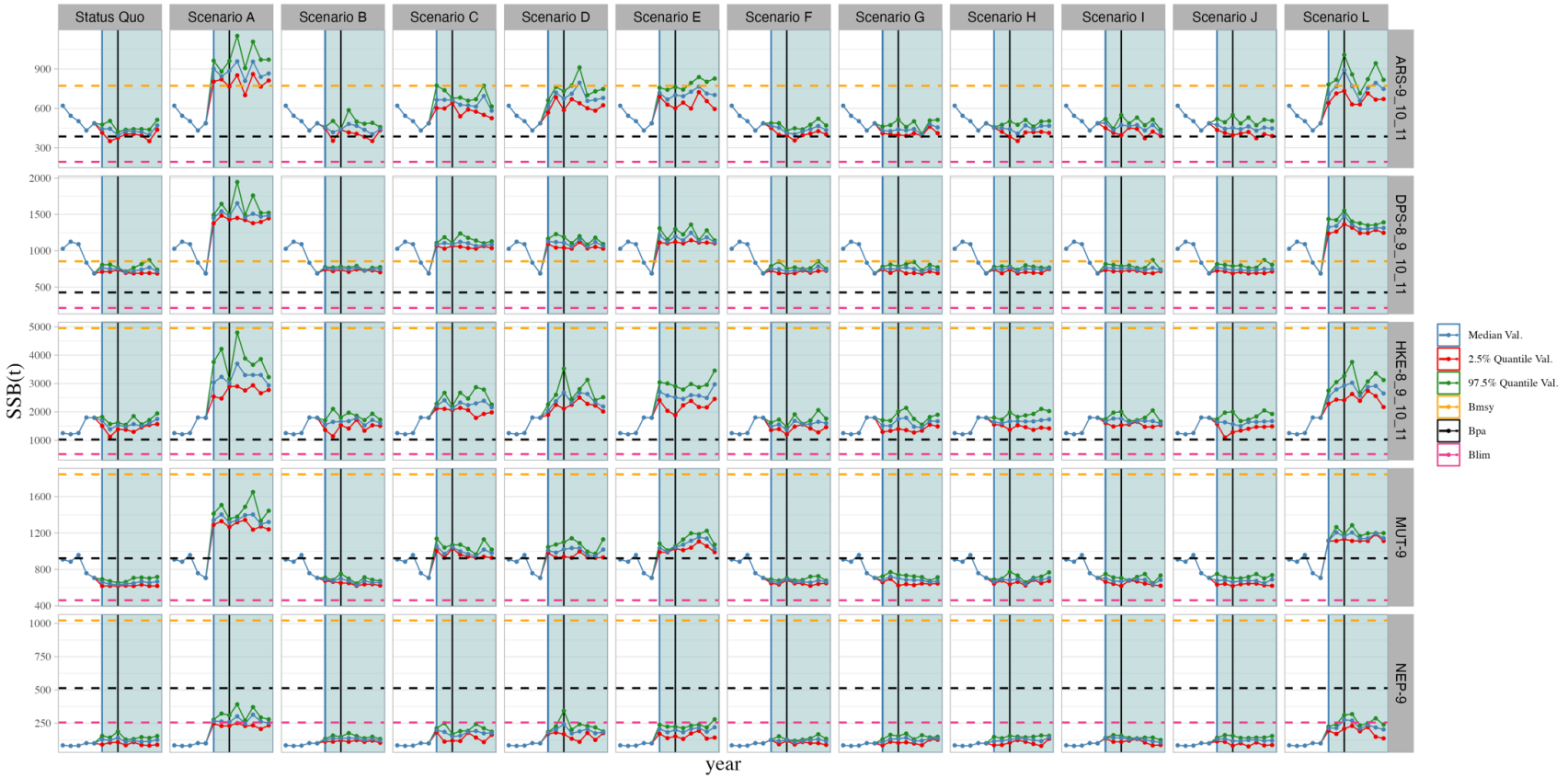



Figure 1.2.8. EMU 2 (SMART model). Predicted Spawning Stock Biomass (SSB) by modelled stock (in row) under alternative scenarios (in column). The stocks are as follow (from top to bottom): Giant red shrimp ARS in the GSAs9-10-11, Deep-water rose shrimp in the GSAs9-10-11, European hake HKE in the GSAs9-10-11, Red mullet MUT in GSA9 and Norway lobster NEP in the GSA9. Historical values of Fbar are given in the white areas and simulated values in the blue area. Simulations run until 2030 and vertical black lines indicate the year 2025. Estimated Bmsy, Bpa and Blim from EWG 22-09 stock assessments are represented.

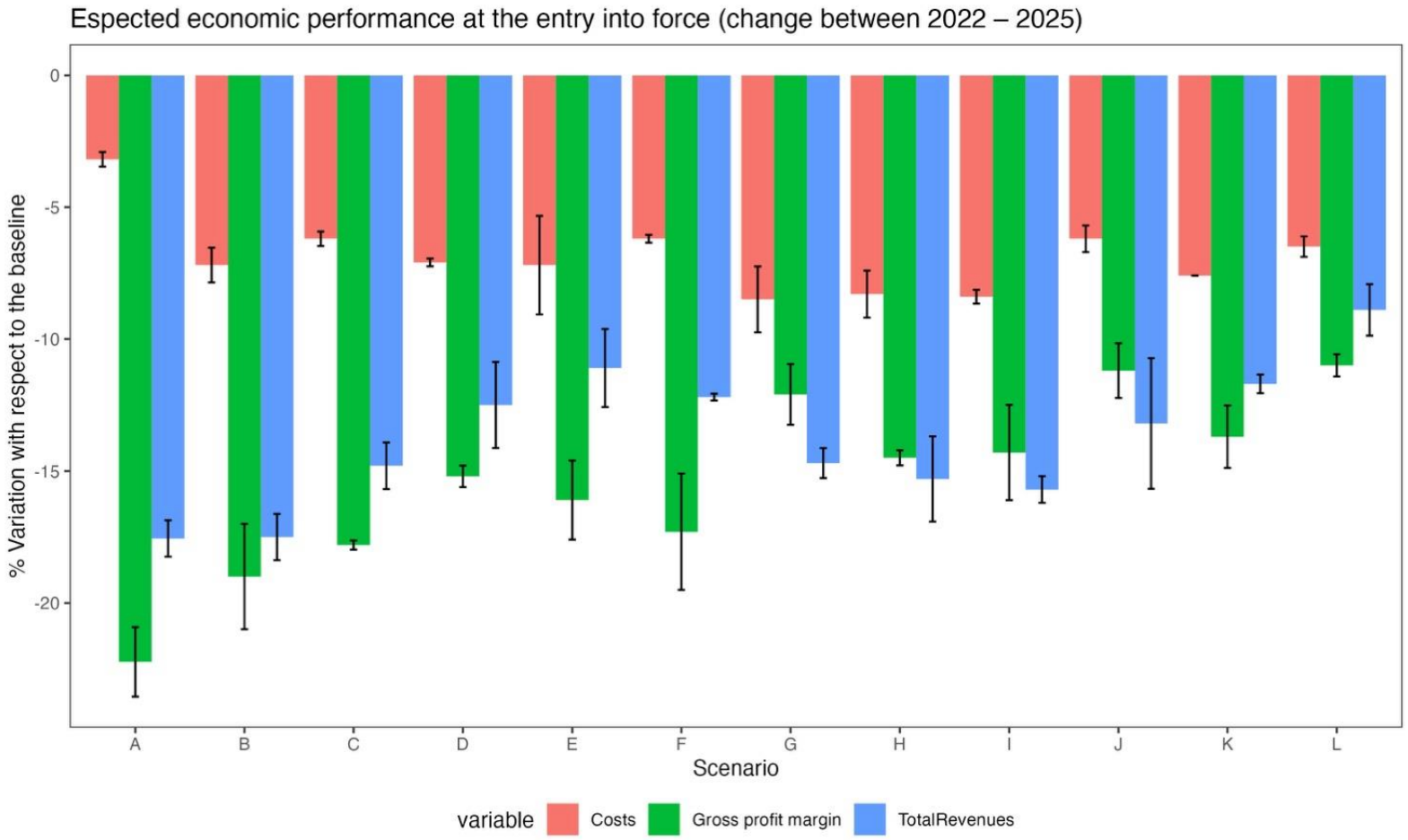



Figure 1.2.9. – Barplot of the main economic indicators by GSA in the different scenarios.

## 2 TIME SERIES OF FISHING EFFORT UPDATED TO 2022 (TOR 1)

EWG 23-11 agreed on presenting the trends of effort expressed in fishing days for Spain, France and Italy in the period 2015-2022 for the following gears: bottom otter trawl (OTB), multi-rig otter trawl (OTT), set gillnet (GNS), trammel net (GTR), and set longline (LLS).

The complete set of tables and graphs for fishing days, days at sea, hours at sea, GT x fishing days, and kW x fishing days by Country (Spain, France, Italy), EMU (1 and 2), GSA (1, 5, 6, 7, 8, 9, 10, 11), gear (OTB, OTT, GNS, GTR, LLS, other), and fleet segment (<12m, 12-18m, 18-24m, >24m) can be found in Annex I.

### 2.1 EMU 1

#### *2.1.1 Time series by MS, GSA, fleet segment, gear*

In EMU 1, EWG 23-11 noted a general and gradual decrease in fishing effort in terms of fishing days from 2015 to 2022. However, as already highlighted by EWG 22-11, an opposite trend was observed for French OTT in GSA 7 (fleet segments 18-24m and >24m), likely due to a shifting from OTB to OTT of some vessels. A slight increase of fishing days, but limited to the last two years of the time series, was also observed for Spanish GRT in GSA 5 (fleet segment <12m). In addition, EWG 23-11 noticed a sharp increase of fishing days in 2019 and 2020 for Spanish LLS in GSA 5 (fleet segment <12m).

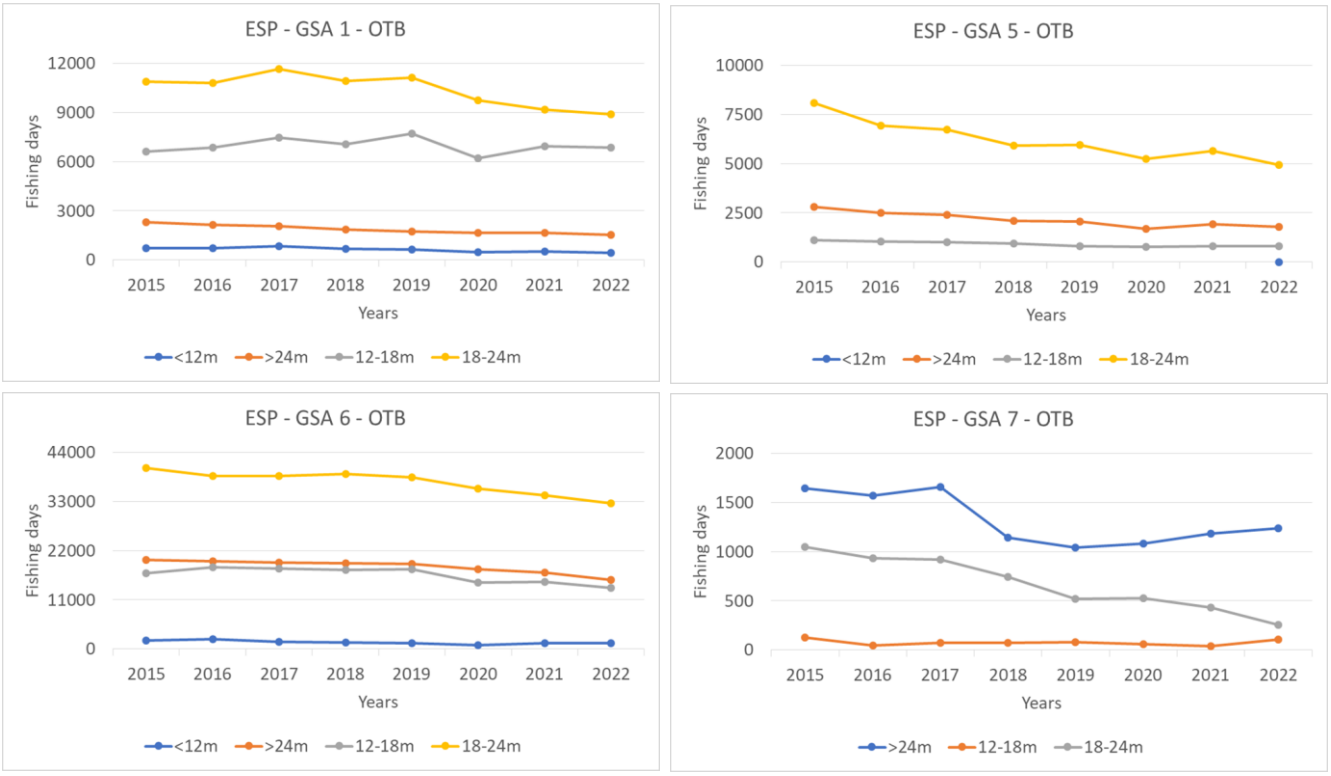
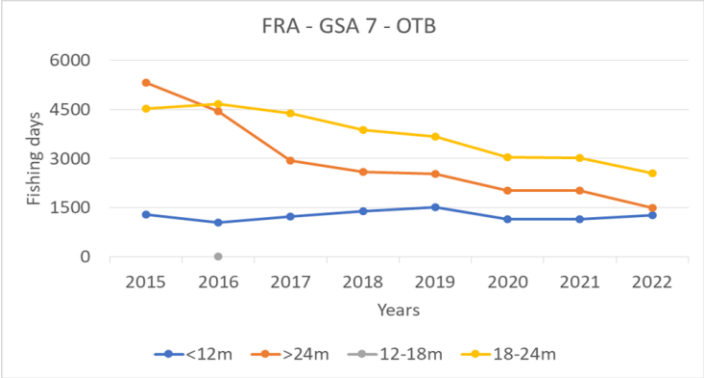



Figure 2.1.1.1 Spain: time series of OTB fishing effort expressed in fishing days by fleet segment and GSA.



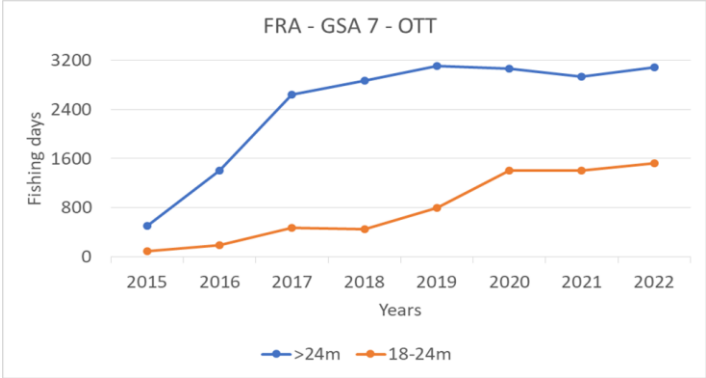
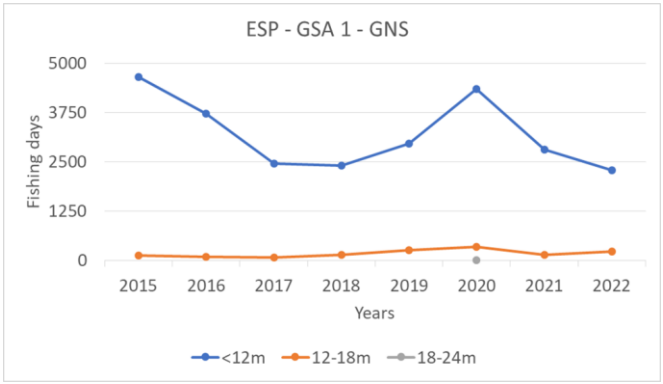
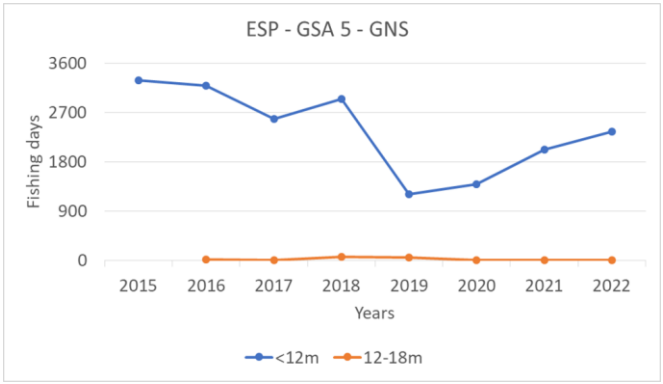




Figure 2.1.1.2 France: time series of OTB and OTT fishing effort expressed in fishing days by fleet segment and GSA.



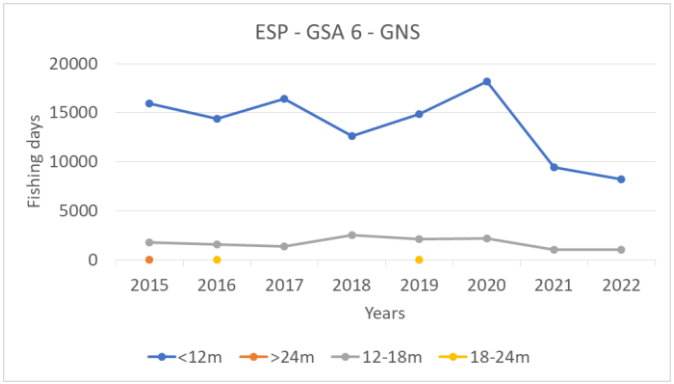




Figure 2.1.1.3 Spain: time series of GNS fishing effort expressed in fishing days by fleet segment and GSA.

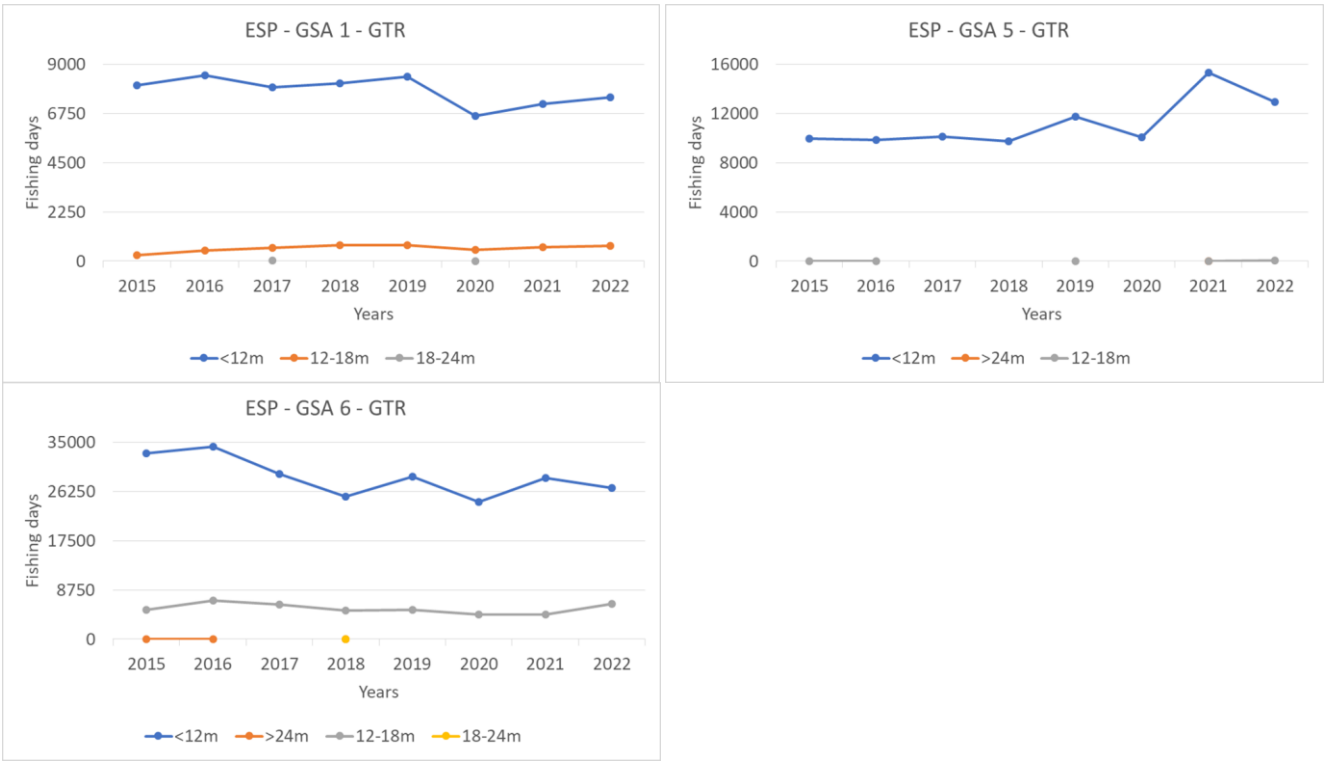



Figure 2.1.1.4 Spain: time series of GTR fishing effort expressed in fishing days by fleet segment and GSA.

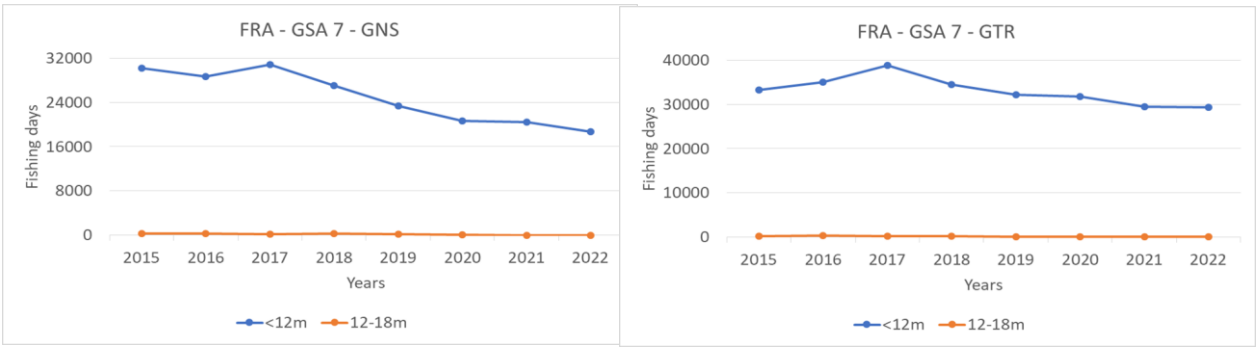



Figure 2.1.1.5 France: time series of GNS and GTR fishing effort expressed in fishing days by fleet segment and GSA.

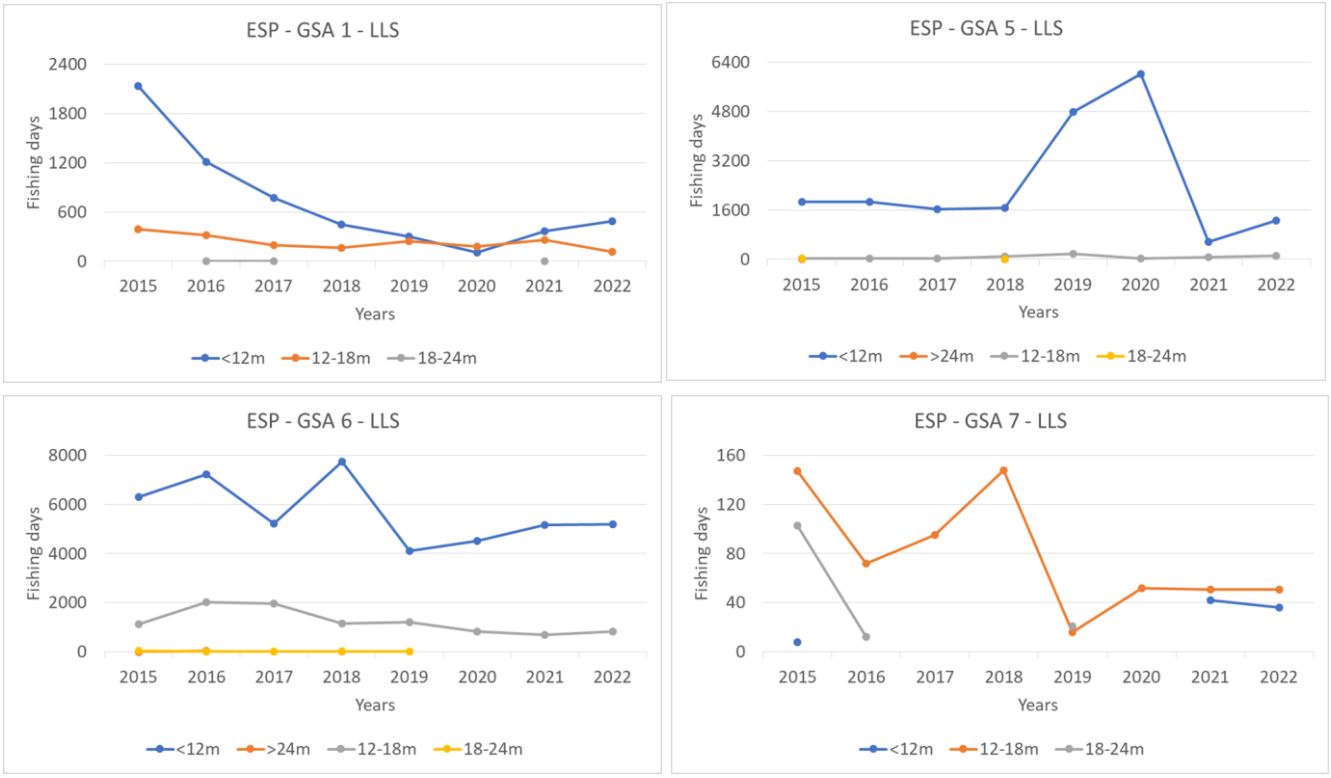



Figure 2.1.1.6 Spain: time series of LLS fishing effort expressed in fishing days by fleet segment and GSA.

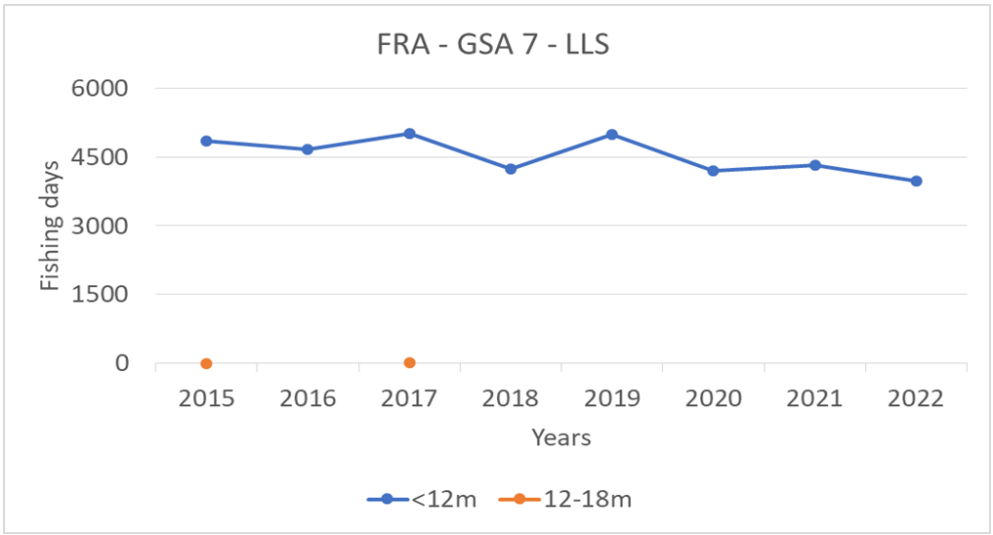



Figure 2.1.1.7 France: time series of LLS fishing effort expressed in fishing days by fleet segment in GSA 7.

### *2.1.2 Comparison between FDI data and effort reference levels in EU regulation 2019/2236, 2021/90, 2022/110 and 2023/195*

The fishing effort (in fishing days) from the FDI database and the fishing effort from the regulation were put in comparison as last year to verify if the effort reported in the FDI database is consistent with values dictated by the regulation. Only the FDI fishing effort from GSAs 1, 2, 5, 6 and 7 of trawl gears were taken into account. For the French and Spanish data, the trawl gears correspond to OTB, OTM, OTT, PTB, PTM and TBB as per EU regulation 2019/2236.

The 2020, 2021 and 2022 fishing opportunities were compared with the 2020, 2021 and 2022 values of fishing effort (in fishing days) from the FDI database. Being the regulation in 2023 based on a reduction of 25% for France and 27% for coastal metier and 30.5% for deep water metier for Spain of the average effort from 2015-2017 of trawl gears, the FDI baseline (i.e. E 2015-2017) minus 25%, 27% or 30.5% of its value was compared with the values from the 2023 regulation (table 2.1.2.1 and 2.1.2.2). The percentage of change between the regulation and the FDI fishing effort was calculated as the difference between the regulation effort and the FDI effort divided by the regulation multiplied by 100. Finally, a comparison of fishing days for 2023 regulation and the additional allocation of fishing days of 3.5% calculated from the baseline between 2015 and 2017 as a compensation mechanism was added for Spain and France in EMU1 only in coastal metier.

For French trawlers, the overall fishing effort from the regulation is higher than that estimated via the FDI database. If we were to apply an effort reduction of 25% based on the baseline (i.e. the average fishing effort for 2015-2017), the fishing days from the 2023 regulation would be 6.86% higher than the fishing effort values obtained for French trawlers after the reduction (table 2.3.1). Also the 2022 regulation resulted to be higher by 8.16 % than the fishing days declared in the FDI dataset for 2022.

For Spanish trawlers as well, the overall fishing effort from the regulation is higher than that estimated via the FDI database. If we were to apply an effort reduction of 27% for coastal metier and 30.5% for deep water metier based on the baseline (i.e. the average fishing effort for 2015-2017), the fishing days from the 2023 regulation would be smaller for costal metier (-5.63%) and higher for deep water metier (35.69%) than the fishing effort values obtained for Spanish trawlers after the reduction (table 2.1.2.2). The 2022 regulation resulted to be higher by 2.56 % than the fishing days declared in the FDI dataset for 2022.

Across fleet segments, the fishing effort from the regulation is greater, for most segments, than that estimated through the FDI database. This could be due to the regulation values being calculated considering the maximum fishing days possible for the year and also difficult to estimate the possible transfer among fleet segments (comment from DG-mare).

Table 2.1.2.1 Comparison of fishing effort (in fishing days) of French trawlers in GSAs 1,2,5,6 and 7 from the FDI database and the fishing effort from Regulation 2019/2236, Regulation 2021/90, Regulation 2022/110 and Regulation 2023/195 for EMU1. Percentage of change between effort from the FDI database and the 2022 regulation is calculated as follow: ((ERegulation2022- 78,5%E2015-2017)/ERegulation2022) *100

| Stock group | Fleet segment | FDI baseline: average of 2015-2017 fishing effort $E_{2015-2017}$ | FDI Fishing effort in 2020 | 2020 Regulation | FDI Fishing effort in 2021 | 2021 Regulation | FDI Fishing effort in 2022 | 2022 regulation | 75 % of the FDI baseline 0.750* $E_{2015-2017}$ | 2023 regulation | % of change between the 2020 regulation and 2020 FDI effort | % of change between the 2021 regulation and 2021 FDI effort | % of change between the 2022 regulation and 2022 FDI effort |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red mullet in GSAs 1, 5, 6 and 7; Hake in GSAs 1-5-6-7; Deep-water rose shrimp in GSAs 1, 5 | ≥ 18 m and < 24 m | 4793 | 4467 | 5144 | 4492 | 4715 | 4077 | 4372 | 3594 | 3972 | 13.15% | 4.72% | 6.75% |
| | ≥ 24 m | 6142 | 5412 | 6258 | 5219 | 5737 | 4825 | 5320 | 4607 | 4833 | 13.52% | 9.02% | 9.31% |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| and 6; Norway lobster in GSAs 5 and 6 | | | | | | | | | | | | | |
| **TOTAL** | **10935** | **9879** | **11402** | **9712** | **10452** | **8902** | **9692** | **8201** | **8805** | **13.36%** | **7.08%** | **8.16%** |

Table 2.11.2.2 Comparison of fishing effort (in fishing days) of Spanish trawlers in GSAs 1,2,5,6 and 7 from the FDI database and the fishing effort from Regulation 2019/2236, Regulation 2021/90, Regulation 2022/110 and Regulation 2023/195 for EMU1. Percentage of change between effort from the FDI database and the 2022 regulation is calculated as follow: ((ERegulation2022- 76,5%E2015-2017)/ERegulation2022) *100

| **Stock group** | **Fleet segment** | **FDI baseline: average of 2015-2017 fishing effort E2015-2017** | **FDI Fishing effort in 2020** | **2020 Regulation** | **FDI Fishing effort in 2021** | **2021 Regulation** | **FDI Fishing effort in 2022** | **2022 regulation** | **73 % of the FDI baseline 0.730* E2015-2017** | **69.5 % of the FDI baseline 0.695* E2015-2017** | **2023 regulation** | **% of change between the 2020 regulation and 2020 FDI effort** | **% of change between the 2021 regulation and 2021 FDI effort** | **% of change between the 2022 regulation and 2022 FDI effort** | **% of change between the 2023 regulation and 73% of the FDI baseline** | **% of change between the 2023 regulation and 69.5 % of the FDI baseline** | **2023 Regulation + 3.5% baseline** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red mullet in GSAs 1, 5, 6, 7; Hake in GSAs | < 12 m | 2708 | 1376 | 2260 | 1780 | 2072 | 1757 | 1921 | 1977 | | 1745 | 39.10% | 14.09% | 8.54% | -13.29% | | 1840 |
| | ≥ 12 m and < 18 m | 25122 | 21316 | 24284 | 21967 | 22260 | 20767 | 20641 | 18339 | | 18752 | 12.22% | 1.32% | -0.61% | 2.20% | | 19631 |
| | ≥ 18 m and < 24 m | 51341 | 45565 | 45563 | 41845 | 41766 | 38822 | 38728 | 37479 | | 35184 | 0.00% | -0.19% | -0.24% | -6.52% | | 36981 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1, 5, 6, 7; Deep-water rose shrimp in GSAs 1, 5, 6; Norway lobster in GSAs 5 and 6. | ≥ 24 m | 19327 | 16790 | 16047 | 14140 | 14710 | 12150 | 13640 | 14109 | | 12392 | -4.63% | 3.87% | 10.92% | -13.85% | | 13068 |
| Blue and red shrimps in GSA 1,5,6,7 | < 12 m | 2 | 0 | 0 | 0 | 0 | 0 | 0 | | 1 | 0 | | | | | | |
| | ≥ 12 m and < 18 m | 786 | 630 | 1139 | 877 | 1044 | 768 | 968 | | 546 | 879 | 44.72% | 16.00% | 20.66% | | 37.85% | |
| | ≥ 18 m and < 24 m | 7967 | 6161 | 10822 | 8341 | 10574 | 8555 | 9805 | | 5537 | 8908 | 43.07% | 21.11% | 12.75% | | 37.84% | |
| | ≥ 24 m | 6918 | 5634 | 9066 | 8156 | 8488 | 8360 | 7871 | | 4808 | 7151 | 37.85% | 3.91% | -6.21% | | 32.77% | |
| **TOTAL** | | **114170** | **97472** | **109181** | **97107** | **100914** | **91178** | **93574** | **71903** | **10892** | **85011** | **10.72%** | **3.77%** | **2.56%** | **-5.63%** | **35.69%** | **71520** |

## 2.2 EMU 2

### *2.2.1 Time series by MS, GSA, fleet segment, gear*

In EMU 2, similarly to what observed in EMU 1, EWG 23-11 noted gradual decreasing trends or stable trends in fishing effort in terms of fishing days from 2015 to 2022. However, a slight opposite trend was observed for Italy LLS in GSA 9 (mostly for the fleet segment <12m).

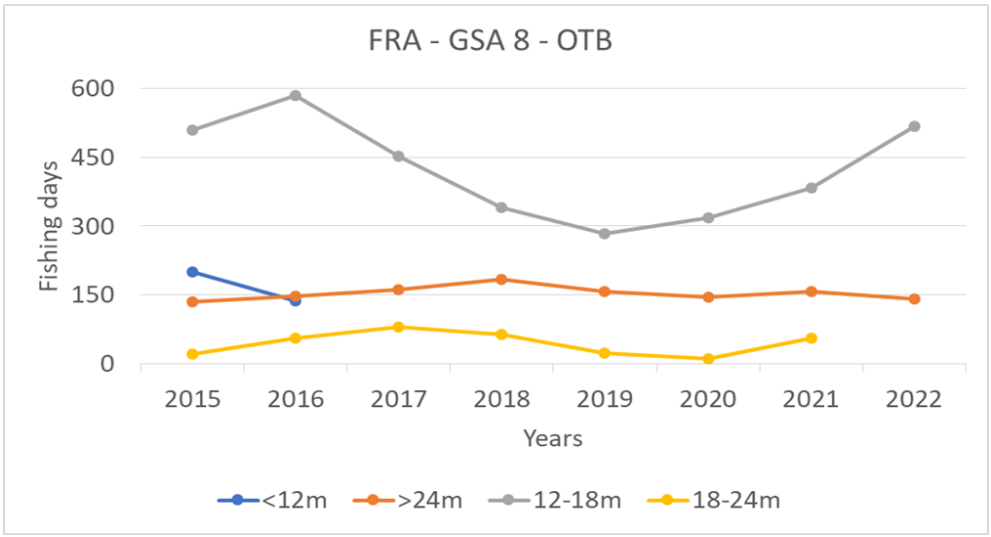



Figure 2.2.1.1 France: time series of OTB fishing effort expressed in fishing days by fleet segment in GSA 8.

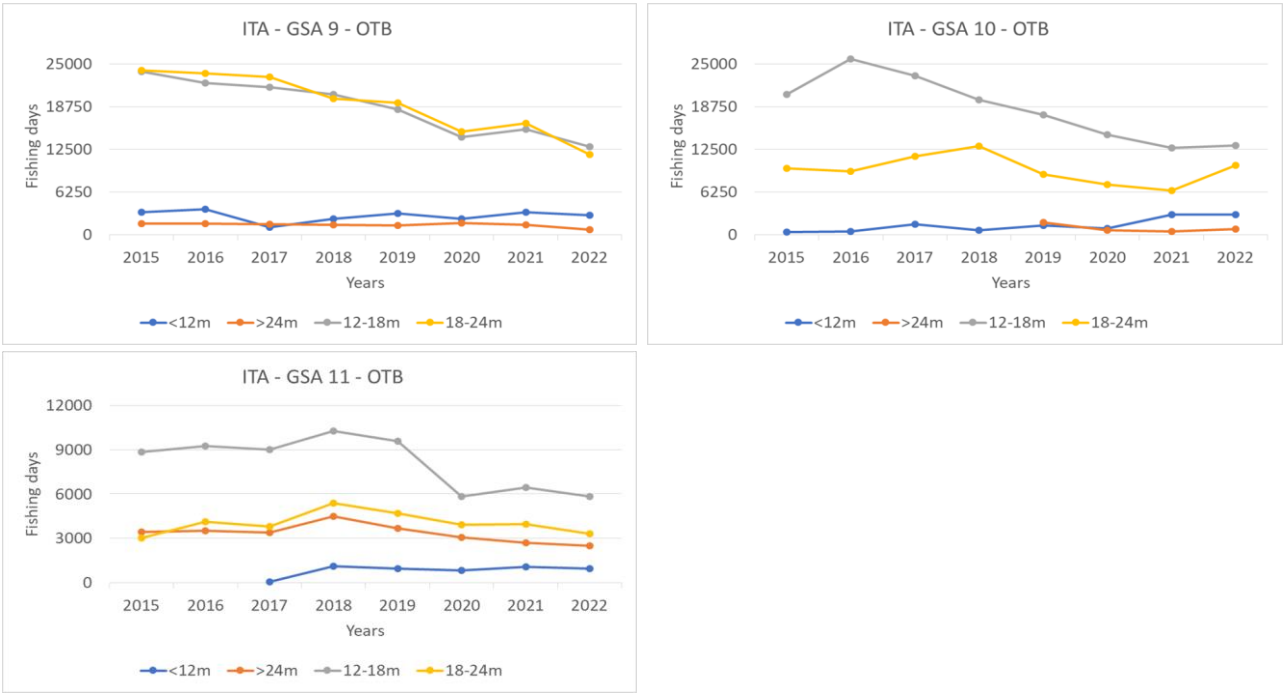
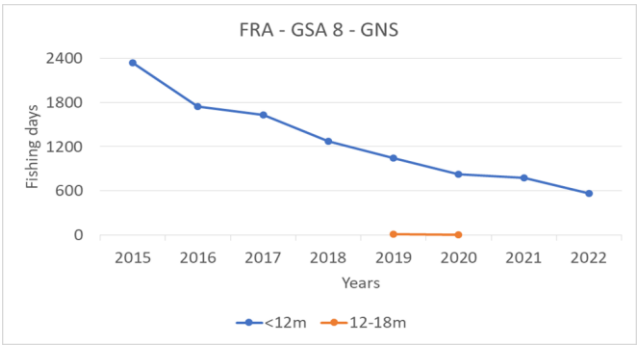



Figure 2.2.1.2 Italy: time series of OTB fishing effort expressed in fishing days by fleet segment and GSA.



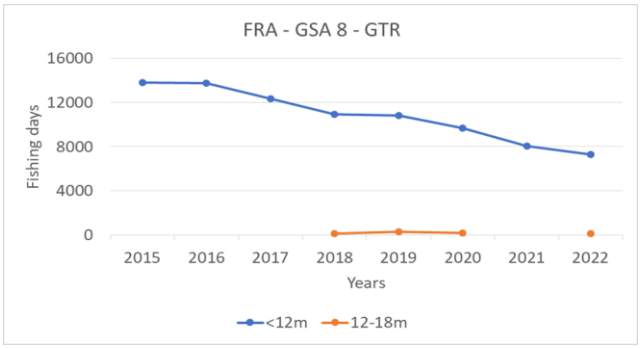
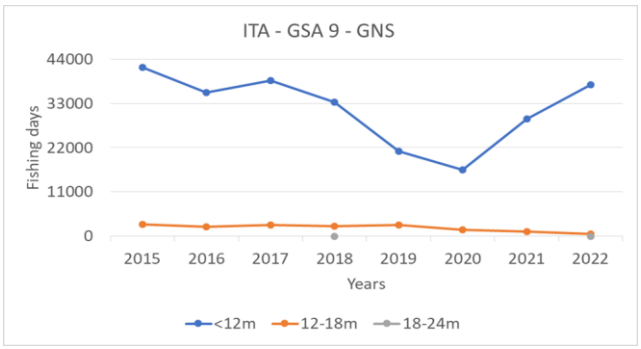
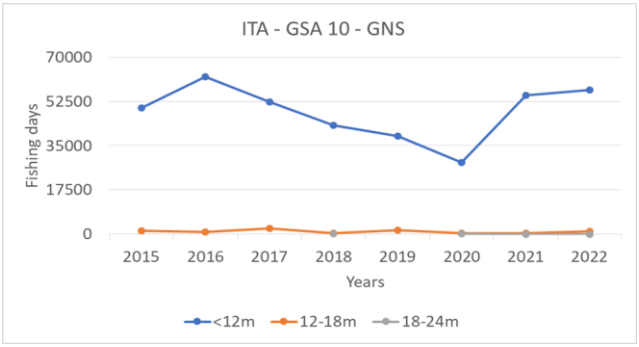




Figure 2.2.1.3 France: time series of GNS and GTR fishing effort expressed in fishing days by fleet segment in GSA 8.



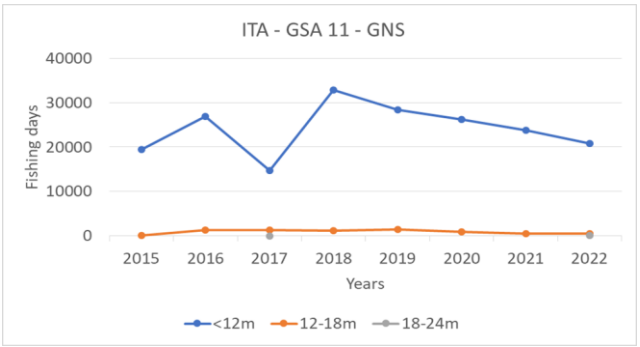




Figure 2.2.1.4 Italy: time series of GNS fishing effort expressed in fishing days by fleet segment and GSA.

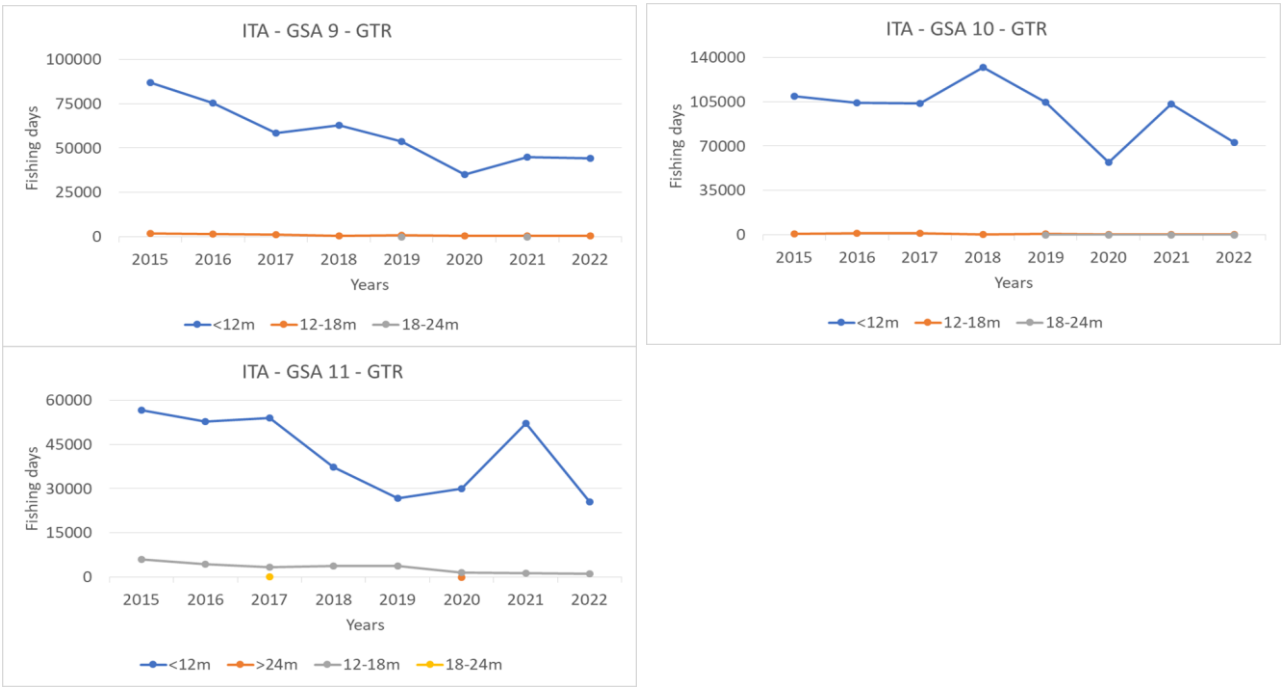



Figure 2.2.1.5 Italy: time series of GTR fishing effort expressed in fishing days by fleet segment and GSA.

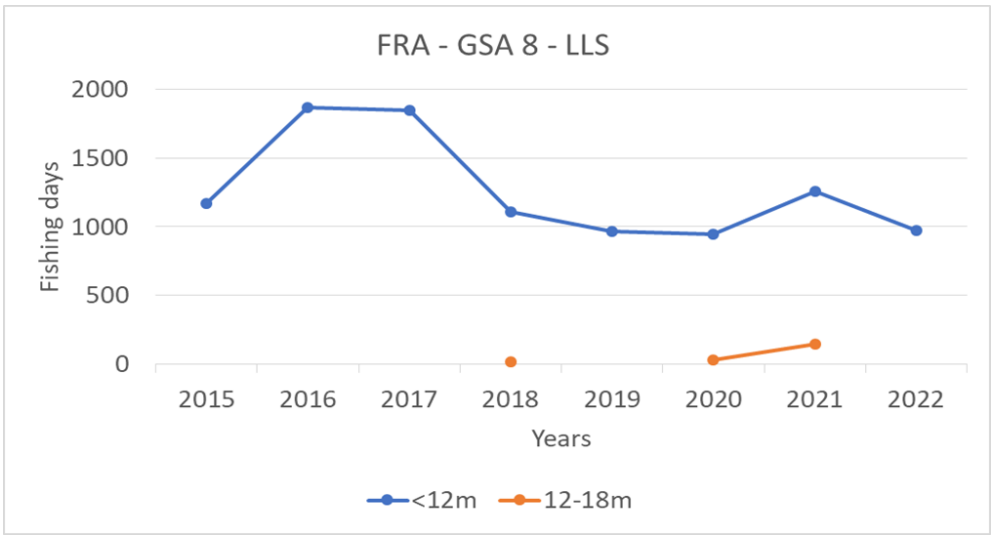



Figure 2.2.1.6 France: time series of LLS fishing effort expressed in fishing days by fleet segment in GSA 8.

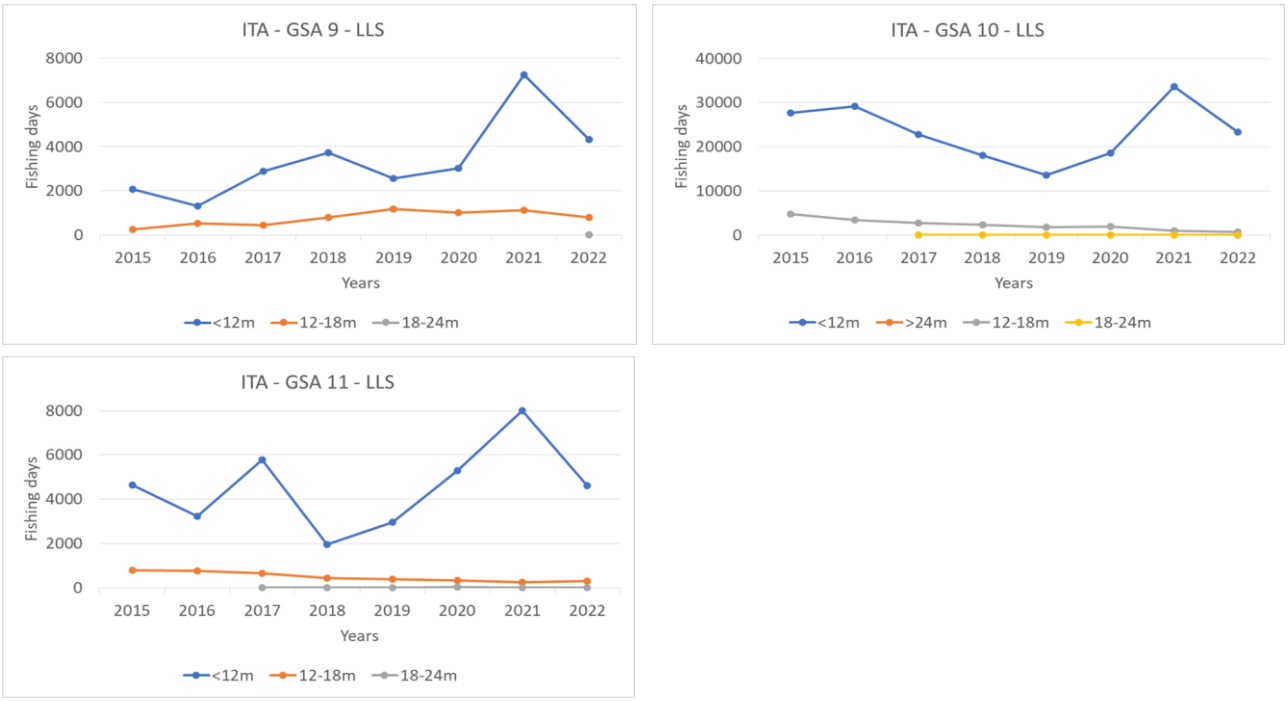



Figure 2.2.1.7 Italy: time series of LLS fishing effort expressed in fishing days by fleet segment and GSA.

### *2.2.2 Comparison between FDI data and effort reference levels in EU regulation 2019/2236, 2021/90, 2022/110 and 2023/195*

We compared the fishing effort (in fishing days) from the FDI database and the fishing effort from the regulation. Only the FDI fishing effort from GSAs 9-10-11 of trawl gears was considered for the Italian data, and FDI fishing effort from GSA 8 for French data. For both countries, the trawl gears correspond to OTB, OTM, TBB and PTM, as listed in the 2019/2236 Regulation.

We compared the 2022 regulation values with the 2022 values of fishing effort (in fishing days) from the FDI database and the 2021 and 2020 FDI data and 2021 and 2020 regulation. The regulation in 2023 is based on a reduction of 33% for Italy, and 25% for France, of the average effort from 2015-2017 of trawl gears, we calculated the FDI baseline (i.e. E(2015-2017)) and compared 67% in the case of Italy and 75 for France, of those values with the values from the 2023 regulation (table 2.2.2.1-2). The percentage of change between the regulation and the FDI fishing effort is calculated as the difference between the regulation effort and the FDI effort divided by the regulation multiplied by 100. Finally, a comparison of fishing days for 2023 regulation and the additional allocation of fishing days of 3.5% calculated from the baseline between 2015 and 2017 as a compensation mechanism was added for France in EMU2.

For Italian trawlers, the fishing effort from the regulation is higher than that estimated via the FDI database. If we were to apply an effort reduction of 33% based on the FDI (i.e. the average fishing effort for 2015-2017), the 2023 regulation would be 0.22% lower than the actual fishing effort reduction applied for Italian trawlers (table 2.2.2.1). Also the 2022 Regulation resulted in being higher by 8.71% than the data for 2022 reported in the official FDI data call and 11.76% higher in 2021, and 22.18% higher in 2020.

For French trawlers, the fishing effort from the regulation is higher than that estimated via the FDI database. If we were to apply an effort reduction of 25% based on the FDI (i.e. the average fishing effort for 2015-2017), the 2023 regulation would be 41% higher than the actual fishing effort reduction applied for Italian trawlers (table 2.2.2.2). Also the 2022 Regulation resulted in being

higher by 38% than the data for 2021 reported in the official FDI datacall and 55% higher in 2021, and 66% higher in 2020.

Across fleet segments, the fishing effort from the regulation is greater, for most segments, than that estimated through the FDI database. This could be due to the regulation values being calculated considering the maximum fishing days possible for the year and also difficult to estimate the possible transfer among fleet segments (comment from DG-mare).

Table 2.22.2.1 Comparison of fishing effort (in fishing days) of Italian trawlers from the FDI database and the fishing effort from Regulation 2019/2236, Regulation 2021/90, Regulation 2022/110 and Regulation 2023/195 for EMU2. Percentage of change between effort from the FDI database and the regulation is calculated as follow: $((E_{Regulation} - 74\%E_{2015\text{-}2017})/E_{Regulation}) *100$

| Stock group | Fleet segment | FDI baseline: average of 2015-2017 fishing effort $E_{2015\text{-}2017}$ | FDI Fishing effort in 2020 | 2020 Regulation | FDI Fishing effort in 2021 | 2021 Regulation | FDI Fishing effort in 2022 | 2022 regulation | 67 % of the FDI baseline<br>0.670 * $E_{2015\text{-}2017}$ | 2023 regulation | % of change between the 2020 regulation and 2020 FDI effort | % of change between the 2021 regulation and 2021 FDI effort | % of change between the 2022 regulation and 2022 FDI effort | % of change between the 2023 regulation and 67 % of the FDI baseline |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red mullet in GSAs 9, 10 and 11; Hake in GSAs 9-10-11; Deep-water rose shrim | < 12 m | 3374 | 4157 | 3081 | 7500 | 2824 | 6937 | 2534 | 2261 | 2294 | -34.92% | -165.58% | -173.77% | 1.45% |
| | ≥ 12 m and < 18 m | 52679 | 30892 | 46350 | 33418 | 42487 | 29092 | 38110 | 35295 | 34505 | 33.35% | 21.35% | 23.66% | -2.29% |
| | ≥ 18 m and < 24 m | 35031 | 23435 | 31170 | 26476 | 28572 | 23093 | 25629 | 23471 | 23205 | 24.82% | 7.34% | 9.90% | -1.15% |
| | ≥ 24 m | 4680 | 4267 | 4160 | 4670 | 3813 | 3644 | 3421 | 3135 | 3097 | -2.57% | -22.48% | -6.53% | -1.24% |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p in GSAs 9-10-11; Norway lobster in GSAs 9 and 10. | | | | | | | | | | | | | | |
| Giant red shrimp in GSAs 9, 10 and 11. | < 12 m | 567 | 129 | 510 | 101 | 467 | 57 | 419 | 380 | 379 | 74.71% | 78.37% | 86.40% | -0.23% |
| | ≥ 12 m and < 18 m | 3345 | 3965 | 3760 | 1290 | 3447 | 2858 | 3091 | 2241 | 2799 | -5.45% | 62.58% | 7.54% | 19.93% |
| | ≥ 18 m and < 24 m | 2838 | 3648 | 3028 | 1099 | 2776 | 2933 | 2489 | 1901 | 2253 | -20.48% | 60.41% | -17.85% | 15.61% |
| | ≥ 24 m | 450 | 1459 | 405 | 233 | 371 | 788 | 333 | 301 | 302 | -260.25% | 37.20% | -136.54% | 0.25% |
| **TOTAL** | | **10296 4** | **7195 2** | **92464** | **7478 7** | **84757** | **6940 3** | **76026** | **68986** | **68834** | **22.18%** | **11.76%** | **8.71%** | **-0.22%** |

Table 2.22.2.2 Comparison of fishing effort (in fishing days) of French trawlers from the FDI database and the fishing effort from Regulation 2019/2236, Regulation 2021/90, Regulation 2022/110 and Regulation 2023/195 for EMU2. Percentage of change between effort from the FDI database and the regulation is calculated as follow: $((E_{Regulation} - 74\%E_{2015-2017})/E_{Regulation}) *100$

| Stock group | Fleet segment | FDI baseline: average of 2015-2017 fishing effort $E_{2015-2017}$ | FDI Fishing effort in 2020 | 2020 Regulation | FDI Fishing effort in 2021 | 2021 Regulation | FDI Fishing effort in 2022 | 2022 regulation | 75 % of the FDI baseline 0.750 * $E_{2015-2017}$ | 2023 regulation | % of change between the 2020 regulation and 2020 FDI effort | % of change between the 2021 regulation and 2021 FDI effort | % of change between the 2022 regulation and 2022 FDI effort | % of change between the 2023 regulation and 75% of the FDI baseline | 2023 Regulation + 3.5% baseline |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red mullet in GSAs 8, 9, 10 and 11; Hake in GSAs 8, 9, | < 12 m | 169 | 0 | 208 | 0 | 191 | 0 | 117 | 126 | 161 | 100% | 100% | 100% | 21% | 167 |
| | ≥ 12 m and < 18 m | 515 | 319 | 833 | 383 | 764 | 517 | 709 | 387 | 644 | 62% | 50% | 27% | 40% | 662 |
| | ≥ 18 m and < 24 m | 53 | 20 | 208 | 55 | 191 | 0 | 117 | 39 | 161 | 90% | 71% | 100% | 76% | 163 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 and 11; Deep-water rose shrimp in GSAs 9, 10 and 11; Norway lobster in GSAs 9 and 10. | ≥ 24 m | 148 | 151 | 208 | 160 | 191 | 141 | 117 | 111 | 161 | 28% | 16% | -21% | 31% | 166 |
| **TOTAL** | | **884** | **490** | **1457** | **598** | **1337** | **658** | **1060** | **663** | **1127** | **66%** | **55%** | **38%** | **41%** | **1158** |

## 2.3 Trajectory of the fisheries in EMU 1 based on FDI analysis

The management plan for the western Mediterranean demersal fisheries has been enforced since 2020, implementing a variety of management measures in the area, including fishing effort reduction and spatio-temporal closures. The purpose of this analysis is to provide a broad context of the state and evolution of the fishery in EMU-1 (encompassing GSAs 1,5,6,7), through the detailed examination of weights, values and prices landed by stocks and fleet segments.

To this end, we used the FDI-data (table A) submitted to JRC through the Mediterranean and black sea data call. These data summarize, at the species and fleet level, the amount of weight (in t) and values (in €) that has been landed by the European fisheries in the Mediterranean Sea.

### *2.3.1 Data selection and preparation*

Data were first subset to (1) focus on EMU 1, and (2) exclude blue fin tuna (FAO code "BFT") as this stock benefit from a specific management regime through ICCAT and is not concerned by the plan. All other species were kept, resulting in the occurrence of 3459 species code, most of which concerning Spanish fleets (329 species code are reported for France, and 3429 for Spain).

However, the contribution of most species is marginal: By selecting the first four hundreds, the resulting dataset accounts for more than 99.9% of the total landings (Fig 1). Hence, the remaining ~3000 species code present in the data concerns very marginal species, some of which are furthermore unlikely to be fished in the area (certain species belongs to boreal or pacific biomes and have no likelihood to be observed in the Mediterranean Sea).

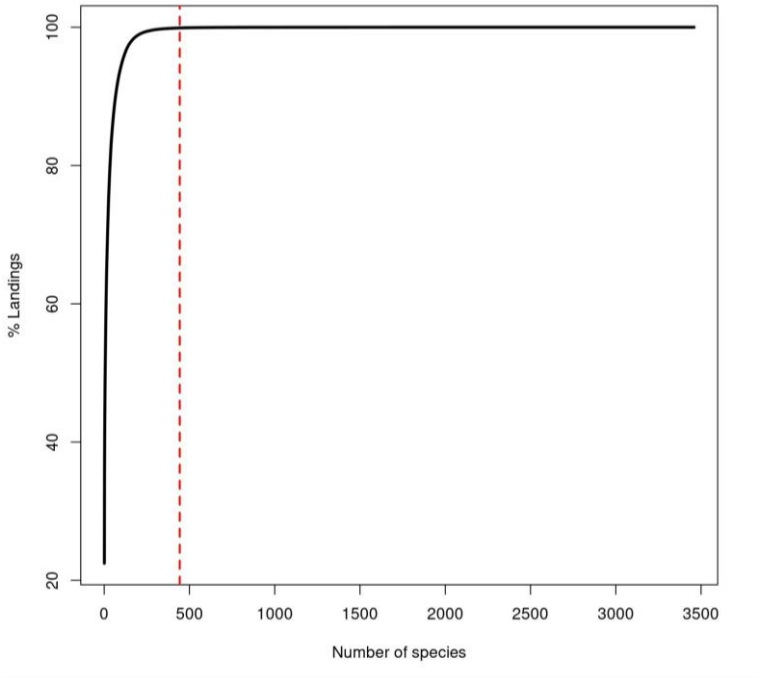



Fig 2.3.1.1. Solid black line: Accumulation curve showing the proportion of landings (y-axis) in EMU 1 accounted for when increasing the number of species (x-axis). 99.9% of landings are accounted for when focusing on the first 443 species (red dashed line).

In a first selection step, we searched for the most important taxons making up 99.9% of either biomass or economic value landed. By doing so, we identified a taxon list of 443 codes, that we simplified manually by regrouping categories, resulting in a list of 151 taxons. Then in a second selection step, we reduced again this list by identifying taxons belongings to the top 90% in terms of landings or values each year. More explicitely, if a given taxon belongs to the top 90% at least one year in terms of either biomass or value, it is retained. By applying this rule, the following 46 taxons were retained (Table 1).

Table 2.3.1.1. List of Taxon retained. The last column lists all other taxons that were grouped under the first column code.

| X3A_CODE | Scientific_name | English_name | Other taxonomic code included |
|---|---|---|---|
| ANE | Engraulis encrasicolus | European anchovy | AHC, ANA, ANE, ENR, STO |
| ARI | Aristeidae | Aristeid shrimps | AJN, ARA, ARS, ARV, SSH |
| BES | Belone spp | Belone | GAR, SAX |
| BOG | Boops boops | Bogue | |
| BSS | Dicentrarchus labrax | European seabass | BSE |
| BZX | Sarda spp | Bonitos | BAU, BEP, BON |
| CTL | Sepiidae, Sepiolidae | Cuttlefish, bobtail squids | CTC, CTR, EJB, EJE, IAR, IAX, ITW |
| DCP | Natantia | Natantian decapods | BOS, PAL, PDZ, SKM |
| DEX | Dentex spp | Dentex | DEC, DEM, DEP |
| DPS | Parapenaeus longirostris | Deep-water rose shrimp | |
| ELX | Anguilla spp | River eels | ELE |
| FIN | Actinopterygii | Finfishes | DIA, DPX, FRF, GRO, MZZ, PEL |
| FLX | Pleuronectiformes | Flatfishes | BLL, CIL, LEF, PLE, TUR |
| FOX | Phycis spp | Forkbeards | FOR, GFB |
| GUX | Triglidae | Gurnards, searobins | CTZ, DYL, GUC, GUG, GUI, GIUM, GUN, GUR, GUU, GUY, LDV, PJC, SCO |
| HKE | Merluccius merluccius | European hake | PHA |
| JAX | Trachurus spp | Jack and horse mackerels | HMM, HOM, JAA |
| JLX | Muricidae | Murex shells | BOQ, BOY, CHQ, FNT, MUE |
| JOD | Zeus faber | John dory | |
| KTT | Acanthocardia tuberculata | Tuberculate cockle | |
| MAX | Scombridae | Mackerels | MAA, MAC, MAS, MAZ, RAB, VMA |
| MGR | Argyrosomus regius | Meagre | |
| MNZ | Lophius spp | Monkfishes | ANF, ANK, MON |
| MUL | Mugilidae | Mullets | AJW, LZP, LZS, MGA, MGC, MGI, MGS, MGU, MLR, MUF, ODL |
| MUX | Mullus spp | Red mullets | GOA, GOX, MUT, MUR |
| MYV | Mytilus spp | Mytilus mussels | MSM |
| NEP | Nephrops norvegicus | Norway lobster | |
| OCT | Octopodidae | Octopuses, etc. | BTQ, EDT, EOI, OCC, OCM, OCN, OCZ, OMZ, OTQ, OUJ |
| PAC | Pagellus erythrinus | Common pandora | |
| PEN | Penaeus spp | Penaeus shrimps | KUP, TGS |
| PIL | Sardina pilchardus | European pilchard | |
| POD | Trisopterus minutus | Poor cod | BIB |
| SAA | Sardinella aurita | Round sardinella | |
| SBA | Pagellus acarne | Axillary seabream | |
| SBG | Sparus aurata | Gilthead seabream | |
| SBX | Sparidae | Porgies, seabreams | AAB, ANN, BRB, CTB, CWC, GRX, MUM, RPG, SBZ, SHR, SRG, SWA |
| SOX | Soleidae | Soles | CET, GSM, KSY, LEM, MIA, MKG, OAL, SOL, SOO, SOS, THS, YNU |
| SQY | Squillidae | Squillids | LQH, LQS, MTS, QLV, YLL |
| SQZ | Loliginidae | Inshore squids | CHO, HQI, ILL, OFE, OGB, OMM, OUL, OUM, OUW, QND, SQC, SQE, SQG, SQI, SQL, SQM, SQR, SQS, SQU, TDQ, YUR |
| SRX | Rajiformes | Rays, stingrays, mantas | BAM, JDP, JRS, MYL, RAJ, RJA, RJC, RJH, RJM, RJN, RJO, RJU, SAW, SKA, TOE, TTR |
| SWM | Portunidae | Swimming crabs, etc. | CMR, CRB, CRG, GER, GRQ, ICC, IOD, KPG, LIO, LQA, NBZ, OLV, UIS |
| TUX | Scombroidei | Tuna-like fishes | ALB, AMB, BIL, BLT, FRI, FRZ, LTA, LEB, MLS, MSP, SKJ, SWO, TUN |
| VLO | Palinuridae | Spiny lobsters | LBE, MWF, PSL, SLO |
| WEX | Trachinus spp | Weevers | TRA, TZA, TZR, WEG, WWA |
| WHB | Micromesistius poutassou | Blue whiting | |
| XOX | Ammodytidae | Sandlances | SAN, ZGC, ZGS |
| ZZZ | Other species | Other species | Anything not listed above |

Regarding fleet segments, they have been identified by considering together the main gear (either Dredge, Traps, Gillnets, Longlines, Trawls, Seine or Unknown), the vessel size (0-6m, 6-12m, 12-18m, 18-24m, 24-40m), and for trawler distinguishing between Demersal (DEM), Pelagic (PEL) or deep-water (DWS) trawlers. This resulted in a list of 41 fleet segments across EMU 1.

### *2.3.2 Data overview*

A global view of landings and values generated by the EMU-1 fisheries is shown in Table 2.3.2.1.

Table 2.3.2.1 Cumulated landings (in t, 2021-2022) and value (in k€, 2021-2022) generated by EMU-1 fisheries. For each species, the spread of the landings across vessel size class is provided, together with the % of value represented by the species for each vessel size class.

| CODE | Scientific_name | Total landings (t, 2021-2022) | % of landings per Vessel Size | | | | | Total Value (k€, 2021-2022) | % of value represented by the species in each size category | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 00-06m | 06-12m | 12-18m | 18-24m | 24-40m | | 00-06m | 06-12m | 12-18m | 18-24m | 24-40m |
| ANE | Engraulis encrasicolus | 26,466 | 0 | 0.5 | 19.4 | 54.5 | 25.5 | 53,462 | 0 | 0.2 | 10.1 | 12.1 | 8.9 |
| PIL | Sardina pilchardus | 17,107 | 0 | 1.5 | 32.3 | 55.3 | 10.9 | 29,146 | 0 | 0.3 | 9 | 6.5 | 2.2 |
| SAA | Sardinella aurita | 10,178 | 0 | 3.4 | 46.1 | 47.5 | 2.9 | 4,176 | 0 | 0.1 | 1.8 | 0.8 | 0.1 |
| JAX | Trachurus spp | 9,305 | 0.1 | 3.6 | 35.6 | 45.1 | 15.5 | 10,692 | 0.1 | 0.3 | 3.5 | 2 | 1.2 |
| OCT | Octopodidae | 8,496 | 1 | 37.2 | 11.8 | 29.9 | 20.1 | 57,004 | 3.3 | 18.3 | 6.7 | 6 | 5.6 |
| TUX | Scombroidei | 5,301 | 0.5 | 15.2 | 35.6 | 41.5 | 7.2 | 34,094 | 1 | 4.6 | 11.2 | 5.3 | 1.7 |
| HKE | Merluccius merluccius | 5,175 | 0.1 | 7.2 | 10.8 | 44.2 | 37.8 | 38,394 | 0.1 | 1.7 | 4.2 | 7 | 9.8 |
| MAX | Scombridae | 4,952 | 0.1 | 5 | 30.3 | 48.6 | 16 | 6,210 | 0.1 | 0.4 | 1.2 | 1.2 | 1 |
| MUX | Mullus spp | 4,828 | 0.4 | 15.9 | 18.2 | 40.4 | 25.1 | 32,547 | 0.8 | 4.5 | 5.6 | 5.1 | 5.2 |
| DPS | Parapenaeus longirostris | 4,306 | 0 | 0.7 | 19.2 | 57.8 | 22.3 | 47,977 | 0 | 0.2 | 8.7 | 11.2 | 7.6 |
| SQZ | Loliginidae | 3,294 | 0.1 | 2.2 | 15.7 | 54.1 | 28 | 22,171 | 0.1 | 0.5 | 2.9 | 5.1 | 4.1 |
| SBG | Sparus aurata | 3,228 | 19.5 | 59.7 | 5.3 | 10.5 | 5 | 28,601 | 26.1 | 12.6 | 1.6 | 1 | 0.7 |
| MUL | Mugilidae | 3,089 | 26.7 | 56.4 | 3.9 | 7.2 | 5.7 | 4,208 | 5.3 | 1.7 | 0.2 | 0.1 | 0.1 |
| MNZ | Lophius spp | 2,898 | 0.1 | 8.4 | 12.3 | 39.4 | 39.8 | 22,053 | 0.1 | 1.3 | 2.9 | 3.7 | 5.6 |
| GUX | Triglidae | 2,231 | 0.8 | 14.9 | 13 | 37.4 | 34 | 11,123 | 0.9 | 2.6 | 1.4 | 1.4 | 1.7 |
| CTL | Sepiidae, Sepiolidae | 1,663 | 1.8 | 40.7 | 23.1 | 25.8 | 8.6 | 16,437 | 1.3 | 4.4 | 3.6 | 1.8 | 1.1 |
| PAC | Pagellus erythrinus | 1,624 | 0.6 | 21.5 | 17.8 | 37.5 | 22.6 | 5,779 | 0.3 | 1.1 | 0.9 | 0.8 | 0.8 |
| ARI | Aristeidae | 1,466 | 0 | 0 | 3.4 | 43.5 | 53.1 | 60,625 | 0 | 0 | 2 | 10.6 | 22.5 |
| SWM | Portunidae | 1,386 | 26.8 | 22.7 | 10.1 | 27.4 | 13 | 4,563 | 6 | 0.8 | 0.4 | 0.4 | 0.4 |
| SQY | Squillidae | 1,361 | 0 | 1.2 | 33.1 | 55.6 | 10.2 | 6,421 | 0 | 0.1 | 2 | 1.4 | 0.5 |
| POD | Trisopterus minutus | 1,324 | 0 | 0.9 | 9.3 | 42.2 | 47.6 | 3,254 | 0 | 0 | 0.3 | 0.6 | 1 |
| BOG | Boops boops | 1,206 | 0.4 | 5.6 | 31.7 | 47.4 | 14.9 | 553 | 0 | 0 | 0.2 | 0.1 | 0.1 |
| FOX | Phycis spp | 1,170 | 0.1 | 5 | 13.3 | 45.1 | 36.4 | 4,217 | 0 | 0.2 | 0.5 | 0.8 | 1 |
| SRX | Rajiformes | 1,028 | 0.5 | 26.8 | 12.8 | 36.4 | 23.5 | 2,905 | 0.1 | 0.5 | 0.3 | 0.4 | 0.5 |
| WHB | Micromesistius poutassou | 1,001 | 0 | 0.4 | 7.3 | 42.6 | 49.6 | 3,447 | 0 | 0 | 0.2 | 0.6 | 1.2 |
| SBX | Sparidae | 1,000 | 5.3 | 56.1 | 12 | 18.2 | 8.4 | 5,179 | 1.2 | 2.3 | 0.7 | 0.3 | 0.2 |
| SBA | Pagellus acarne | 936 | 0.4 | 13.9 | 20.5 | 42 | 23.1 | 1,515 | 0 | 0.2 | 0.3 | 0.2 | 0.2 |
| ELX | Anguilla spp | 931 | 67 | 33 | 0 | 0 | 0 | 6,660 | 21.3 | 1.5 | 0 | 0 | 0 |
| BSS | Dicentrarchus labrax | 902 | 24.8 | 65.8 | 2.1 | 4.5 | 2.8 | 11,600 | 15.8 | 5.1 | 0.2 | 0.2 | 0.2 |
| FLX | Pleuronectiformes | 891 | 0.3 | 10.3 | 23.4 | 48 | 17.9 | 7,675 | 0.3 | 1 | 1.3 | 1.3 | 1.1 |
| DCP | Natantia | 831 | 0 | 5.6 | 24.7 | 34.9 | 34.9 | 10,450 | 0 | 0.5 | 3 | 1.2 | 2.6 |
| BZX | Sarda spp | 797 | 1.8 | 37.1 | 26 | 34.6 | 0.6 | 3,571 | 0.3 | 1 | 0.8 | 0.5 | 0 |
| SOX | Soleidae | 598 | 2.4 | 52.9 | 12.9 | 17.2 | 14.6 | 10,991 | 1.1 | 3.8 | 1.3 | 0.8 | 1.3 |
| JLX | Muricidae | 533 | 2.2 | 41.4 | 7.1 | 38.6 | 10.8 | 3,961 | 0.4 | 1.2 | 0.4 | 0.6 | 0.3 |
| NEP | Nephrops norvegicus | 531 | 0 | 1.2 | 10.8 | 48 | 40 | 17,505 | 0 | 0.2 | 1.8 | 3.4 | 4.8 |
| MYV | Mytilus spp | 450 | 10.2 | 89.8 | 0 | 0 | 0 | 479 | 0.2 | 0.3 | 0 | 0 | 0 |
| KTT | Acanthocardia tuberculata | 385 | 2.3 | 93.7 | 4 | 0 | 0 | 403 | 0 | 0.3 | 0 | 0 | 0 |
| WEX | Trachinus spp | 351 | 0.1 | 7.1 | 17.9 | 46.2 | 28.8 | 1,432 | 0 | 0.1 | 0.2 | 0.3 | 0.3 |
| PEN | Penaeus spp | 228 | 2.4 | 20 | 44.4 | 25.9 | 7.3 | 5,714 | 0.5 | 0.8 | 2.4 | 0.6 | 0.3 |
| VLO | Palinuridae | 221 | 2 | 78.5 | 11.4 | 4.9 | 3.1 | 10,084 | 0.8 | 5.5 | 1.2 | 0.2 | 0.2 |
| XOX | Ammodytidae | 194 | 0 | 99.2 | 0.6 | 0.2 | 0 | 3,064 | 0 | 2.1 | 0 | 0 | 0 |
| DEX | Dentex spp | 188 | 1.7 | 81.8 | 9.1 | 6.1 | 1.2 | 4,056 | 0.3 | 2.3 | 0.4 | 0.1 | 0 |
| MGR | Argyrosomus regius | 171 | 1.9 | 94.7 | 1.3 | 2.1 | 0.1 | 558 | 0.1 | 0.4 | 0 | 0 | 0 |
| JOD | Zeus faber | 166 | 0.5 | 18.6 | 16.8 | 48.3 | 15.8 | 4,037 | 0.1 | 0.5 | 0.7 | 0.8 | 0.5 |
| BES | Belone spp | 159 | 0.1 | 2.9 | 46.7 | 50 | 0.2 | 273 | 0 | 0 | 0.1 | 0.1 | 0 |
| FIN | Actinopterygii | 151 | 3.6 | 50.1 | 14.3 | 29.1 | 2.8 | 764 | 0.1 | 0.4 | 0 | 0 | 0 |

In addition, the evolution of landings and values from 2013 to 2022 in EMU 1 is presented in Fig. 2.3.2.1.

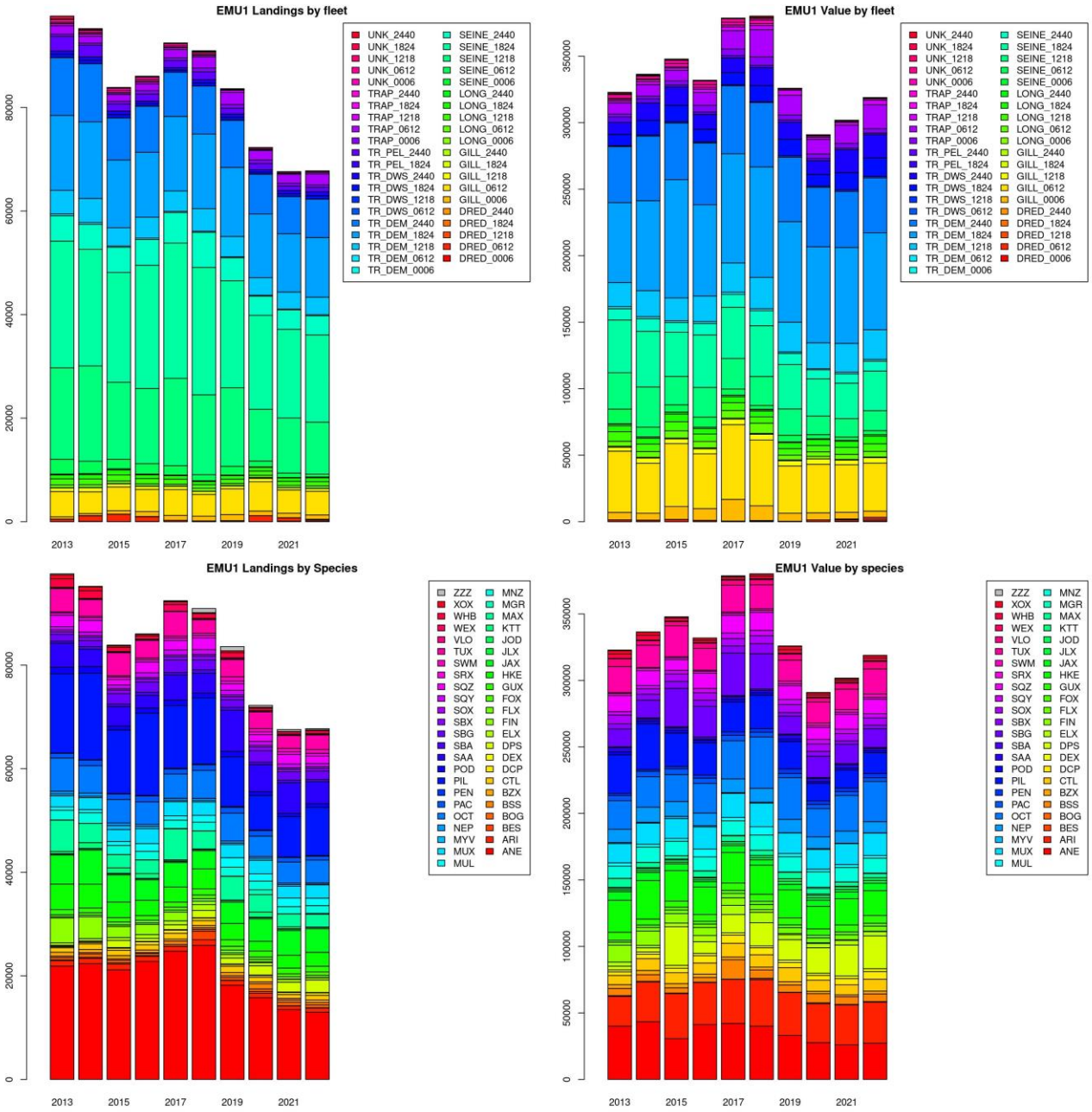



Figure 2.3.2.1. Evolution of landings (y-axis, in tons, left panels) and values (y-axis, in K€, right panel) across fleets (upper panels) and species (lower panels) through years (x-axis, spanning 2013-2022)

The landings and values by fleet clearly illustrate that most of the biomass and value landed are concentrated in a few fleet segments, namely Seiners in the 12-18, 18-24m and 24-40m size class that together land a yearly average of ~40000 tons of biomass for a value of ~63000 K€; Demersal trawlers in the 12-18, 18-24 and 24-40m size class that together land a yearly average of ~26000 tons of biomass for a value of ~140000 K€; Gillnetters in the 0-6m and 6-12m that together land a yearly average of ~5500 tons of biomass for a value of ~50000 K€, and vessels operating traps

(made of either either nets or pots) in the 06-12m size class that land a yearly average of ~2000 tons of biomass for a value of 13000 K€.

Landings and values across species are a little more evenly distributed than across fleet (Fig. 2). The most important taxons are:

Anchovies (ANE), ~20000 tons per year representing ~35000 K€;

Sardines (PIL), ~12000 tons per year representing ~22000 K€;

Octopods (OCT), ~5000 tons per year representing ~26000 K€;

Aristeus (ARI), ~950 tons per year representing ~31000 K€;

Hake (HKE), ~3000 tons per year representing ~22000 K€;

Gilt-Head bream (SBG), ~1800 tons per year representing ~20000 K€;

Mullus spp (MUX), ~2500 tons per year representing ~16000 K€;

Deep-water rose shrimp (DPS), ~1200 tons per year representing ~15000 K€;

Large pelagics (TUX), ~3500 tons per year representing ~18000 K€;

Squids and Cuttlefishes (SQZ), ~1700 tons per year representing ~11000 K€

Lophius spp. (MNZ), ~1700 tons per year representing ~11000 K€

The trend across years of total landings and values differs a bit: if a negative trend is observed in landings since 2013, total values have been more stable. Still, both seems to present slightly reduced values since 2020.

### *2.3.3 A focus on fleet segments concerned by the MAP*

#### 2.3.3.1 Demersal trawlers

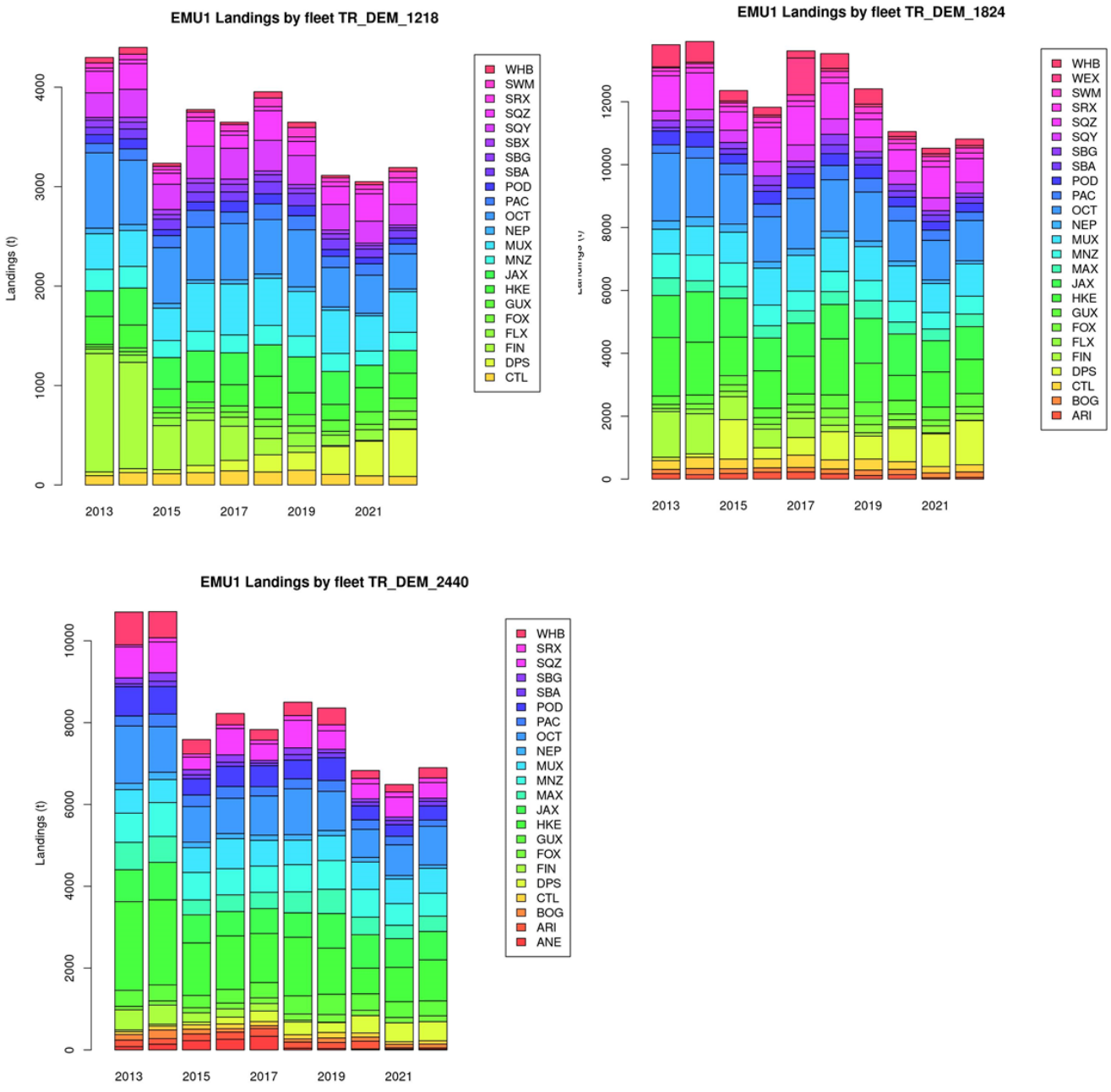



Figure 2.3.3.1.1. Evolution of landings (y-axis) through years (x-axis) and across taxons (colors) for demersal trawlers of various size class.

In EMU-1, Demersal trawlers of various size targets a similar community, with a few differences: For example ARI are not present in the landings of 12-18m vessels, and SQY are absent from 24-40. Still, in all size class, the dominant taxons in the landings are squids and cuttlefishes (SQZ), octopods (OCT), red mullets (MUX), anglers (MNZ), Horse mackerels (JAX), Hake (HKE), Gurnards (GUX), and deepwater rose shrimp (DPS). The landings of the demersal trawlers have reduced over the years, with the time period of the enforcement of the MAP (2020-2022) usually showing the lowest values of the time series. When translated in terms of values (Fig. 2.3.3.1.2).

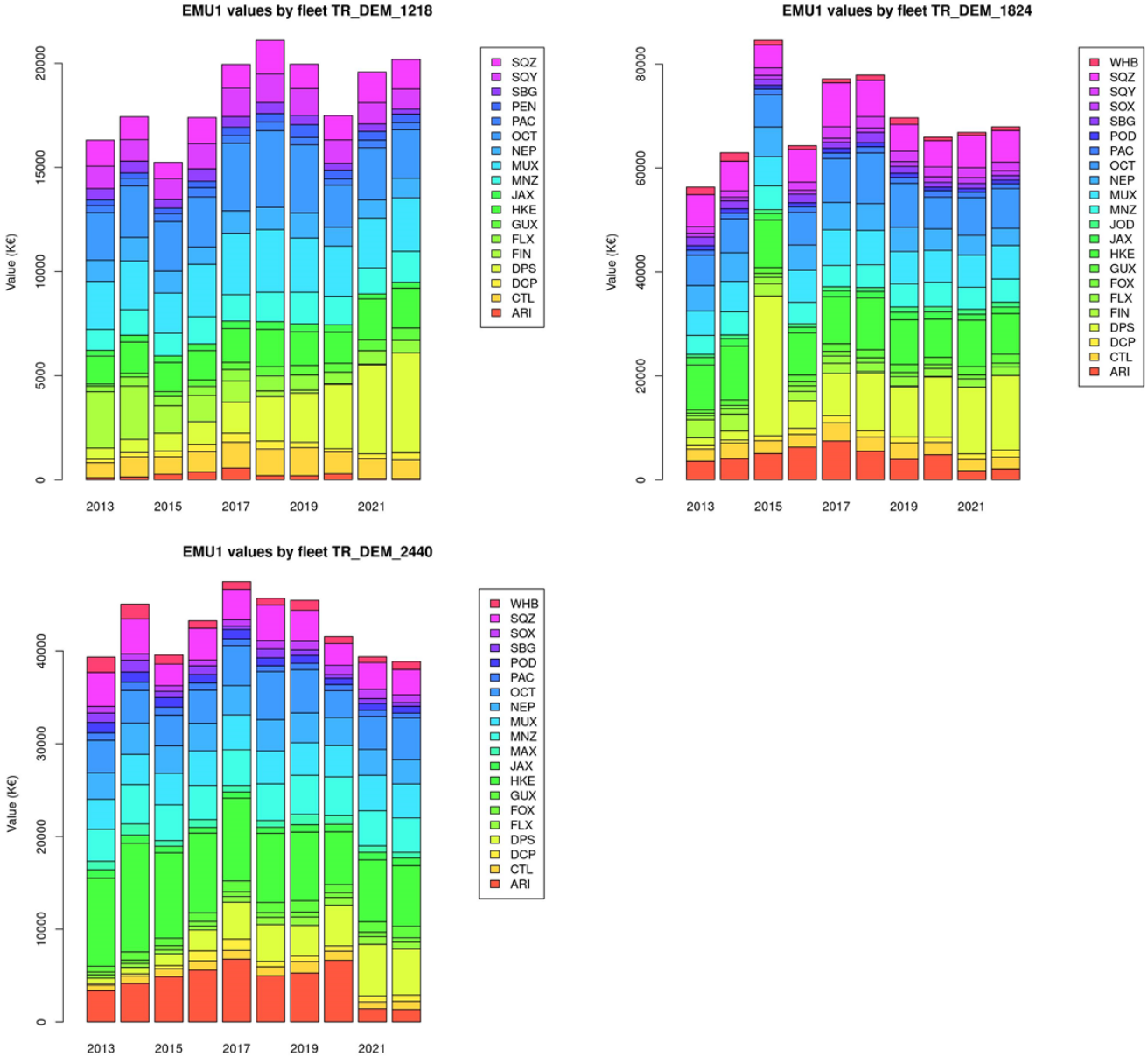



Figure 2.3.3.1.2. Evolution of values (y-axis) through years (x-axis) and across taxons (colors) for demersal trawlers of various size class

The economic importance of taxons such as SQZ, OCT, MUT, MNZ, HKE and DPS is emphasized. To better understand the joint evolution of landings and values of the most important taxons for each fleet, we produced "trajectory plots" representing each stocks in a landings * values space (Fig 5). For the sake of simplicity, we only represent taxons accounting for at least 5% in either landing or value of that fleet segment.

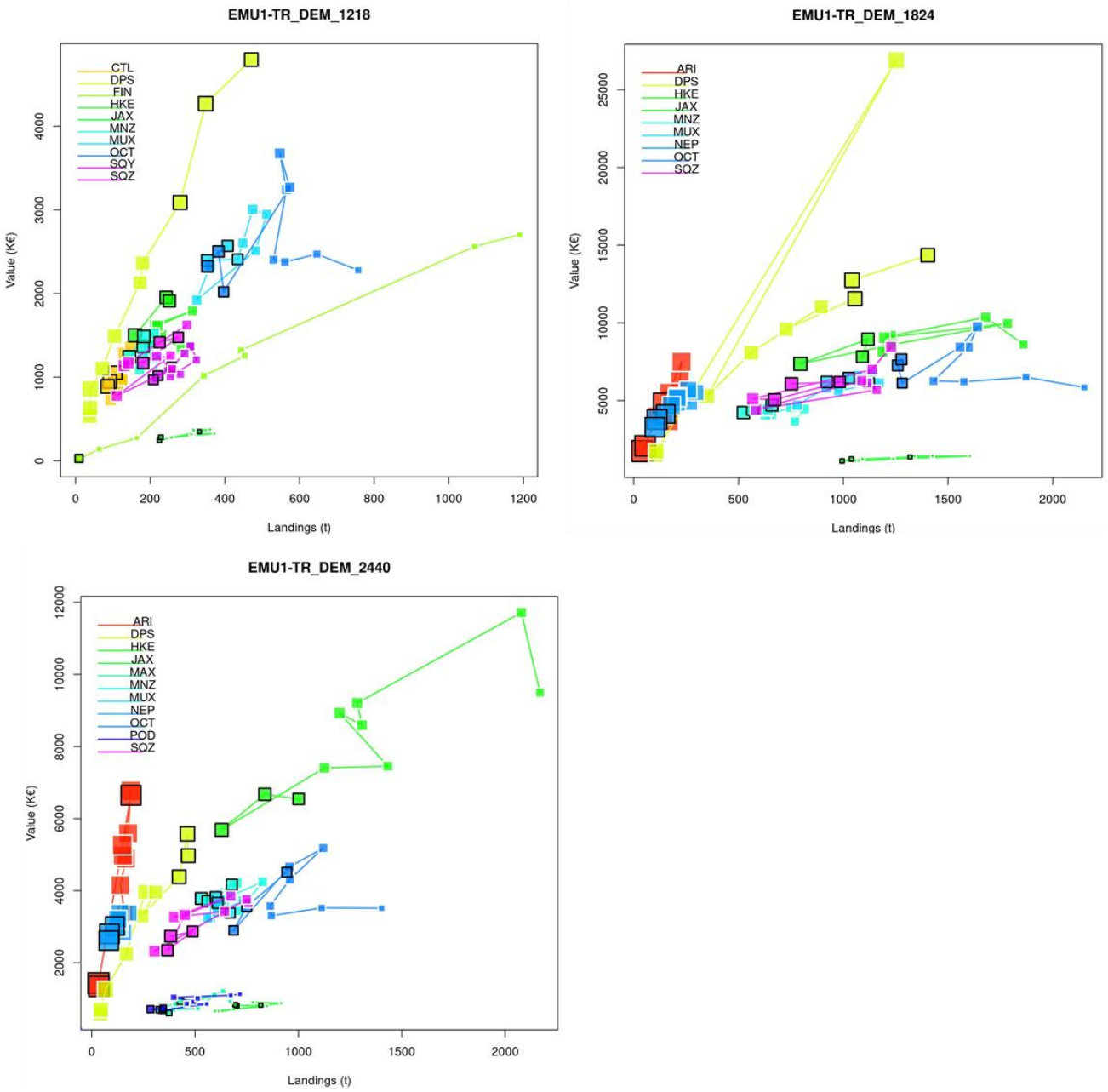



Figure 2.3.3.1.3 . Trajectory plots of the main taxons (c olors) landed by demersal trawlers of 12-18m (upper left), 18-24m (uper-right) and 24-40m (lower right). Symbol size is proportional to log(price). Each symbol corresponds to a year, positioned in a landings (x-axis) * value (y-axis) space. Terminal years during wich westmed-MAP has been enforced (2020-2022) are outlined with black contour.

Trajectory plots clearly reveals the most economically important taxons for each fleet segments, and provides insights in the direction towards which the landings and monetary values extracted from it goes.

For all demersal trawlers, deep-water rose shrimp (DPS) has become a major player in the recent years, while the landings or values of other important stocks seems to have either stagnated or decreased. Most important decreases concerns Hake (HKE) and deepwater *Aristeus* shrimp (ARI) in 18-24m and 24-40m demersal trawlers, and finfishes (FIN) in 12-18m. If the latter can be attributable to an increased sampling effort in harbour, or an improvement of the quality of declarative data (with operators in fishmarket reporting catches with an increased taxonomic resolution), the reduction in HKE and ARI landings arise in the context of over-harvesting for both stocks.

The slope of each taxons in the trajectory plots also quickly identifies the most profitable stocks: higher slopes indicates higher prices, that is stocks for which the incentive to fish more is very strong as more landings translates quickly into more values. This is the case for DPS, ARI and norway lobster (NEP). On the other hand, some stocks such as Octopods (OCT) in 18-24m trawlers provides similar values even if landings decreases. This is made possible through price increase in low landings context. In trajectory plots, such stocks appear as horizontal cloud of points. For these stocks, the incentive to fish more might be reduced, as loss due to decreased landings seems somewhat compensated through price adjustement.

#### 2.3.3.2 Deep-water trawlers

Deep-water trawlers in EMU 1 strongly relies on ARI, that makes up to ~50% of their landings and accounts for ~90% of their landed value (Fig. 2.3.3.2.1). Such strong dependence is also clearly observable on Trajectory plots (Fig. 2.3.3.2.2).

Interestingly, the pattern displayed by ARI trajectories differs between demersal and deep-water trawl. In Demersal trawlers, ARI landings and values are strongly related and hence the ARI trajectory is spread along a straight, increasing line. In deep-water trawlers however, the relationship between landings and values is somewhat weakened, mostly because of price variability: years with lower landings tend to maintain a higher value through price adjustement.

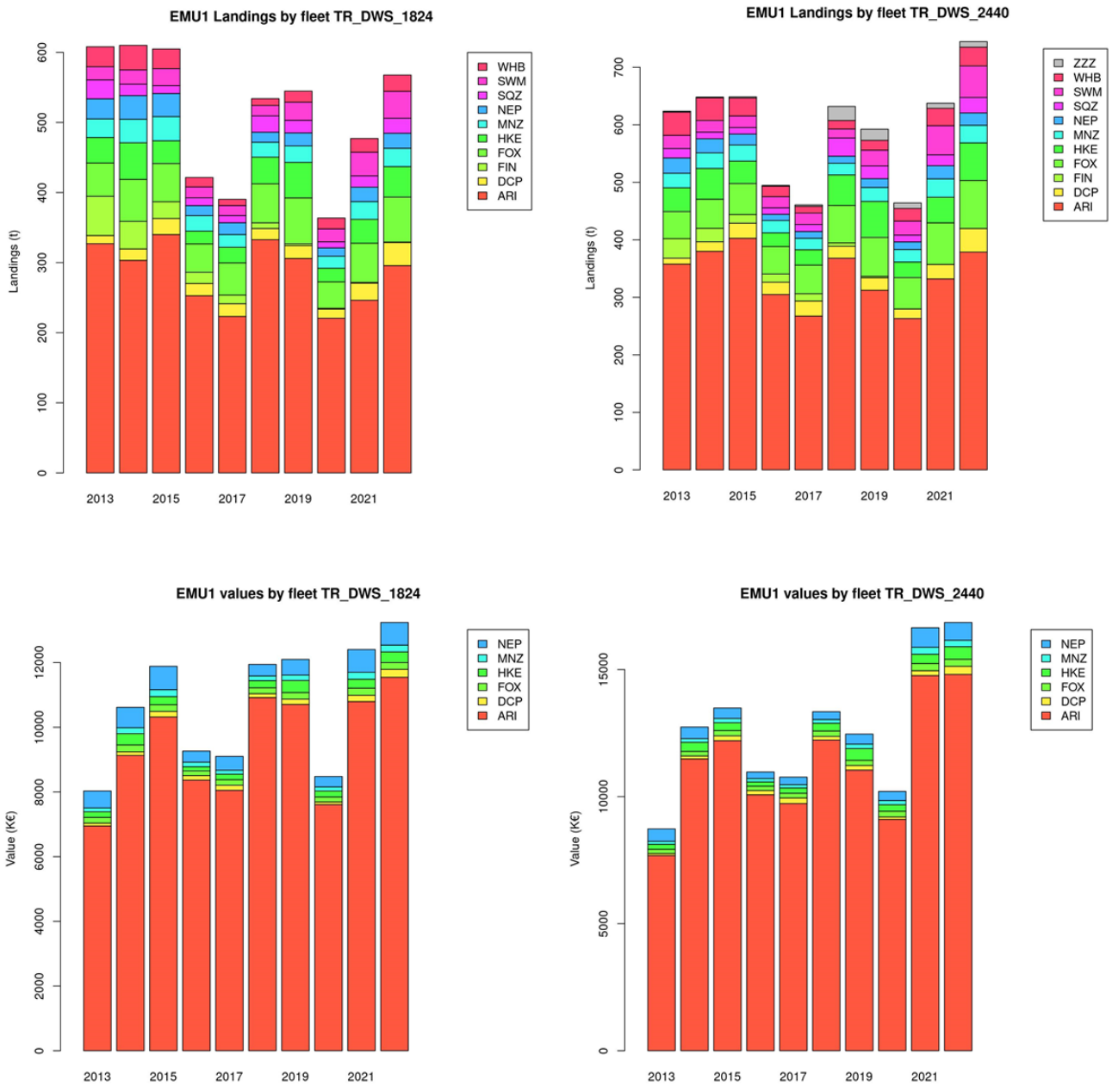



Figure 2.3.3.2.1. Evolution of landings (y-axis, upper panel) and values (y-axis, lower panels) through years (x-axis) and across taxons (colors) for deep-water trawlers of 18-24m (left) and 24-40m (right).

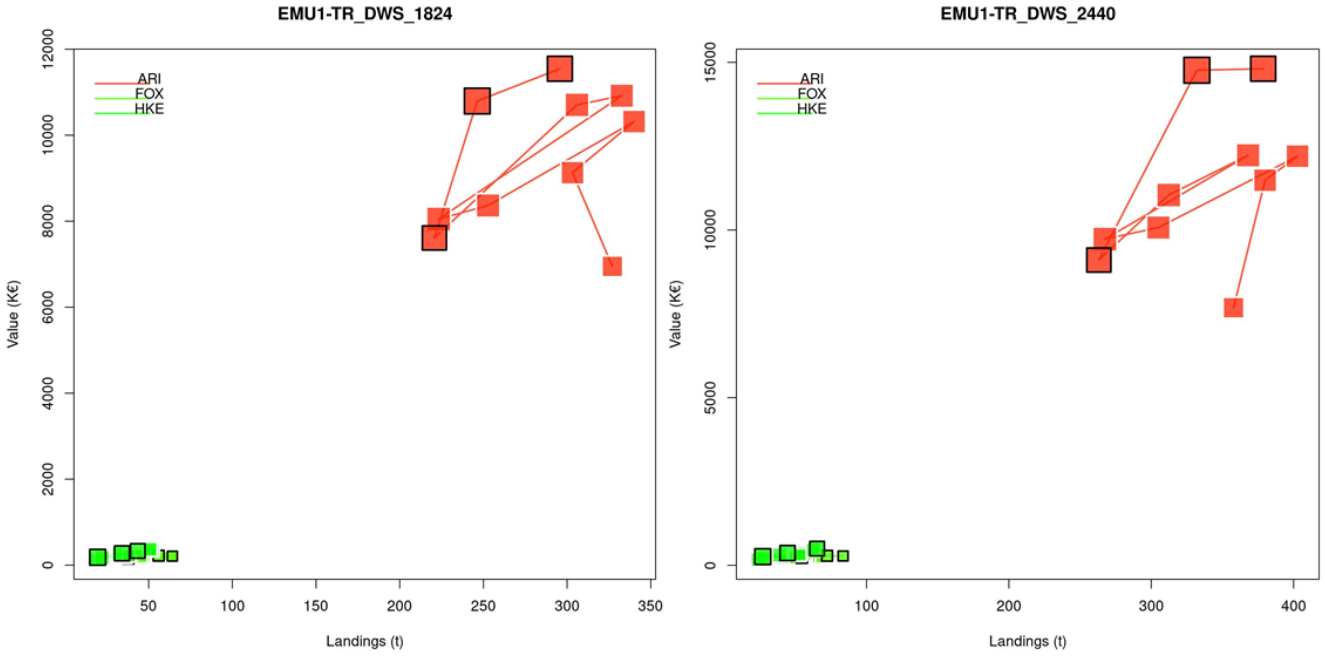



Figure 2.3.3.2.2. Trajectory plots of the main taxons (colors) landed by deep-water trawlers 18-24m (left) and 24-40m (right). See fig. 4 for complete legend.

### 2.3.3.3 Other gears: gillnets and traps (6-12m)

There is no place in this report section to cover all stocks and fleet in EMU 1. However, small-scale vessels are an important part of the mediterannean fishing fleet, with specific targets and economy. To illustrate these differences, we cover in the next section vessels using Gillnetts and Traps in the 06 – 12m size class.

Fig. 2.3.3.3.1 highlights the strong contrast between vessels operating gillnets and targeting a wide variety of taxons, and vessels operating traps whose landings and values are strongly dependent on Octopods (OCT) and eels (ELX) to a lesser extent. Still, a few taxons are still responsible for the most part of the revenue landed in Gillnetters. These are homarids (VLO) and large pelagics (TUX), Soleidae (SOX), Gild-head bream (SBG), red mullets (MUX), Sepiidae (CTL) and seabass (BSS).

Trajectory plots for Gillnetters and Traps in 06-12m (Fig. 2.3.3.3.2) clearly emphasizes the importance of SBG for the former, and of OCT for the latter. In gillnetters, an interesting pattern is the decrease in the value obtained from SBG landings, despite landings being maintained at moderate to high levels, suggesting a SBG price reduction in the recent years.

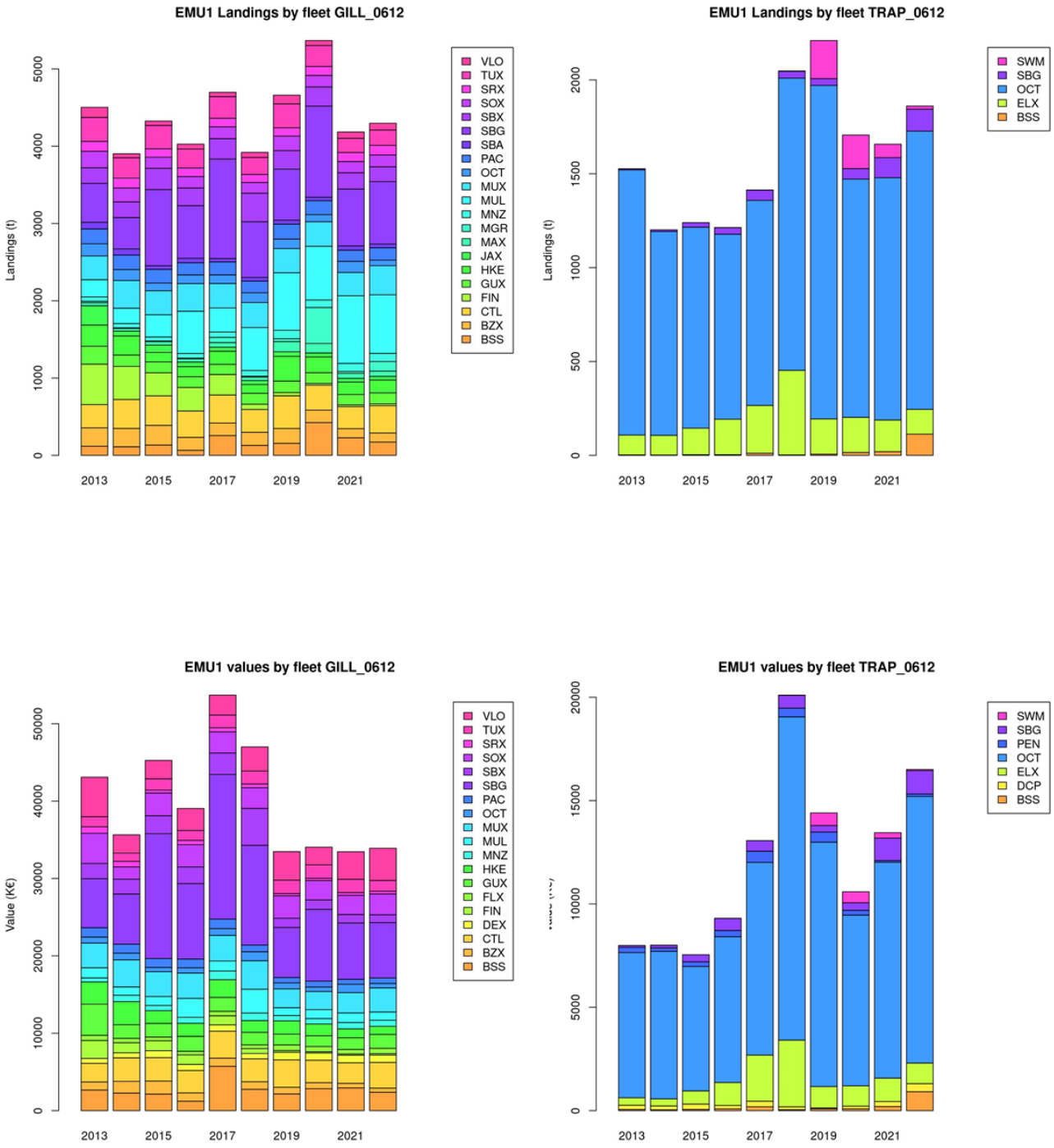



Figure 2.3.3.3.1. Evolution of landings (y-axis, upper panel) and values (y-axis, lower panels) through years (x-axis) and across taxons (colors) for Gillnetters of 06-12m (left) and Traps of 06-12m (right).

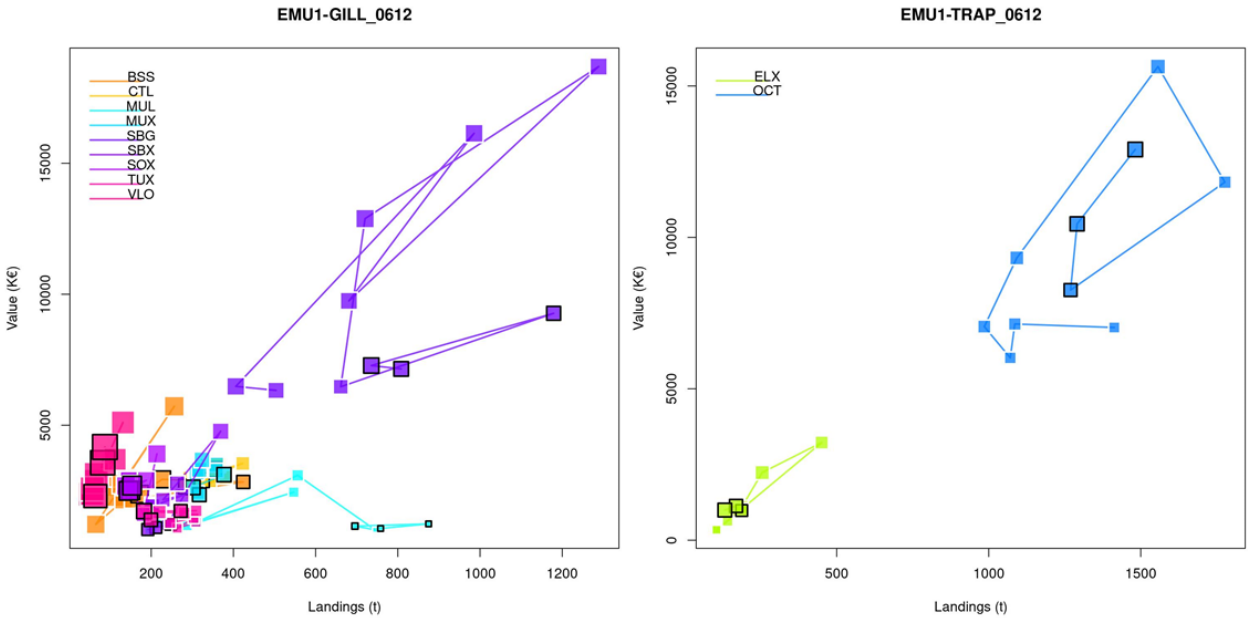



Figure 2.3.3.3.2. Trajectory plots of the main taxons (colors) landed by gillnetters 06-12m (left) and vessels operating traps 06-12m (right). See fig. 4 for complete legend.

### *2.3.4 Transition rates in EMU-1 fisheries before and during the plan*

In this last section, we will focus on transition rates across "species/fleet segment". We define a "species/fleet segment" (SFS) as a landed taxon by a given fleet, for example, the SFS "HKE_GILL06-12" indicates Hake landed by 06-12m gillnetters. We will take advantage of the 10 years time serie provided by FDI data (2013-2022) to compare the global evolution of SFSs between three time period: 2014-2017, 2017-2019 and 2020-2022. For simplicity, we will refer to these time period as "B1", "B2", and "P", respectively. Scaled transition rates were computed for each SFS as follows:

TR_B2B1 = (SFS in period B2 – SFS in period B1) / reference. ("Before plan")

TR_PB2 = (SFS in period P – SFS in period B2) / reference. ("During plan")

Where the reference is the averaged SFS in the entire time series. In other word, the transition rates express the proportion of change between two time period, scaled over the average value for the entire serie. Negative values indicate reduction, positive values indicate increase, and 0 indicate no change. Boxplots of SFS transition rates across fleet segments between time periods and computed with landed values are shown in Fig. 2.3.4.1.

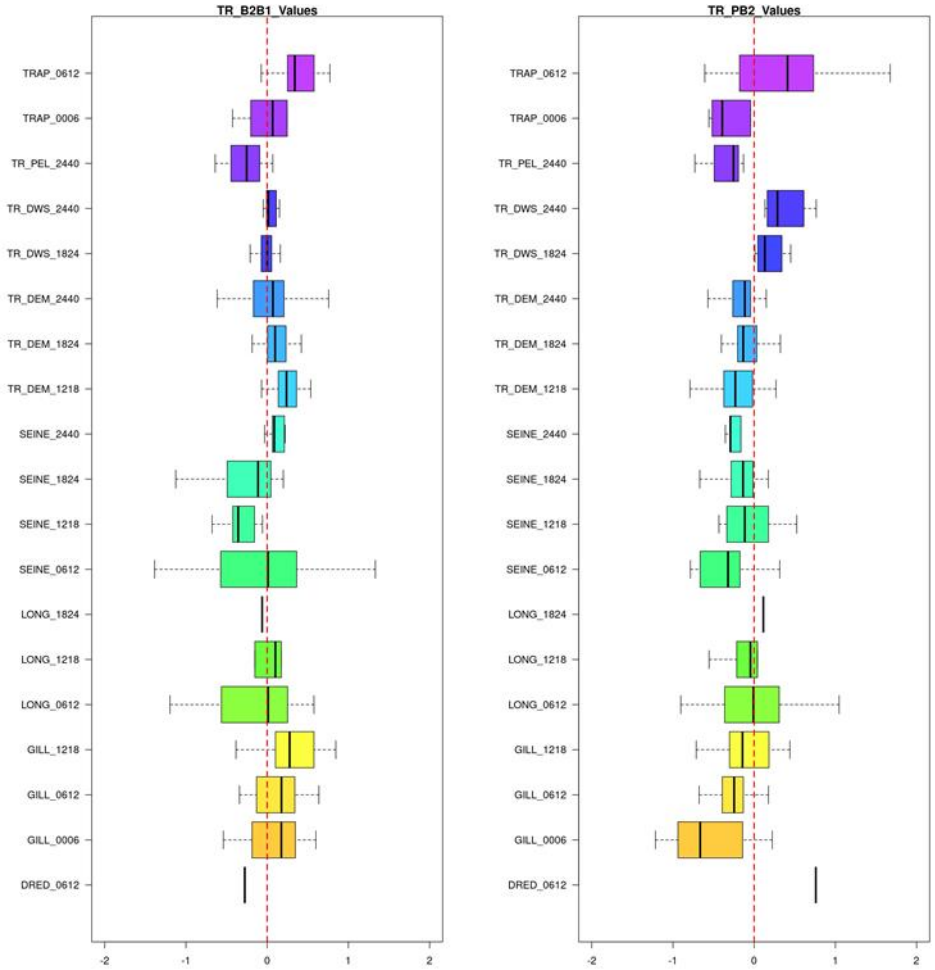



Figure 2.3.4.1. SFS scaled transition rates (x-axis) across fleets (y-axis), between time periods B2 and B1 (before management plan, left panel) and P and B2 (during management plan, right panel). The red dashed vertical line indicate 0 transition (no change)

SFS Transition rates have slightly evolved before and during the plan for some fleet segments (FIG 9). Notably for demersal trawlers, SFS transition rates before plan were rather small and either positive (TR_DEM_12-18 and 18-24) or evenly spread between positive and negative values (TR_DEM_24-40), while they became mostly negative during the plan, suggesting a substantial value reduction during the plan for most SFS belonging to these three fleet segments. The reverse is observed for deep-water trawlers (TR_DWS-18-24 and 24-40), whose transition rates were close to 0 before plan, but increased markedly during the plan, indicating more value landed by these fleets in the recent years. Lastly for pelagic trawlers, their transition rates have been negative both before and during the plan, suggesting that these boat have faced a strong negative context in the last decade.

Among other fleets, yet not targeted by the plan, vessels operating traps in the 06-12m displays the highest transition rates, while small vessels operating traps (00-06m), smaller seiners (06-12m) and smaller gillnetters (00-06m) display the most negative transition rates.

### *2.3.5 Conclusions*

The present analysis provides a bio-economic description of the FDI-data available for EMU-1. It highlights the high complexity of the fisheries in the area, being in terms of fleet and in terms of targeted stocks. It emphasizes the strong dependence of some fleets to some stocks, such as deep-water trawls on ARI, demersal trawls on SQZ, OCT, MUX, MNZ, HKE and DPS, Gillnetters on VLO, TUX, SBX, SBG, MUX, CTL and BSS, or vessels operating traps on OCT.

During the plan, all fleet segments have not evolved in the same way. If all demersal trawlers seems to face a substantial contraction of their landed values, deep-water trawlers are increasing their landed value, most likely thanks to an increased ARI price. Still, for many other fleet, the transition rates before and during the plan remains similar.

# 3 ANALYSIS OF THE RELATIONSHIP BETWEEN FISHING EFFORT AND FISHING MORTALITY USING THE MOST RECENT DATA SETS AND STOCK ASSESSMENTS (TOR 2)

## 3.1 Relationship between fishing mortality and fishing effort

### *3.1.1 Input data*

The EWG 22-11 is requested to analyse the F-E relationship in the two EMUs (Effort Management Units): EMU1 for GSAs 1 to 7 and EMU2 for GSAs 8 to 11 (3.1.1).

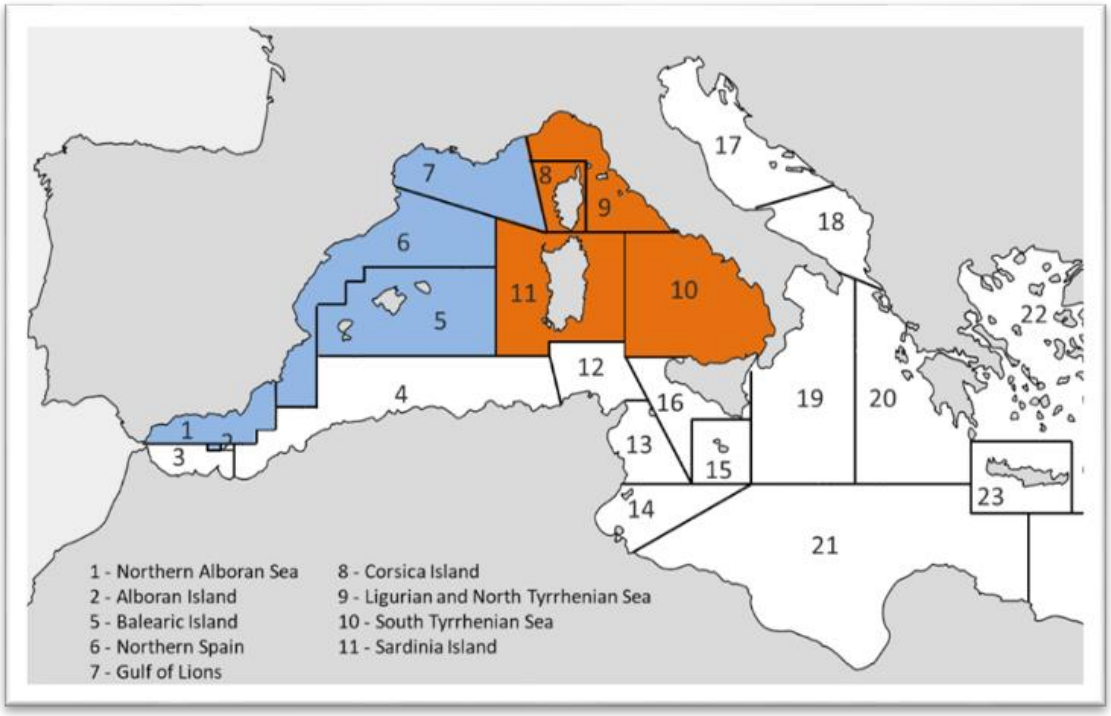



Figure 3.1.1.1 Mediterranean fishing management units ("GSAs") under the WMMAP for demersal fisheries. The west GSAs are grouped as Effort Management Unit 1 (EMU1) for management purposes and highlighted in blue, while the east GSAs are designated EMU2, in red.

To respond to ToR 2, EWG 23-11 based the analysis on the most recent stock assessments' results from EWG 23-09 "Western Mediterranean stock assessments". The report EWG receive the summary results and the vectors of fishing mortality estimated during EWG 23-09 for all the species listed in 3.1.1 (species as category 1 stocks included in the WMMAP), at the GSA level or EMU level (Table 3.1.2).

Table 3.1.1.1 Species covered by the WMMAP for demersal fisheries.

| Common name | Scientific name | FAO 3-alpha code |
|---|---|---|
| **Hake** | *Merluccius merluccius* | HKE |
| **Red mullet** | *Mullus barbatus* | MUT |
| **Deep-water rose shrimp** | *Parapenaeus longirostris* | DPS |
| **Norway lobster** | *Nephrops norvegicus* | NEP |
| **Giant red shrimp (only EMU2)** | *Aristaeomorpha foliacea* | ARS |
| **Blue and red shrimp** | *Aristeus antennatus* | ARA |

The analysis was also performed considering the main gears targeting the species to evaluate how much gears other than bottom otter trawls, such as gillnets and longlines contribute to demersal stocks fishing mortality.

Table 3.1.1.2. Contribution of trawling fleets and fleets using other gears to the catches of the main target stocks in the Western Mediterranean, based on fisheries production data for 2022 made available by JRC to this EWG.

| EMU | Stock (species and area) | % trawl(1) | Other gear | Fbar range |
|---|---|---|---|---|
| EMU1 | HKE 1_5_6_7 | 85% | nets (GTR or GNS): 7%<br>longline (LLS): 7% | 1-3 |
| EMU1 | MUT 1 | 82% | nets (GTR or GNS): 17.5% | 1-3 |
| EMU1 | MUT 6 | 90% | nets (GTR or GNS): 9.8% | 1-3 |
| EMU1 | DPS 1 | 100% | | 1-2 |
| EMU1 | DPS 5_6_7 | 100% | | 1-2 |
| EMU1 | NEP 6 | 100% | | 3-6 |
| EMU1 | ARA 5 | 100% | | 1-3 |
| EMU1 | ARA 6_7 | 100% | | 1-2 |
| EMU2 | HKE 8_9_10_11 | 58% | nets (GTR or GNS): 30% | 1-3 |
| EMU2 | MUT 9 | 94.6% | nets (GTR or GNS): 4.9% | 1-3 |
| EMU2 | DPS 9_10_11 | 100% | | 1-2 |
| EMU2 | NEP 9 | 100% | | 2-6 |

| EMU | Stock (species and area) | % trawl(1) | Other gear | Fbar range |
|---|---|---|---|---|
| EMU2 | ARS 9_10_11 | 100% | | 1-3 |

Note: (1) "trawl" is exclusively OTB in GSAs 1, 5 and 6, but combines OTB, OTM and OTT in GSA 7 (France).

### *3.1.2 Methods*

For each stock considered, a vector of partial *F* was computed for each fishing gear accounting for more than 1% of the catches in weight. To this end, the catch at length in numbers per fishing gear made available by the JRC as files landings.csv and discards.csv was converted to catch at age in numbers ("slicing") using routine *l2a* of FLR package *FLa4a* and the relative contribution to *F* was computed according to the formula:

$$F_{a,g}^{y} = F_{a}^{y} \frac{C_{a,g}^{y}}{\sum_{j}^{G} C_{a,j}^{y}}$$

where $F_a^y$ is the vector of fishing mortality at age *a* for each year *y*, $C_{a,g}^y$ is the reconstructed catch-at-age in numbers *a* for year *y* and each area *x* fishing gear *g* combination (*G* is the total number of area *x* fishing gear combinations). The $F_a^y$ vector was obtained from the *R* objects in electronic Appendix I of EWG 23-11.

In case of reconstructed data during the assessment for some year and gear those were used update the catch at age matrices.

After the slicing procedure, and the update in case of reconstruction, the SOP correction factors were applied to catch numbers at age by GSA and gear and then the partial *F* computed.

For hake and deep-water rose shrimp in EMU2 (GSAs 8,9,10,11), and red mullet in EMU2 (GSA 9) the age slicing routine was applied by sex accordingly with the data procedure preparation adopted during the assessments of EWG 23-09.

Regarding the time-span of the reconstructed catch-at-age series ($C_{a,g}^y$) it is important to note that the length frequency data for fishing gear other than OTB was consistently available only from 2010 in the Spanish GSAs and 2011 in the French GSA, despite the existence of information on total catches since 2002 in some cases. In the Italian GSAs total catches and landings at length information are available since 2002 (2012 in GSA 8), while discard at length are consistently available since 2009. Hence, the partial *F* vectors were calculated since 2013.

The results presented and discussed in the following sections refer to the most recent year in the assessment (2022), although the relative importance of the various fishing gears have remained stable over time in the last years.

For each stock, the relationship between the effort (days at sea) and the fishing mortality is analyzed throughout a bivariate analysis that measures the strength of association between two variables and the direction of the relationship. Explicitly, Pearson correlation's method is applied by gear for the whole EMU and for each GSA which contribute to the total. All the analysis are plotted by distributing the points in a cloud of values and over imposing the lines which hypothesize a linear relationship between fishing effort and fishing mortality. In the figures the solid line represents the linear regression on the observed values, while the dashed line represents the linear regression forced to pass from the origin according to the reasonable assumption that F is nihil

when no fishing effort is exerted on the stock. The correlation coefficients are also plotted within each graph.

To properly link and find the relationship between the effort (days at sea) and the fishing mortality a check of target assemblages from FDI dataset matching with the landings by gear for the selected GSAs and species was done. The results shown in the table below highlight that effort is related to a maximum of 12 assemblages (Table.1.3). For the purposes of the analysis and taking in to account the biology and depth distribution of the species EWG 23-11 state that the DWS assemblage should be excluded from the total effort for red mullet in each EMU and GSA, while for ARA and ARS only the efforts belonging to CRU, DWS, DES, MDD and NK assemblages should be conversely considered.

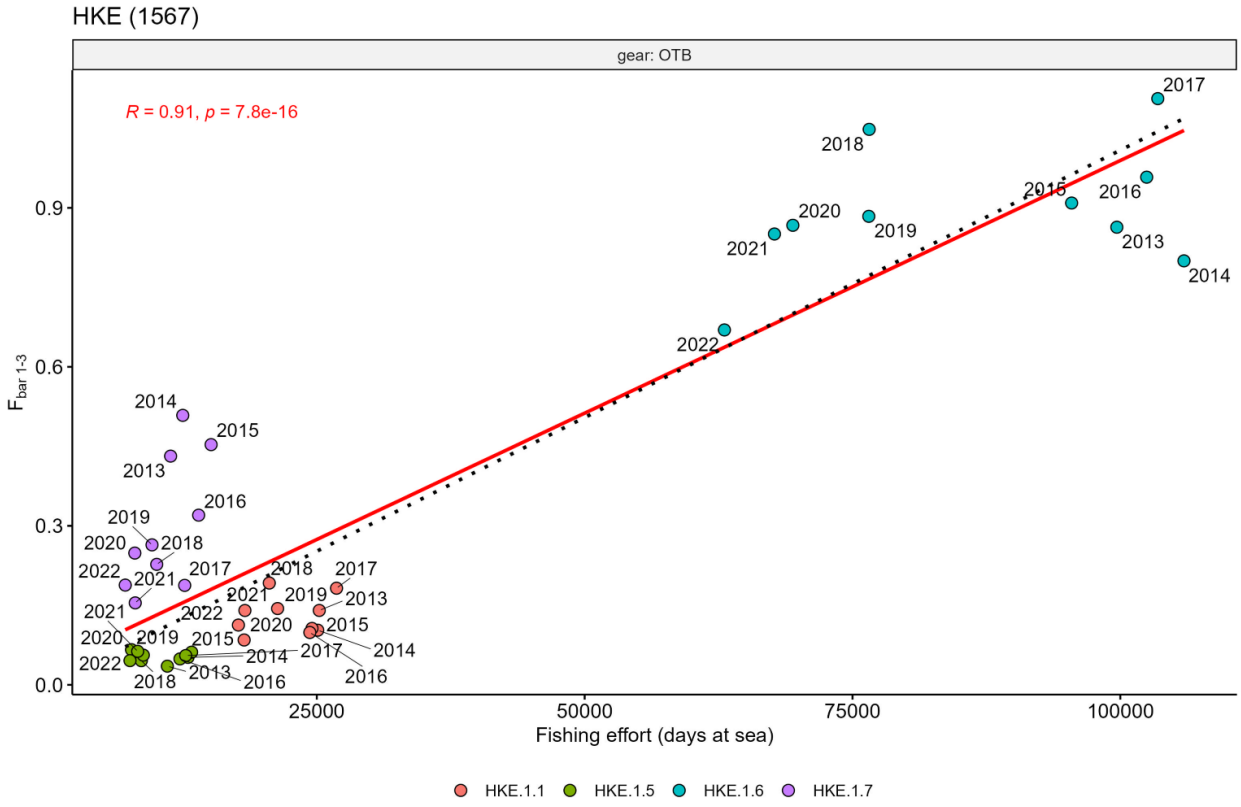
Table 3.1.1.3 Target assemblages related to the areas and species object of the analysis (code match)

| Code match | Code | Target assemblage description |
|---|---|---|
| | ANA | Anadromous |
| CAT | CAT | Catadromous |
| CEP | CEP | Cephalopods |
| CRU | CRU | Crustaceans |
| DEF | DEF | Demersal fish |
| | DES | Demersal species (Benthic species) |
| DWS | DWS | Deep-water species |
| FIF | FIF | Finfish |
| | FWS | Freshwater species |
| | GLE | Glass eel |
| LPF | LPF | Large pelagic fish |
| | MCD | Mixed crustaceans and demersal fish |
| | MCF | Mixed cephalopods and demersal fish |
| MDD | MDD | Mixed demersal and deep water species |
| | MIS | Miscellany |
| MOL | MOL | Molluscs |
| | MPD | Mixed pelagic and demersal fish |
| SLP | SLP | Small and large pelagic fish |
| SPF | SPF | Small pelagic fish |
| NK | NK | not known |

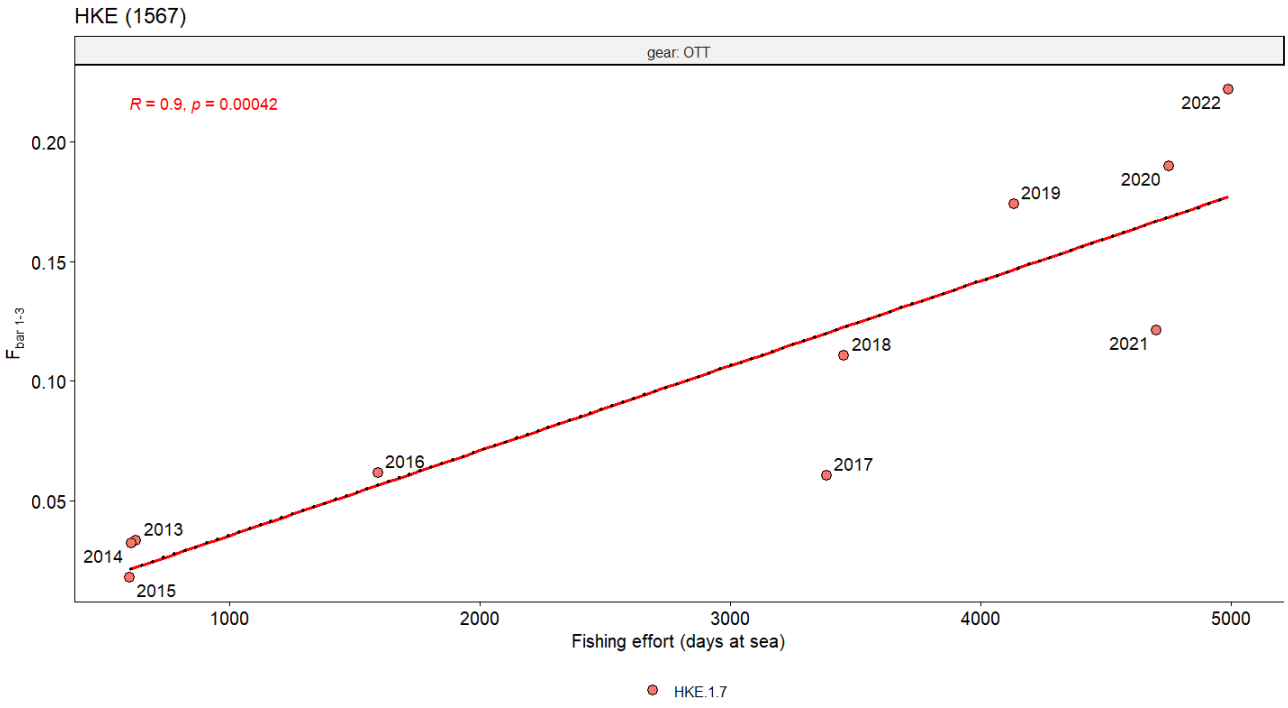
### *3.1.3 Results*

#### 3.1.3.1 HKE EMU1-GSAs 1-5-6-7

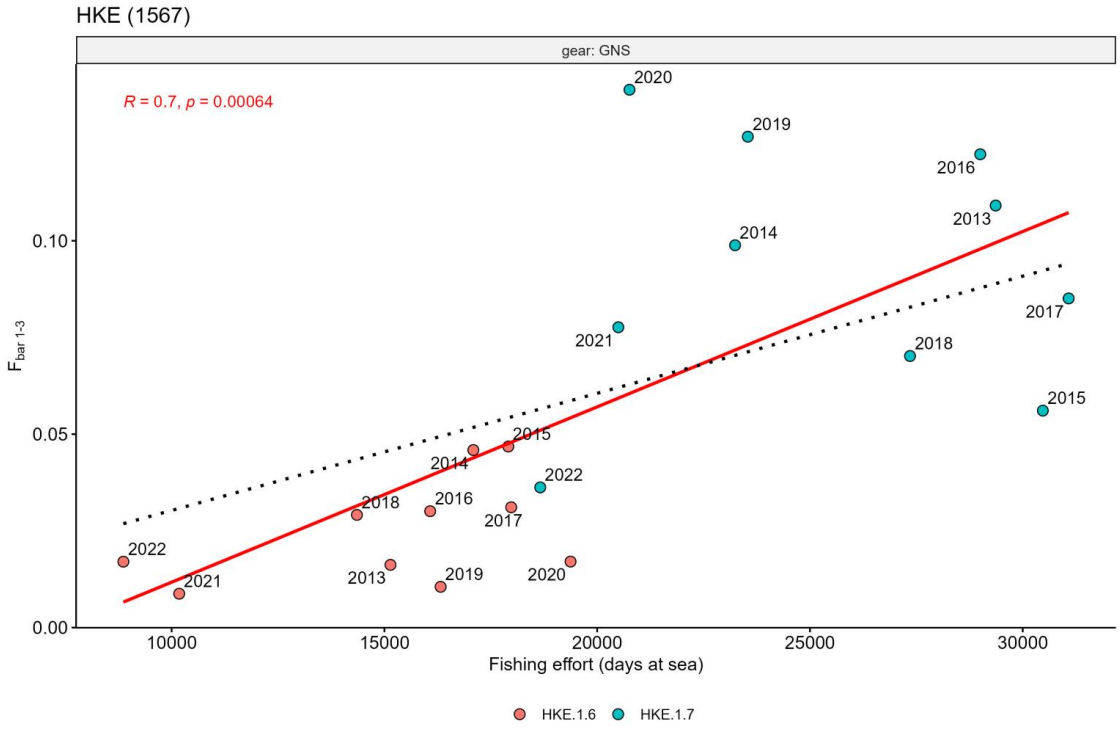
The relationship between the effort (days at sea) and the fishing mortality by gear is reported for HKE in EMU1 in Figure 3.1.3.1 a-e. In the graph the points are distributed in a cloud of values and the lines hypothesize a linear relationship between fishing effort and fishing mortality. The solid line represents the linear regression on the observed values. The dashed line represents the linear regression forced to pass from the origin according to the reasonable assumption that F is nihil when no fishing effort is exerted on the stock. The correlation coefficients are also plotted.


HKE (1567)
gear: OTB
R = 0.91, p = 7.8e-16
F bar 1-3
Fishing effort (days at sea)
HKE.1.1
HKE.1.5
HKE.1.6
HKE.1.7

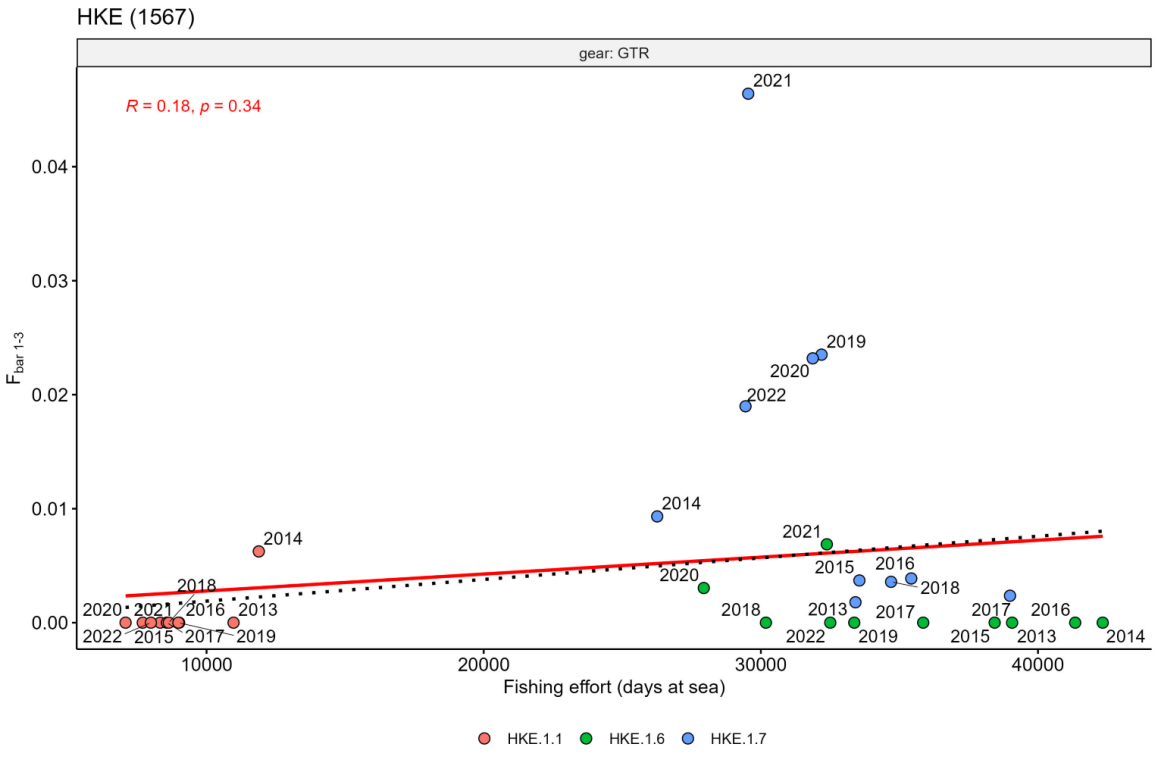
a


HKE (1567)
gear: OTT
R = 0.9, p = 0.00042
F bar 1-3
Fishing effort (days at sea)
HKE.1.7

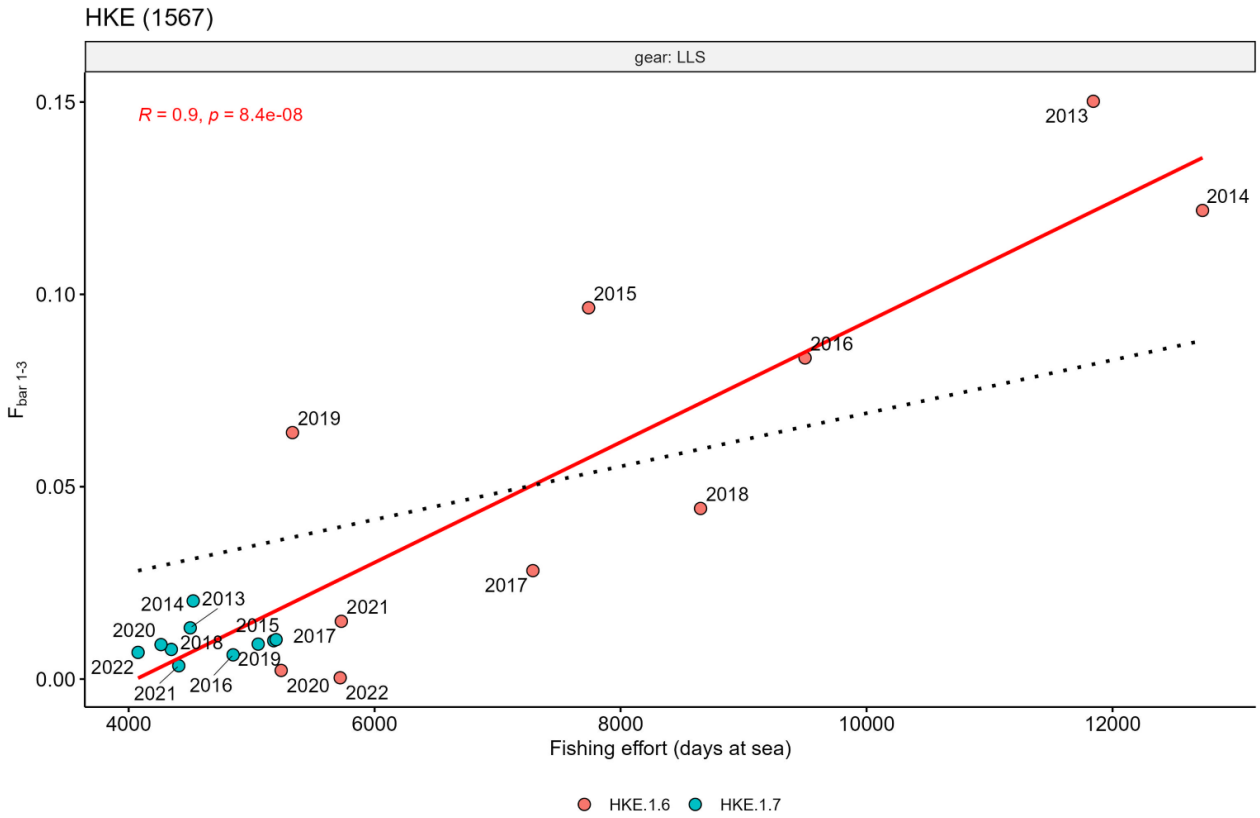
b


HKE (1567)
gear: GNS
R = 0.7, p = 0.00064
F bar 1-3
Fishing effort (days at sea)
HKE.1.6
HKE.1.7

c


HKE (1567)
gear: GTR
R = 0.18, p = 0.34
F bar 1-3
Fishing effort (days at sea)
HKE.1.1
HKE.1.6
HKE.1.7

d




e

Figure 3.1.3.1.1 – Relationship between total effort and Fbar (1-3) for HKE by gears (a-e) in EMU 1 (GSA 1, 5, 6 and 7 combined). Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

The analysis shown in Figure 3.1.3.1 highlights a positive linear relationship between fishing mortality and the fishing effort for both trawl gears (OTB-OTT), gillnet (GNS) and longlines (LLS) while the relationship is neither meaningful nor explanatory for trammel net (GTR).

By performing the analysis for each GSA which belongs to the whole EMU, in most of the GSA the values are distributed in a cloud that does not allow to highlight any clear relationship between fishing mortality and the fishing effort. Only in GSA 7 for OTT and in GSA 6 for LLS the relationship is significantly stronger and much clear (Figure 3.1.3.1b and Figure 3.1.3.1.3).

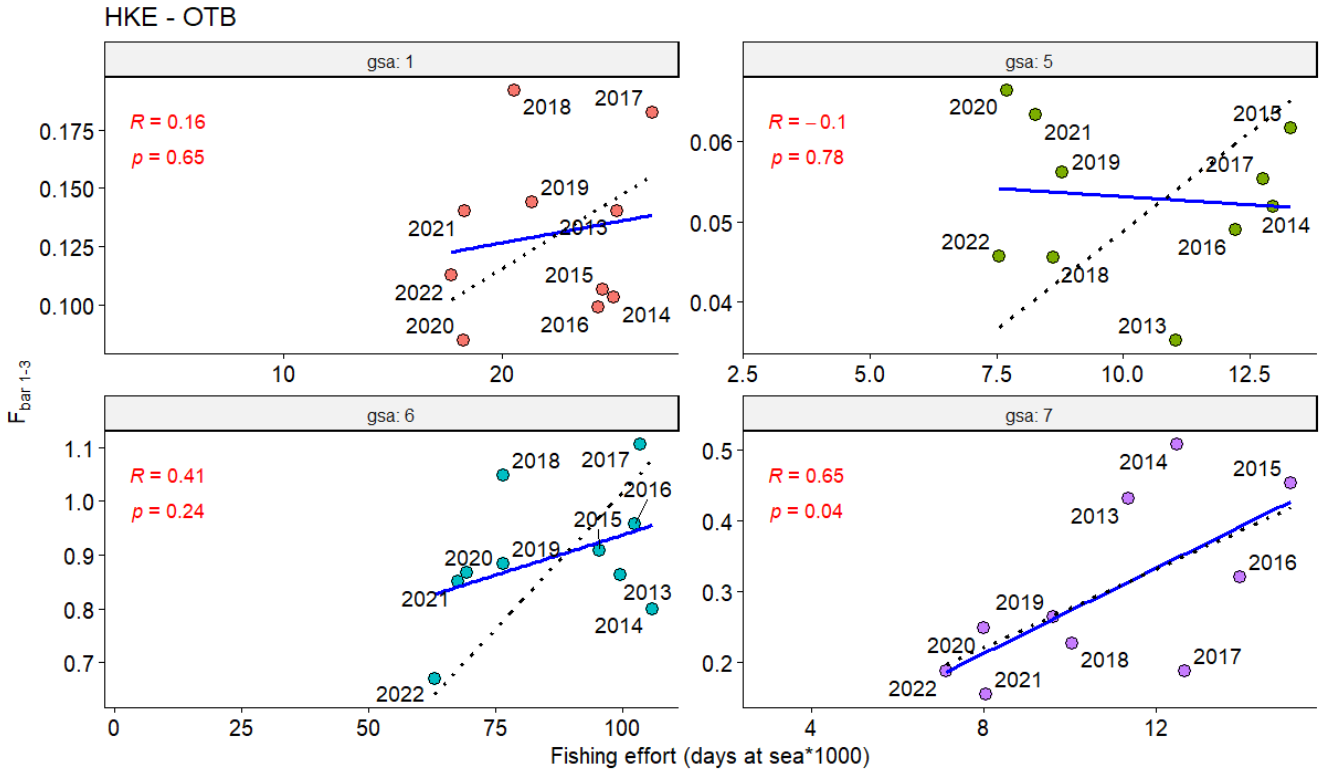



Figure 3.1.3.1.2 – Relationship between nominal effort and Fbar(1-3) for hake in GSAs 1, 5, 6 and 7. Blue line: linear regression for each GSA. Black dashed line: linear regression forced through the origin for each GSA.

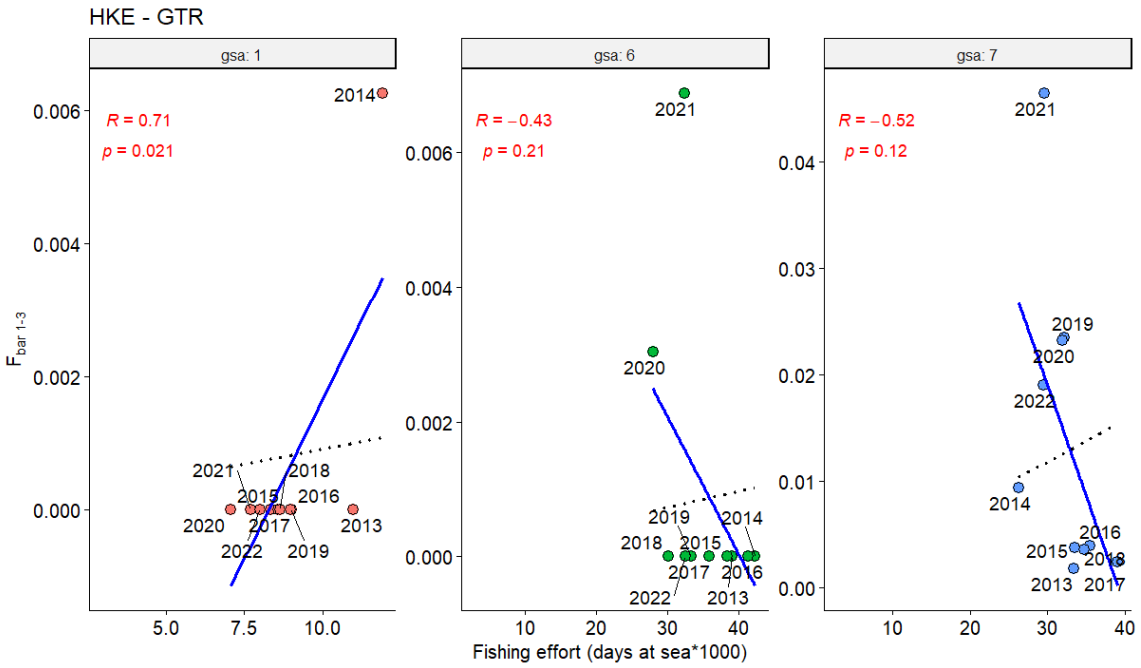



Figure 3.1.3.1.3 – Relationship between total effort and Fbar (1-3) for HKE by trammel net (GTR) in GSAs 1, 5, 6 and 7. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

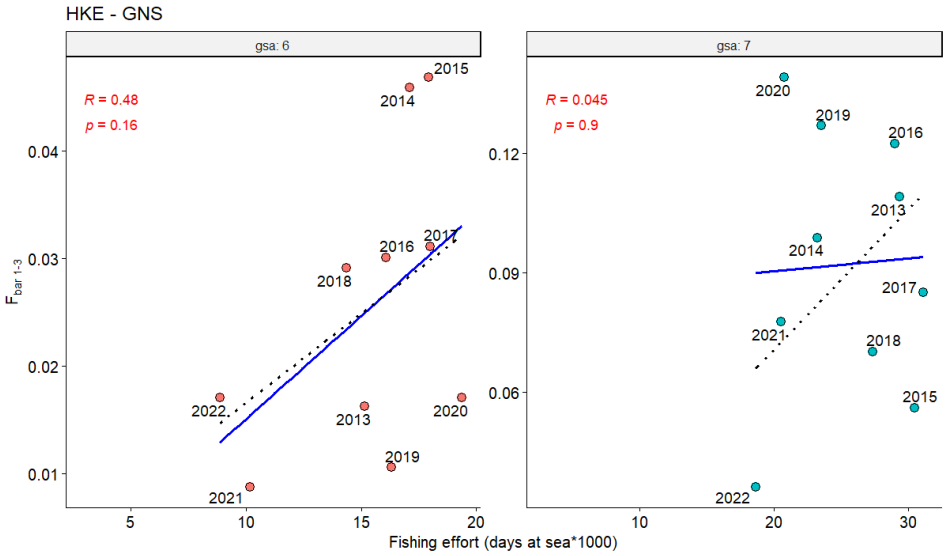



Figure 3.1.3.1.4 – Relationship between total effort and Fbar (1-3) for HKE by gillnets (GNS) in GSAs 1, 5, 6 and 7. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

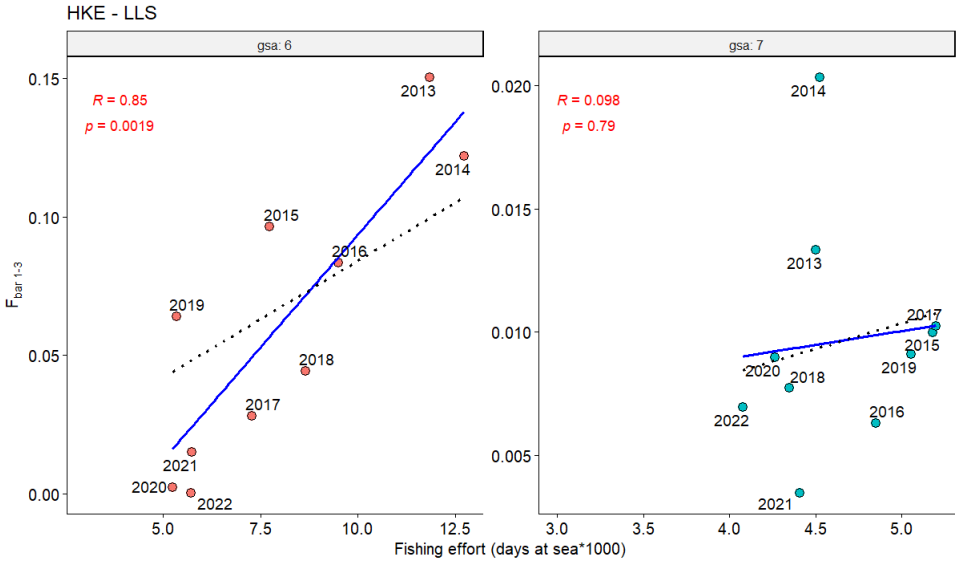



Figure 3.1.3.1.5 – Relationship between total effort and Fbar (1-3) for HKE by longlines (LLS) in GSAs 1, 5, 6 and 7. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.2 MUT EMU1-GSA1

The relationship between the effort and the fishing mortality for red mullet in GSA 1 of EMU1 is reported for all gears in Figure 3.1.3.2.**Error! Reference source not found.**. The points are distributed in a cloud of values that does not allow to highlight any clear relationship between fishing mortality and the fishing effort.

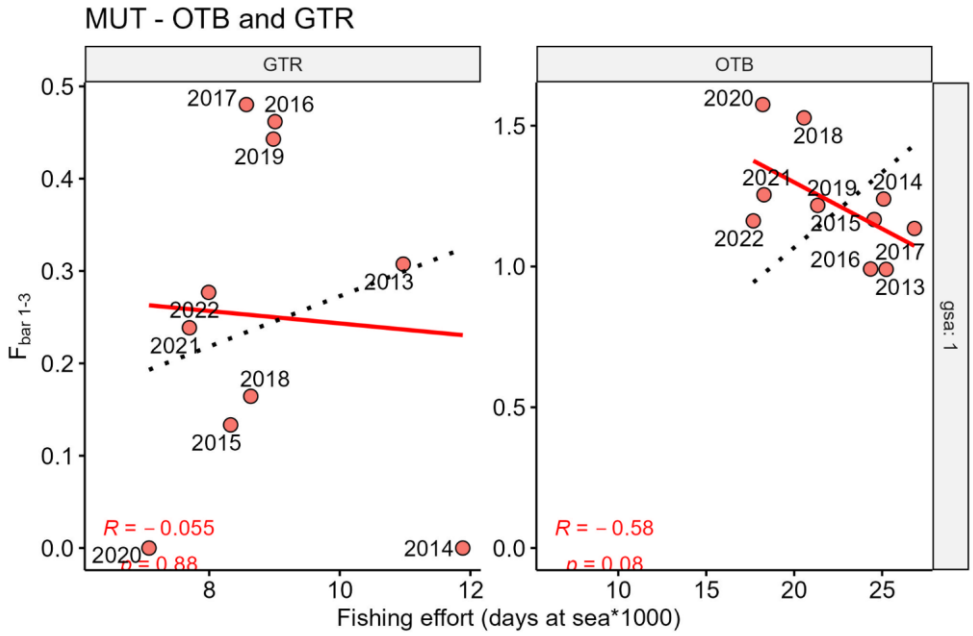



Figure 3.1.3.2.1 – Relationship between total effort and Fbar (1-3) for MUT in the management unit 1, GSA 1, by gear. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.3 MUT EMU1-GSA6

The relationship between the effort and the fishing mortality for red mullet in GSA 6 of EMU1 is reported for all gears in Figure . The points are distributed in a cloud of values that highlight a clear and significant relationship between fishing mortality and the fishing effort only for OTB.

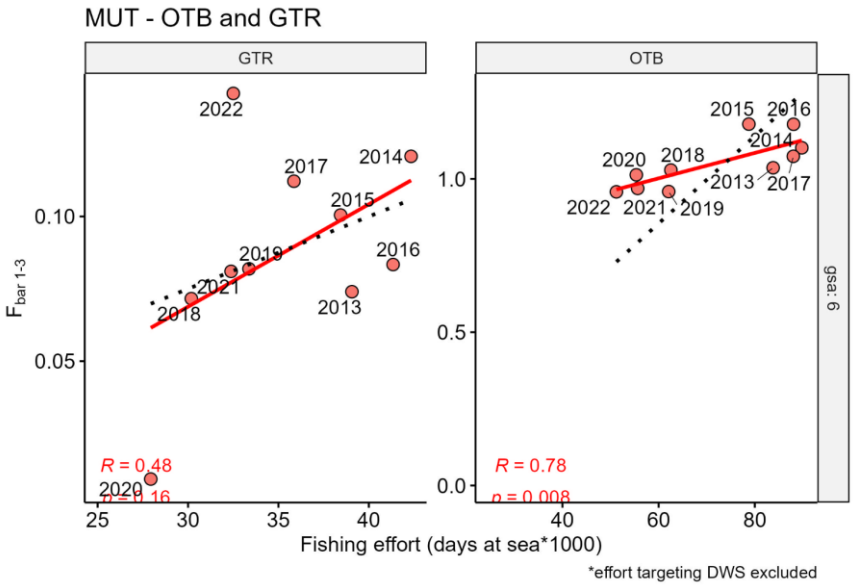



Figure 3.1.3.3.1 – Relationship between total effort and Fbar (1-3) for MUT in the management unit 1, GSA 6, by gear. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.4 ARA EMU1-GSA 5

The relationship between the effort and the fishing mortality for ARA was analyzed for OTB in GSA 5. The analysis does not show a significant relationship (Figure 3.1.).

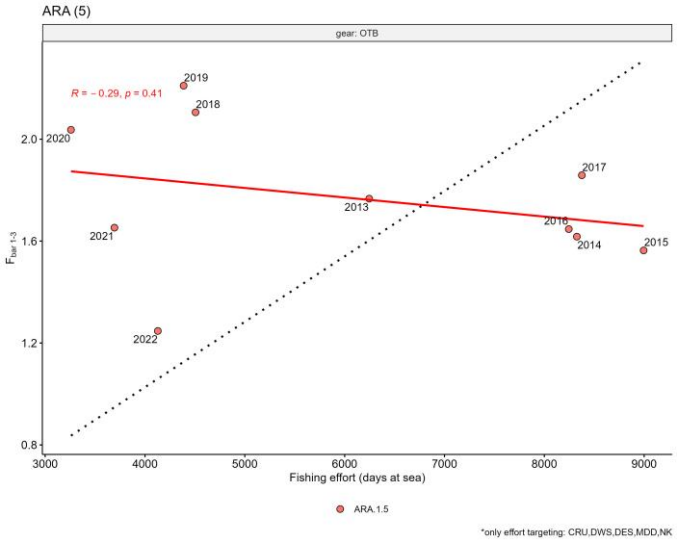



Figure 3.1.3.4.1 – Relationship between total effort and Fbar (1-3) for ARA by GSA for OTB in the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.5 ARA EMU1-GSAs 6 and 7

The relationship between the effort and the fishing mortality for Red and blue shrimp was analyzed for the main gear (OTB). A positive and significant relationship was found (Figure 3.1.).

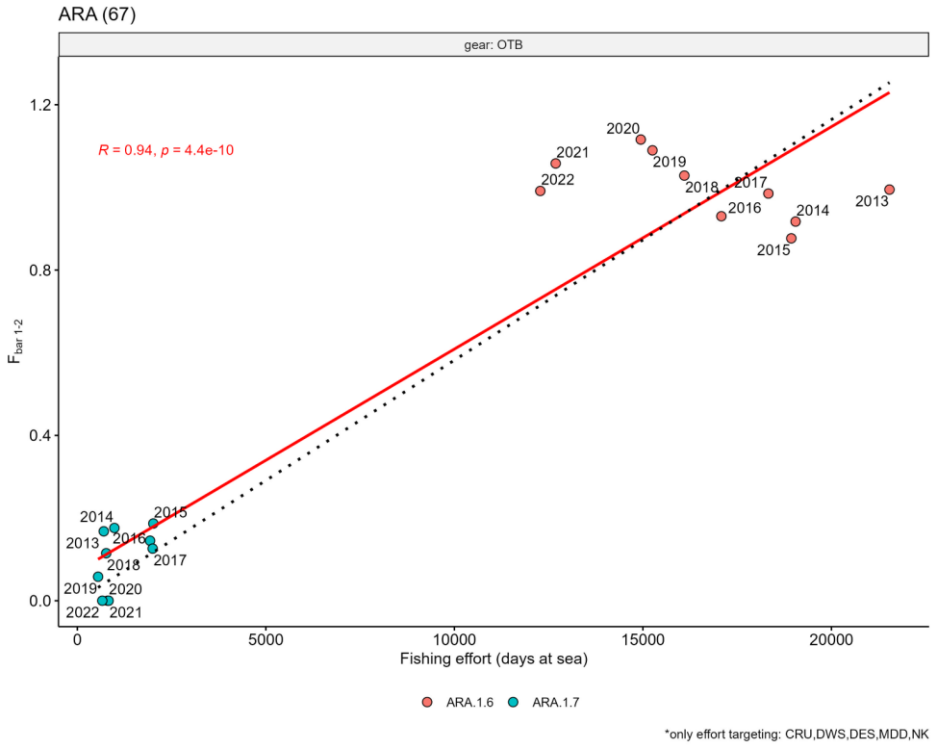



Figure 3.1.3.5.1 – Relationship between total effort and Fbar (1-2) for ARA in EMU 1 (GSAs 6 and 7 combined). Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

By exploring the contribution at GSA level, both GSA 6 and 7 showed a similar positive trend (Figure 3.1.6).

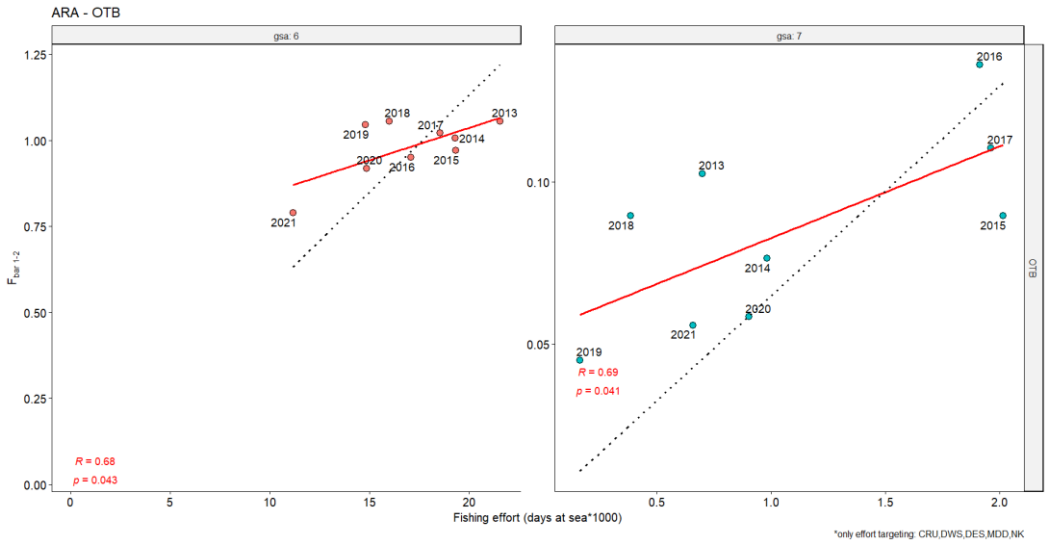


Figure 3.1.62 – Relationship between total effort and Fbar (1-2) for ARA by GSA (6 and 7) for OTB in the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.6 NEP EMU1-GSA 6

Nephrops in GSA 6 do not show a relationship between the effort and the fishing mortality (Figure 3.1.).

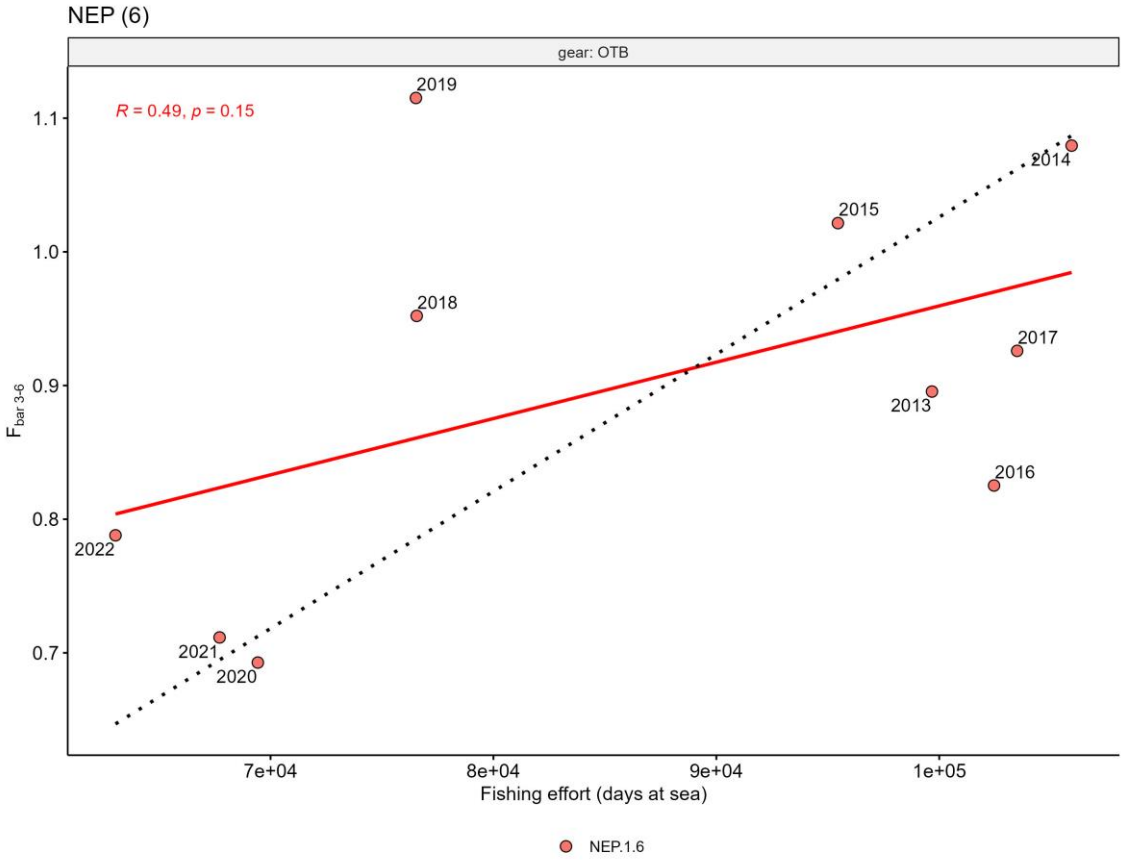



Figure 3.1.3.6.1 – Relationship between total effort and Fbar (3-6) for NEP by OTB in the GSA 6 of the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.7 DPS EMU1-GSA 1

For the Deep-water rose shrimp in unit EMU1, GSA 1 the relationship between the effort and the fishing mortality was analysed and a weak correlation was found (Figure 3.1.).

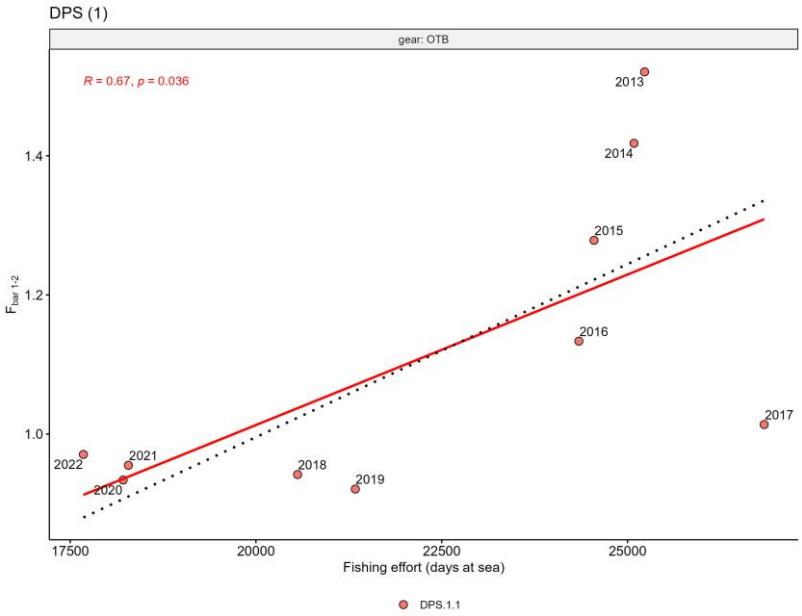



Figure 3.1.3.7.1 – Relationship between total effort and Fbar (1-2) for DPS by OTB in the GSA 1 of the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.8 DPS EMU1-GSAs 5-6-7

For the Deep-water rose shrimp in EMU1, GSAs 5, 6 and 7 the relationship between the effort and the fishing mortality was analysed. A positive and significant relationship was found for the whole EMU (Figure 3.1.). However, at GSA level the analysis does not highlight a positive correlation between the two variables (Figure).

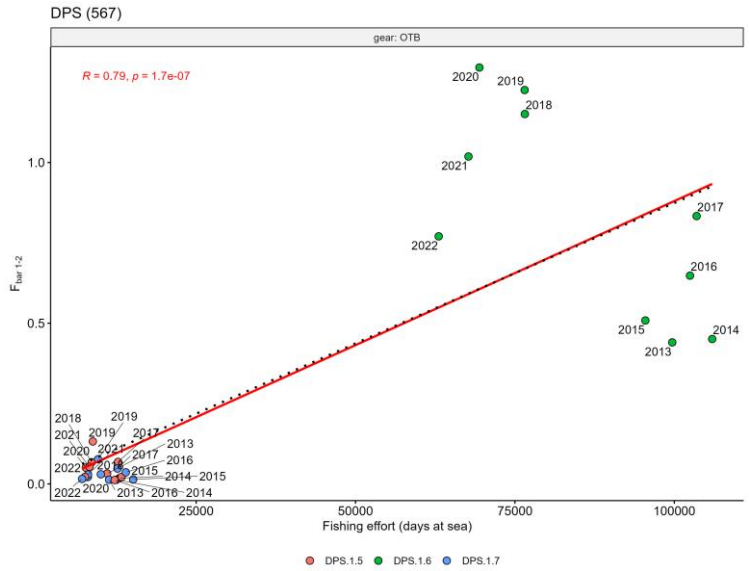



Figure 3.1.3.8.1 – Relationship between total effort and Fbar (1-2) for DPS (GSAs 5, 6 and 7 combined) for OTB in the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

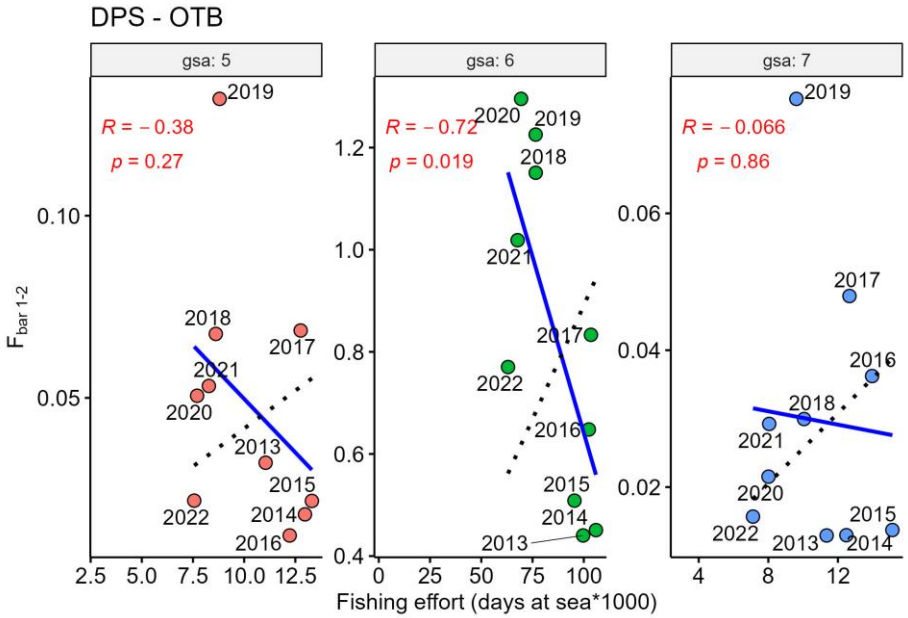



Figure3.1.3.8.2 – Relationship between total effort and Fbar (1-2) for DPS by GSA (5, 6 and 7) for OTB in the management unit 1. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.9 HKE EMU2-GSAs 8-9-10-11

The correlation between total effort and fishing mortality for European hake in EMU2 (GSAs 8, 9, 10, 11) was analysed for all gears (**Error! Reference source not found.**). A positive correlation w as found for passive nets.

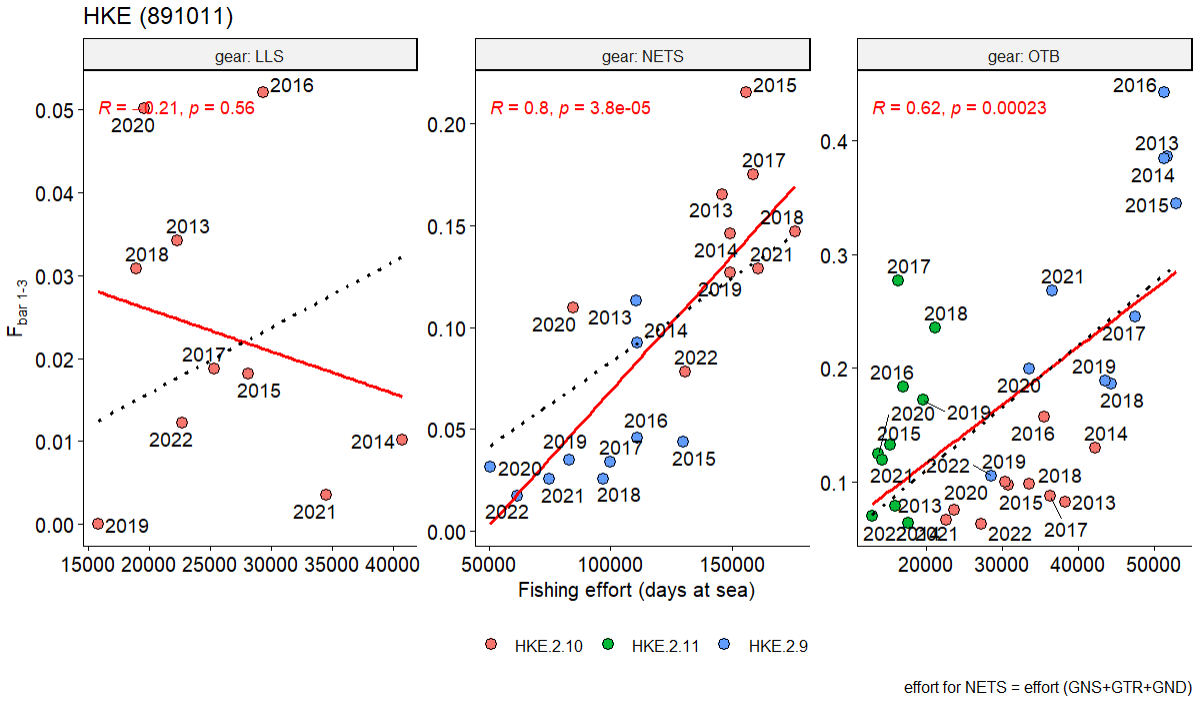



Figure 3.1.3.9.1 – Relationship between total effort and Fbar (1-3) for HKE by gears in EMU 2 (GSA 8, 9 10 and 11 combined). Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

By splitting the analysis at GSA level, a significant relationship was found only for OTB in GSA9 (Figure **Figure 3.1.3.9.2 – Relationship between total effort and Fbar (1-3) for HKE-OTB by GSA (9, 10 and 11) in the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.**), while for the other gears all the analysis does not find any relationship (Figure ). It is worth of note that data for GSA10, as specified in section 3.2.2, are biased by a lack of information of ages greater than 1 thus affection the partition of F and the general results of this analysis.

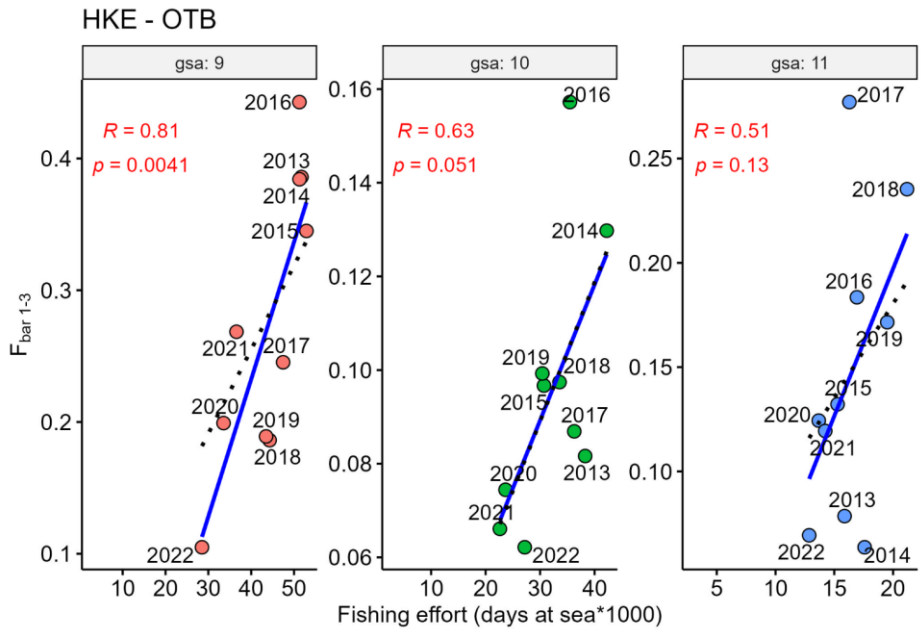



Figure 3.1.3.9.2 – Relationship between total effort and Fbar (1-3) for HKE-OTB by GSA (9, 10 and 11) in the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

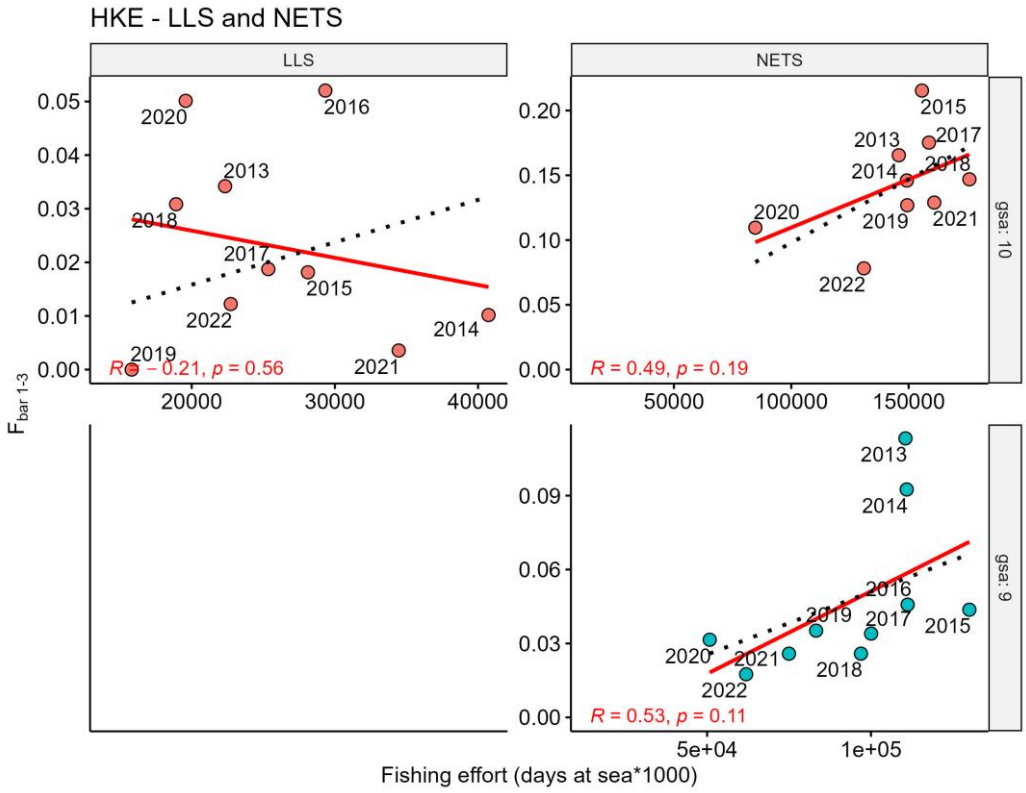



Figure 3.1.3.9.3 – Relationship between total effort and Fbar (1-3) for HKE by GSA (9, 10 and 11) and passive gears in the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.10 MUT EMU2-GSA9

The red mullet corresponding to the stock assessment unit in EMU2 GSA9 is shown in the following figures and table.

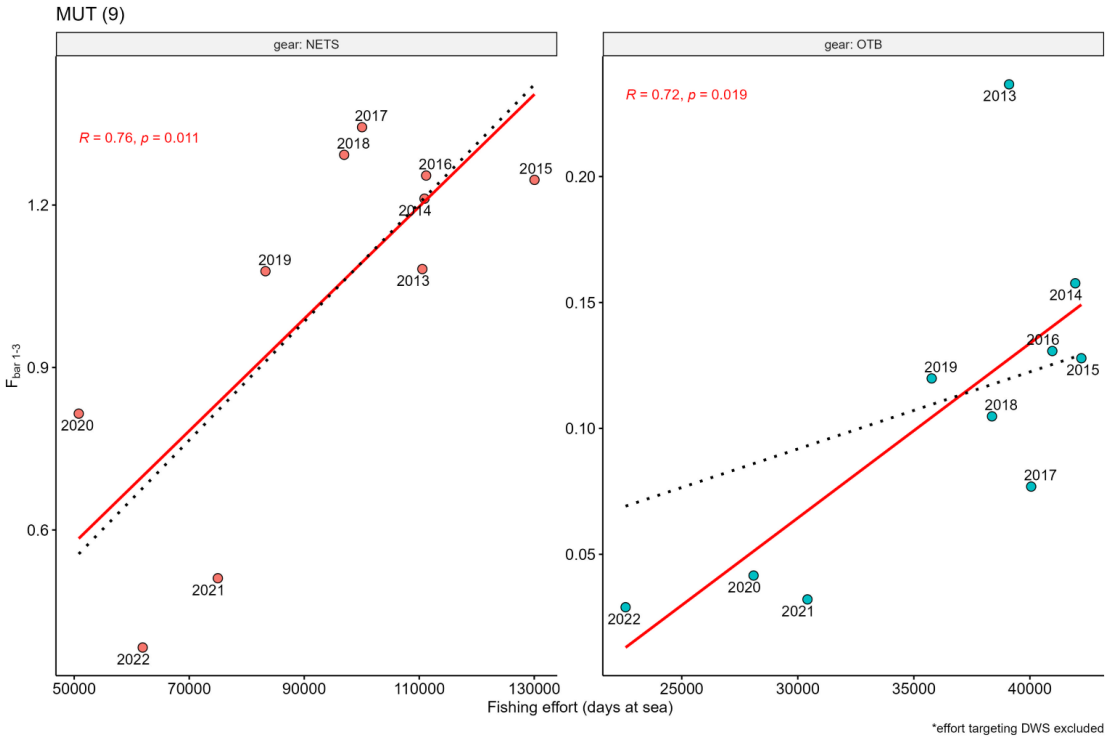



Figure 3.1.3.10.1 – Relationship between total effort and Fbar (1-3) for MUT by gear in GSA 9 of the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.11 DPS EMU2-GSAs 9, 10 and 11

The relationship between total effort and fishing mortality of deep-water rose shrimp in EMU2, GSAs 9, 10 and 11 is shown for OTB in the following figures.

At EMU level the points are distributed in a cloud of values that does not highlight a positive correlation between the two variables (Figure **Error! Reference source not found.**).

On the contrary at GSA level (Figure ), a significant positive relationship between the two variables was detected only in GSA 9.

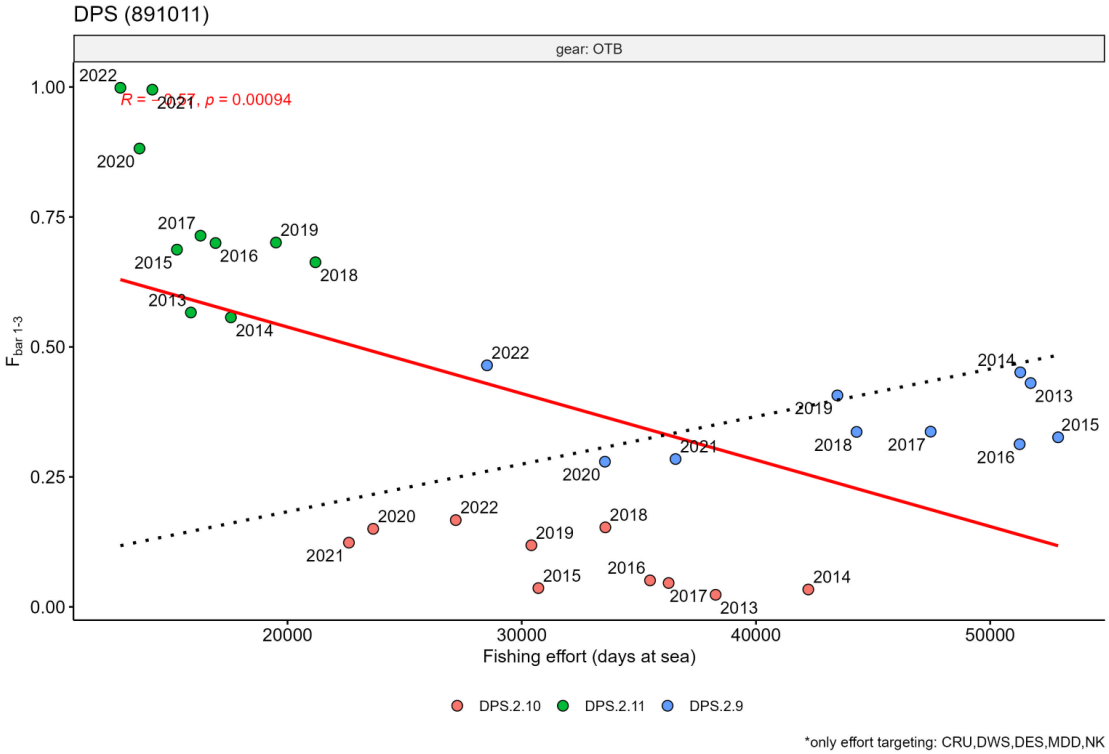



Figure 3.1.3.11.1 – Relationship between total effort and Fbar (1-3) for DPS by OTB in the management unit 2 (GSA 9, 10 and 11 combined). Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

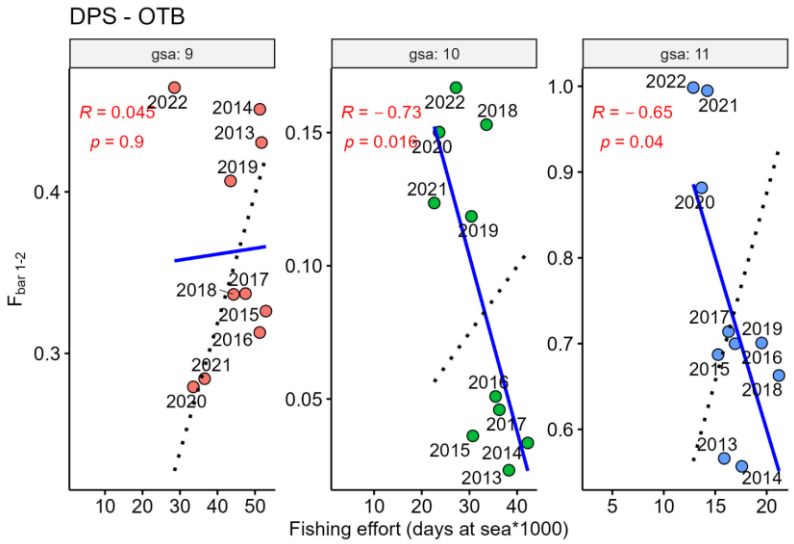



Figure 3.1.3.11.2 – Relationship between total effort and Fbar (1-3) for DPS-OTB by GSA (9, 10 and 11) in the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

### 3.1.3.12 ARS EMU2-GSAs 8, 9 and 10

The Red and blue shrimp relationship between total effort and fishing effort for ARS in EMU2 (GSAs 9,10 and 11) was explored for OTB. As shown in Figure **Error! Reference source not found.**and REF _Ref147410484 \h * MERGEFORMAT Figure **Error! Reference source not found.** there is no a correlation neither in the EMU nor in any of the single GSA.

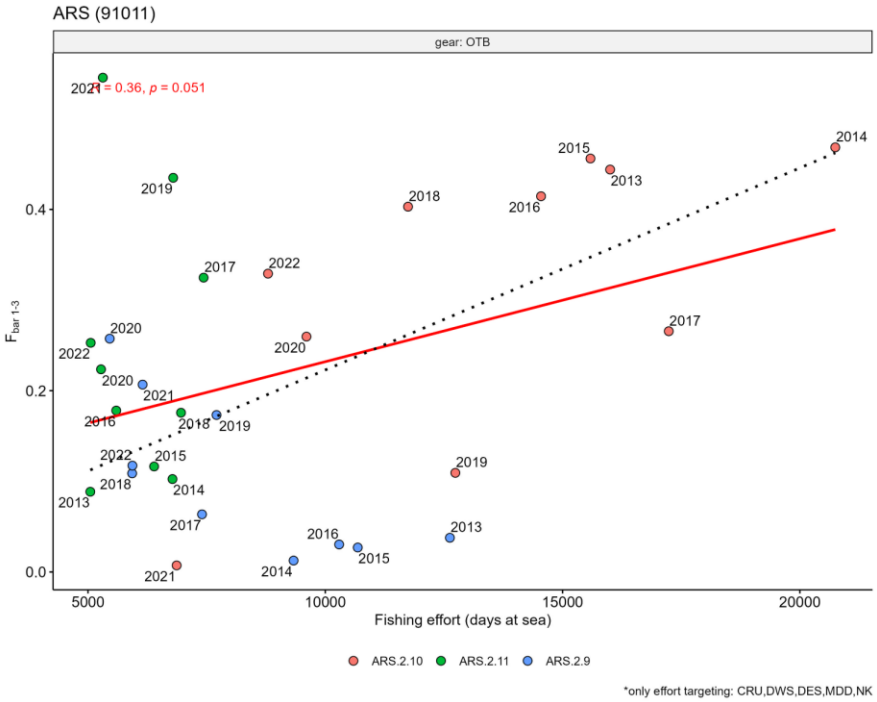



Figure 3.1.3.12.1 – Relationship between total effort and Fbar (1-3) for ARS by OTB in the management unit 2 (GSAs 9, 10 and 11 combined). Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

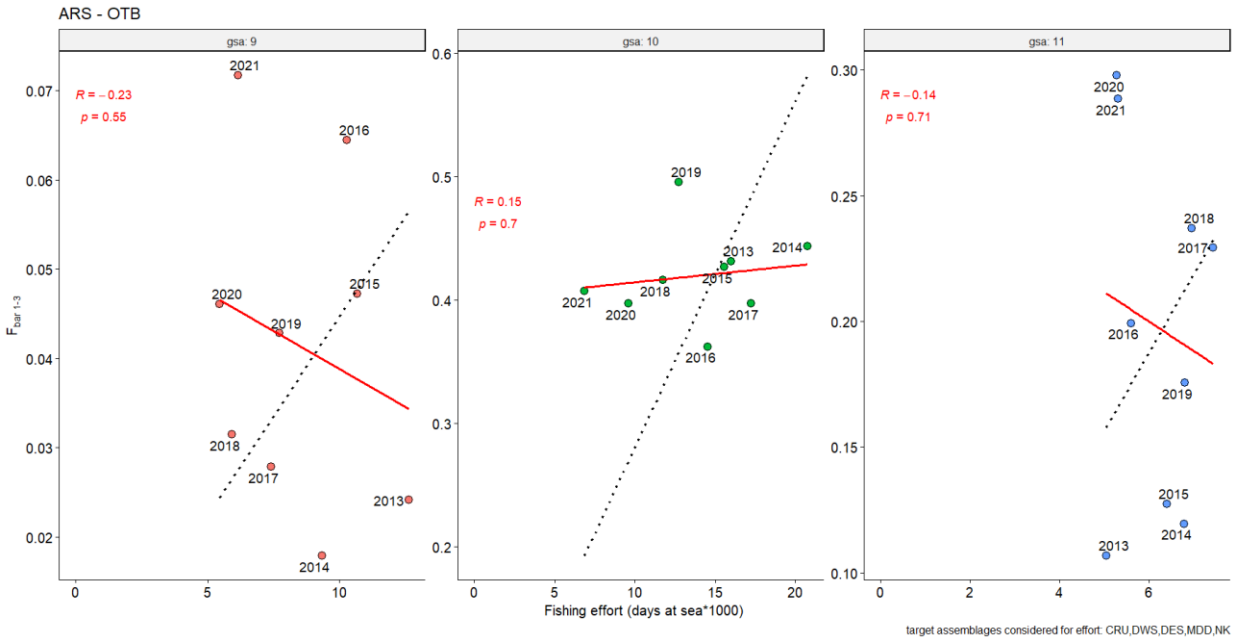



Figure 3.1.3.12.2 – Relationship between total effort and Fbar (1-3) for ARS-OTB by GSA (9, 10 and 11) in the management unit 2. Continuous line: linear regression on the observed points. Dashed line: linear regression forced through the origin.

## 3.2 Estimation of fishing mortality by gear

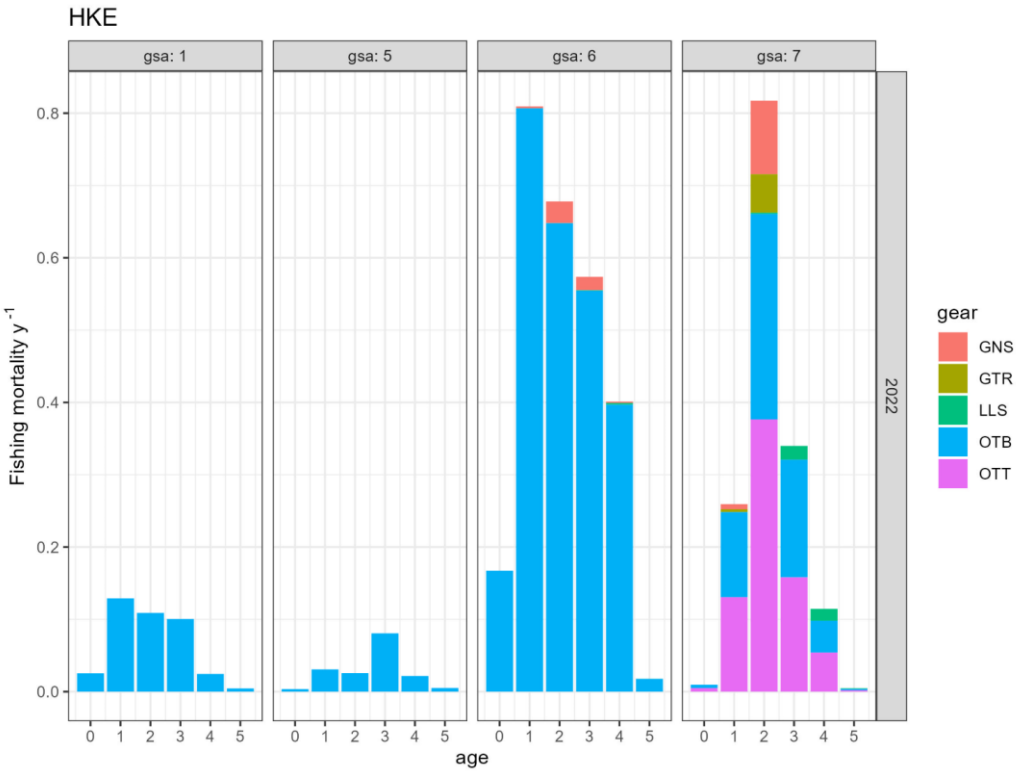
### *3.2.1 Methods*

For the methodology see Section 3.1.2.

### *3.2.2 Results*

#### 3.2.2.1 Vector of partial F for HKE EMU1-GSAs 1-5-6-7

The vector of partial *F* by gears for hake corresponding to the stock assessment in unit EMU1 (GSAs 1, 5, 6 and 7) is shown in the following figure and, for the time series 2013-2021, in the table below.

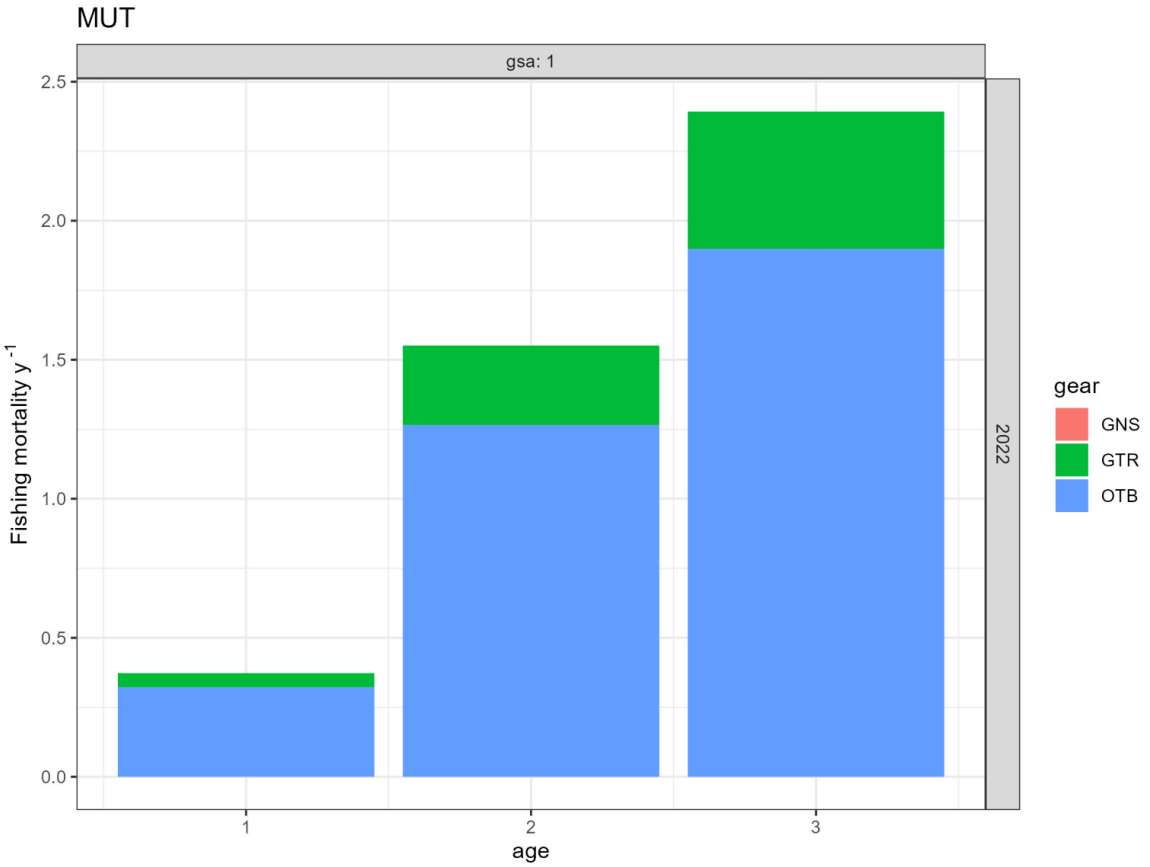

HKE
gsa: 1
gsa: 5
gsa: 6
gsa: 7
2022
Fishing mortality y-1
0.0
0.2
0.4
0.6
0.8
0 1 2 3 4 5
age
gear
GNS
GTR
LLS
OTB
OTT

| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HKE.1567 | 1 | 1 | GTR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | GTR | 1 | 0 | 2.00E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | GTR | 2 | 0 | 0.0044 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | GTR | 3 | 0 | 0.0142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | GTR | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | GTR | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 1 | OTB | 0 | 0 | 0 | 1.00E-04 | 1.00E-04 | 0.0184 | 0.0119 | 0.0081 | 0.003 | 0.0071 | 0.0254 |
| HKE.1567 | 1 | 1 | OTB | 1 | 0.0713 | 0.0698 | 0.0692 | 0.0696 | 0.1913 | 0.16 | 0.1591 | 0.0816 | 0.1663 | 0.129 |
| HKE.1567 | 1 | 1 | OTB | 2 | 0.1937 | 0.1114 | 0.1426 | 0.1521 | 0.2263 | 0.2408 | 0.1659 | 0.0948 | 0.1491 | 0.1089 |
| HKE.1567 | 1 | 1 | OTB | 3 | 0.1562 | 0.1282 | 0.1075 | 0.0749 | 0.1294 | 0.1753 | 0.107 | 0.0776 | 0.1056 | 0.1005 |
| HKE.1567 | 1 | 1 | OTB | 4 | 0.0562 | 0.0322 | 0.0447 | 0.0094 | 0.0214 | 0.0432 | 0.0038 | 0.0585 | 0.0061 | 0.0245 |
| HKE.1567 | 1 | 1 | OTB | 5 | 5.00E-04 | 0 | 0 | 0.0028 | 0 | 0 | 0 | 0 | 0 | 0.0045 |
| HKE.1567 | 1 | 5 | OTB | 0 | 0.001 | 0.0019 | 3.00E-04 | 2.00E-04 | 1.00E-04 | 0.0045 | 0.0146 | 0.0028 | 7.00E-04 | 0.0036 |
| HKE.1567 | 1 | 5 | OTB | 1 | 0.0548 | 0.0612 | 0.0625 | 0.0346 | 0.0369 | 0.0586 | 0.0899 | 0.0951 | 0.0261 | 0.0308 |
| HKE.1567 | 1 | 5 | OTB | 2 | 0.0315 | 0.0452 | 0.0677 | 0.0538 | 0.0724 | 0.0492 | 0.0549 | 0.0403 | 0.0801 | 0.0256 |
| HKE.1567 | 1 | 5 | OTB | 3 | 0.0193 | 0.0491 | 0.0548 | 0.0584 | 0.0567 | 0.029 | 0.0236 | 0.0637 | 0.0837 | 0.0808 |
| HKE.1567 | 1 | 5 | OTB | 4 | 0.065 | 0.0316 | 0.0642 | 0.0557 | 0.0498 | 0.0127 | 0.0107 | 0 | 0.0525 | 0.0217 |
| HKE.1567 | 1 | 5 | OTB | 5 | 5.00E-04 | 0.0033 | 0 | 6.00E-04 | 0 | 0.0038 | 0 | 0.0172 | 0 | 0.005 |
| HKE.1567 | 1 | 6 | GNS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 6 | GNS | 1 | 7.00E-04 | 0.0013 | 0.0012 | 3.00E-04 | 0.0014 | 0.0016 | 0.0011 | 2.00E-04 | 1.00E-04 | 0.0026 |
| HKE.1567 | 1 | 6 | GNS | 2 | 0.0341 | 0.0544 | 0.0634 | 0.0536 | 0.0551 | 0.0662 | 0.0271 | 0.048 | 0.0089 | 0.0299 |
| HKE.1567 | 1 | 6 | GNS | 3 | 0.0138 | 0.082 | 0.0758 | 0.0364 | 0.0369 | 0.0196 | 0.0034 | 0.003 | 0.0173 | 0.0185 |
| HKE.1567 | 1 | 6 | GNS | 4 | 0.0069 | 0.0211 | 0.0155 | 0.0086 | 0.01 | 0.0047 | 0 | 0 | 0.0021 | 0.002 |
| HKE.1567 | 1 | 6 | GNS | 5 | 1.00E-04 | 3.00E-04 | 6.00E-04 | 0.0017 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 6 | GTR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 6 | GTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00E-04 | 0 |
| HKE.1567 | 1 | 6 | GTR | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0085 | 0.0089 | 0 |
| HKE.1567 | 1 | 6 | GTR | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.00E-04 | 0.0116 | 0 |
| HKE.1567 | 1 | 6 | GTR | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0019 | 0 |
| HKE.1567 | 1 | 6 | GTR | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 6 | LLS | 0 | 0 | 1.00E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 6 | LLS | 1 | 1.00E-04 | 0.0064 | 0.0013 | 0.0012 | 2.00E-04 | 0 | 1.00E-04 | 0 | 0 | 1.00E-04 |
| HKE.1567 | 1 | 6 | LLS | 2 | 0.0696 | 0.0986 | 0.0532 | 0.0548 | 0.0626 | 0.0061 | 0.0079 | 5.00E-04 | 0.0014 | 1.00E-04 |
| HKE.1567 | 1 | 6 | LLS | 3 | 0.3809 | 0.2604 | 0.235 | 0.1945 | 0.0218 | 0.1269 | 0.1843 | 0.0062 | 0.0436 | 8.00E-04 |
| HKE.1567 | 1 | 6 | LLS | 4 | 0.4351 | 0.1903 | 0.0909 | 0.2455 | 0.1192 | 0.1692 | 0.2097 | 0.0215 | 0.0194 | 0.0024 |
| HKE.1567 | 1 | 6 | LLS | 5 | 0 | 0.0116 | 0.0228 | 0.007 | 0.0033 | 0.012 | 0.0097 | 0.0017 | 0.001 | 1.00E-04 |
| HKE.1567 | 1 | 6 | OTB | 0 | 0.088 | 0.121 | 0.1293 | 0.0879 | 0.1175 | 0.1324 | 0.0981 | 0.0709 | 0.1044 | 0.1673 |
| HKE.1567 | 1 | 6 | OTB | 1 | 0.9074 | 0.7443 | 0.8076 | 0.8447 | 1.1236 | 1.1426 | 0.9635 | 0.9592 | 1.0095 | 0.8067 |
| HKE.1567 | 1 | 6 | OTB | 2 | 1.1025 | 1.0733 | 1.1681 | 1.1911 | 1.1301 | 1.169 | 0.8179 | 0.8581 | 0.7897 | 0.6478 |
| HKE.1567 | 1 | 6 | OTB | 3 | 0.5805 | 0.5825 | 0.7518 | 0.8378 | 1.0648 | 0.8326 | 0.8706 | 0.784 | 0.7529 | 0.5544 |
| HKE.1567 | 1 | 6 | OTB | 4 | 0.2167 | 0.2047 | 0.2502 | 0.2703 | 0.3603 | 0.091 | 0.0397 | 0.1285 | 0.3826 | 0.3968 |
| HKE.1567 | 1 | 6 | OTB | 5 | 0.0055 | 0.0152 | 0 | 0.0025 | 0.0202 | 0.0023 | 0.0072 | 0.0044 | 0.0321 | 0.0177 |
| HKE.1567 | 1 | 7 | GNS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00E-04 | 0 | 0 | 0 |
| HKE.1567 | 1 | 7 | GNS | 1 | 0.0121 | 0.0173 | 0.0118 | 0.0091 | 0.0075 | 0.0051 | 0.0635 | 0.0376 | 0.0112 | 0.0071 |
| HKE.1567 | 1 | 7 | GNS | 2 | 0.2458 | 0.1971 | 0.1315 | 0.2929 | 0.2478 | 0.1715 | 0.2856 | 0.3718 | 0.191 | 0.1017 |
| HKE.1567 | 1 | 7 | GNS | 3 | 0.0694 | 0.0821 | 0.025 | 0.0651 | 0 | 0.034 | 0.0317 | 0.0077 | 0.0308 | 0 |
| HKE.1567 | 1 | 7 | GNS | 4 | 0.0892 | 0.0066 | 0 | 0.0319 | 0 | 0.0179 | 0 | 0 | 0.0142 | 0 |
| HKE.1567 | 1 | 7 | GNS | 5 | 0.002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HKE.1567 | 1 | 7 | GTR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 7 | GTR | 1 | 2.00E-04 | 0.0011 | 6.00E-04 | 3.00E-04 | 3.00E-04 | 3.00E-04 | 0.0125 | 0.0066 | 0.0062 | 0.0038 |
| HKE.1567 | 1 | 7 | GTR | 2 | 0.0041 | 0.0184 | 0.0079 | 0.0089 | 0.0068 | 0.008 | 0.0538 | 0.0623 | 0.1104 | 0.0531 |
| HKE.1567 | 1 | 7 | GTR | 3 | 0.0011 | 0.0085 | 0.0026 | 0.0024 | 0 | 0.0024 | 0.0043 | 6.00E-04 | 0.0226 | 0 |
| HKE.1567 | 1 | 7 | GTR | 4 | 0.0019 | 0.0013 | 0 | 0.0011 | 0 | 0.0022 | 0 | 0 | 0.0104 | 0 |
| HKE.1567 | 1 | 7 | GTR | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 7 | LLS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.1567 | 1 | 7 | LLS | 1 | 1.00E-04 | 3.00E-04 | 1.00E-04 | 0 | 0 | 1.00E-04 | 2.00E-04 | 0 | 0 | 0 |
| HKE.1567 | 1 | 7 | LLS | 2 | 0.0122 | 0.0144 | 0.0055 | 0.0028 | 0.0036 | 0.0084 | 0.0021 | 0.0025 | 3.00E-04 | 0.0018 |
| HKE.1567 | 1 | 7 | LLS | 3 | 0.0277 | 0.0463 | 0.0244 | 0.0161 | 0.0271 | 0.0146 | 0.025 | 0.0244 | 0.0101 | 0.019 |
| HKE.1567 | 1 | 7 | LLS | 4 | 0.0371 | 0.0516 | 0.0191 | 0.028 | 0.041 | 0.0262 | 0.0275 | 0.0288 | 0.0048 | 0.0163 |
| HKE.1567 | 1 | 7 | LLS | 5 | 0.0315 | 0.0058 | 0.0038 | 0.0048 | 0.0036 | 0.0055 | 0.0011 | 8.00E-04 | 2.00E-04 | 8.00E-04 |
| HKE.1567 | 1 | 7 | OTB | 0 | 0.0367 | 0.0411 | 0.0125 | 0.0282 | 0.0038 | 0.007 | 0.0067 | 0.0126 | 0.0011 | 0.0048 |
| HKE.1567 | 1 | 7 | OTB | 1 | 0.5718 | 0.7213 | 0.6572 | 0.529 | 0.1906 | 0.1901 | 0.2099 | 0.1998 | 0.0932 | 0.1177 |
| HKE.1567 | 1 | 7 | OTB | 2 | 0.4891 | 0.573 | 0.5199 | 0.2898 | 0.2797 | 0.3143 | 0.4515 | 0.3123 | 0.2742 | 0.2841 |
| HKE.1567 | 1 | 7 | OTB | 3 | 0.2339 | 0.2311 | 0.1828 | 0.1417 | 0.0928 | 0.1776 | 0.131 | 0.2339 | 0.0967 | 0.1628 |
| HKE.1567 | 1 | 7 | OTB | 4 | 0.0895 | 0.0602 | 0.1734 | 0.1078 | 0.0265 | 0.0474 | 0.0523 | 0.1102 | 0.0218 | 0.0441 |
| HKE.1567 | 1 | 7 | OTB | 5 | 0.0034 | 0.0072 | 0.0153 | 0.0195 | 0.0129 | 0.0124 | 0.014 | 0.008 | 0.0015 | 0.0019 |
| HKE.1567 | 1 | 7 | OTT | 0 | 0.0035 | 0.0033 | 5.00E-04 | 0.0069 | 0.001 | 0.0043 | 0.0049 | 0.0111 | 9.00E-04 | 0.0049 |
| HKE.1567 | 1 | 7 | OTT | 1 | 0.0545 | 0.0532 | 0.0309 | 0.1276 | 0.079 | 0.0999 | 0.138 | 0.1583 | 0.0748 | 0.1306 |
| HKE.1567 | 1 | 7 | OTT | 2 | 0.0366 | 0.0334 | 0.0187 | 0.0443 | 0.0786 | 0.1661 | 0.3058 | 0.2416 | 0.2267 | 0.3765 |
| HKE.1567 | 1 | 7 | OTT | 3 | 0.0081 | 0.0095 | 0.0038 | 0.0131 | 0.0237 | 0.0658 | 0.0786 | 0.1694 | 0.0616 | 0.1581 |
| HKE.1567 | 1 | 7 | OTT | 4 | 0.0053 | 0.0028 | 0.0044 | 0.0167 | 0.0061 | 0.0212 | 0.0363 | 0.0992 | 0.0201 | 0.0541 |
| HKE.1567 | 1 | 7 | OTT | 5 | 2.00E-04 | 4.00E-04 | 4.00E-04 | 0.0033 | 0.0026 | 0.0074 | 0.0108 | 0.0081 | 0.0014 | 0.002 |

### 3.2.2.2 Vector of partial F for MUT EMU1-GSA1

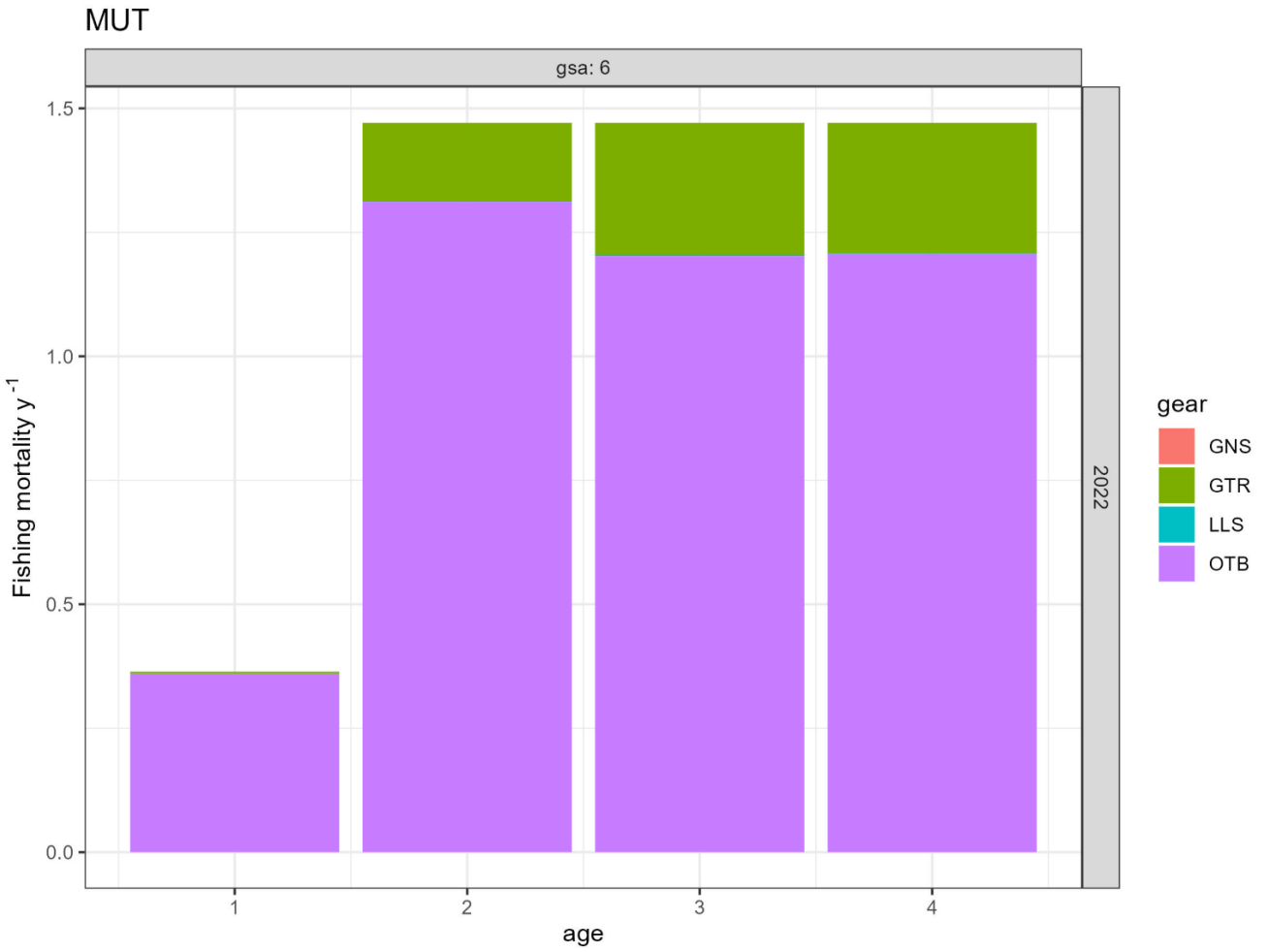
The vector of partial *F* by gears for red mullet corresponding to the stock assessment in unit EMU1, GSA 1 is shown in the following figure and, for the time series 2013-2021, in the table below.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MUT.1 | 1 | 1 | GNS | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.00E-04 | 0 |
| MUT.1 | 1 | 1 | GNS | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0035 | 0 |
| MUT.1 | 1 | 1 | GNS | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0068 | 0 |
| MUT.1 | 1 | 1 | GNS | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 1.00E-04 | NA |
| MUT.1 | 1 | 1 | GTR | 1 | 0 | 0 | 0.0064 | 0.052 | 0.0528 | 0.0572 | 0.0179 | 0 | 0.0386 | 0.0509 |
| MUT.1 | 1 | 1 | GTR | 2 | 0.0882 | 0 | 0.1949 | 0.4717 | 0.2752 | 0.2346 | 0.4328 | 0 | 0.1914 | 0.2859 |
| MUT.1 | 1 | 1 | GTR | 3 | 0.8343 | 0 | 0.1987 | 0.8616 | 1.1127 | 0.2012 | 0.878 | 0 | 0.4856 | 0.4937 |
| MUT.1 | 1 | 1 | GTR | 4 | 0.0099 | 0 | 0.0664 | 0.2138 | 0.0666 | 0.011 | 0.0165 | NA | 0.006 | NA |
| MUT.1 | 1 | 1 | OTB | 1 | 0.3362 | 0.3212 | 0.3304 | 0.3245 | 0.3658 | 0.3813 | 0.4121 | 0.4081 | 0.3487 | 0.3219 |
| MUT.1 | 1 | 1 | OTB | 2 | 1.3104 | 1.3363 | 1.2065 | 1.0944 | 1.466 | 1.5895 | 1.3564 | 1.6978 | 1.4187 | 1.2651 |
| MUT.1 | 1 | 1 | OTB | 3 | 1.323 | 2.0613 | 1.9631 | 1.5542 | 1.5732 | 2.6126 | 1.882 | 2.6188 | 1.9966 | 1.8988 |
| MUT.1 | 1 | 1 | OTB | 4 | 0.1811 | 0.1824 | 0.125 | 0 | 0.1711 | 0.238 | 0.2278 | NA | 0.2142 | NA |

### 3.2.2.3 Vector of partial F for MUT EMU1-GSA6

The vector of partial *F* by gears for red mullet corresponding to the stock assessment in unit EMU1, GSA 6 is shown in the following figure and, for the time series 2013-2021, in the table below.

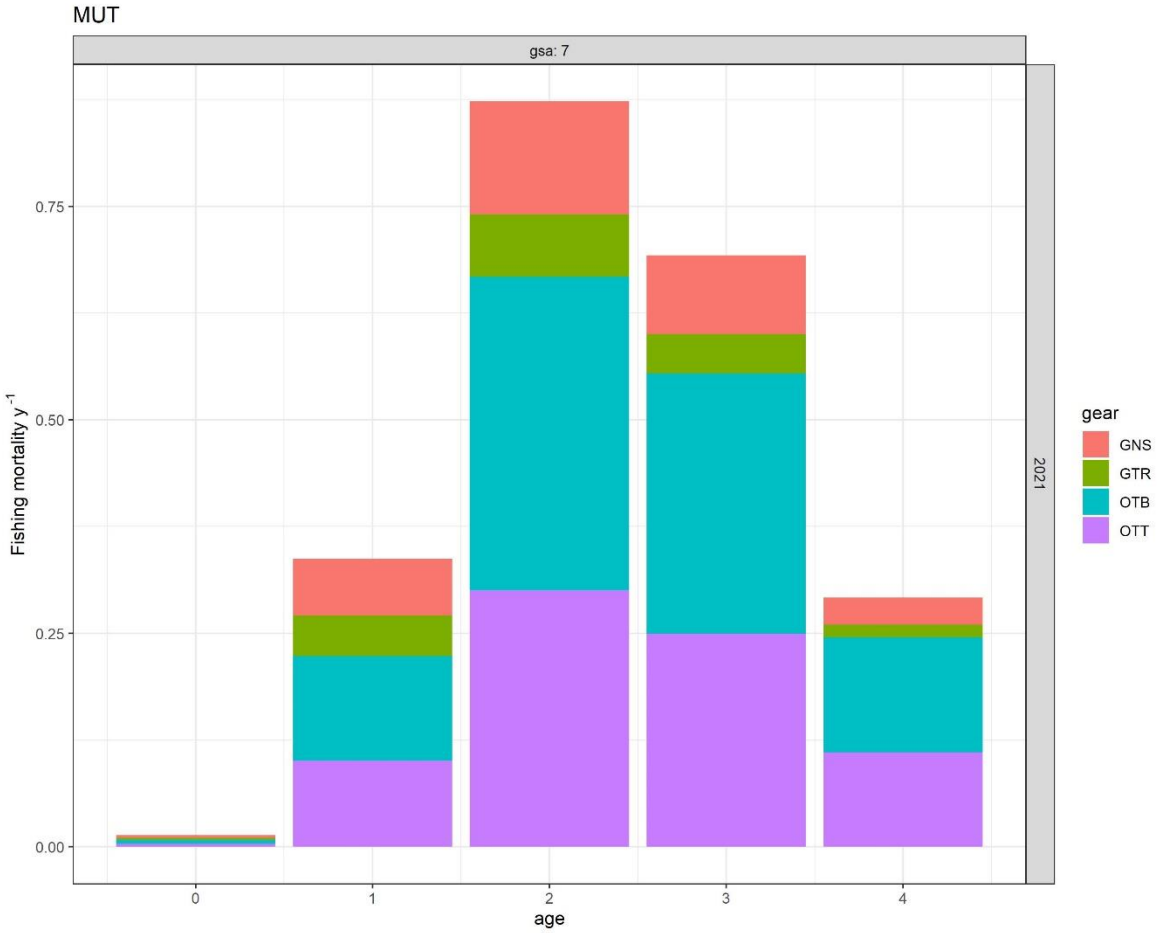



| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MUT.6 | 1 | 6 | GNS | 0 | NA | NA | NA | 0 | 0 | 0 | NA | NA | NA | NA |
| MUT.6 | 1 | 6 | GNS | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00E-04 | 0 |
| MUT.6 | 1 | 6 | GNS | 2 | 0 | 3.00E-04 | 9.00E-04 | 0 | 0 | 0 | 7.00E-04 | 5.00E-04 | 0.0022 | 0 |
| MUT.6 | 1 | 6 | GNS | 3 | 0 | 8.00E-04 | 0.0019 | 0 | 0 | 0 | 0.0015 | 0.001 | 0.0044 | 0 |
| MUT.6 | 1 | 6 | GNS | 4 | 0 | 0.0013 | 0.0015 | 0 | 0 | 0 | 0.001 | 5.00E-04 | 0.0037 | 0 |
| MUT.6 | 1 | 6 | GTR | 0 | NA | NA | NA | 0 | 0 | 0 | NA | NA | NA | NA |
| MUT.6 | 1 | 6 | GTR | 1 | 0.0118 | 0.0059 | 0.01 | 0.0037 | 0.0023 | 0.0058 | 0.0022 | 1.00E-04 | 0.0029 | 0.0041 |
| MUT.6 | 1 | 6 | GTR | 2 | 0.148 | 0.1682 | 0.1881 | 0.1102 | 0.1139 | 0.1178 | 0.1258 | 0.0088 | 0.0976 | 0.1575 |
| MUT.6 | 1 | 6 | GTR | 3 | 0.0621 | 0.1883 | 0.1033 | 0.1362 | 0.2203 | 0.0913 | 0.1177 | 0.0189 | 0.1426 | 0.266 |
| MUT.6 | 1 | 6 | GTR | 4 | 0.0572 | 0.2099 | 0.2893 | 0.1522 | 0.2762 | 0.0248 | 0.1704 | 1.00E-04 | 0.1132 | 0.2626 |
| MUT.6 | 1 | 6 | LLS | 0 | NA | NA | NA | 0 | 0 | 0 | NA | NA | NA | NA |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MUT.6 | 1 | 6 | LLS | 1 | 1.00E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 1.00E-04 | 0 | 1.00E-04 |
| MUT.6 | 1 | 6 | LLS | 2 | 0.0014 | 4.00E-04 | 0.0011 | 3.00E-04 | 7.00E-04 | 0 | 6.00E-04 | 0.0046 | 1.00E-04 | 0.0017 |
| MUT.6 | 1 | 6 | LLS | 3 | 0.003 | 7.00E-04 | 0.0015 | 5.00E-04 | 0.0011 | 0 | 8.00E-04 | 0.0065 | 1.00E-04 | 0.0025 |
| MUT.6 | 1 | 6 | LLS | 4 | 9.00E-04 | 8.00E-04 | 9.00E-04 | 6.00E-04 | 6.00E-04 | 0 | 4.00E-04 | 0.0073 | 0 | 0.0019 |
| MUT.6 | 1 | 6 | OTB | 0 | NA | NA | NA | 1.00E-04 | 1.00E-04 | 1.00E-04 | NA | NA | NA | NA |
| MUT.6 | 1 | 6 | OTB | 1 | 0.3555 | 0.3982 | 0.4132 | 0.4132 | 0.3897 | 0.3579 | 0.342 | 0.3391 | 0.3447 | 0.3599 |
| MUT.6 | 1 | 6 | OTB | 2 | 1.3346 | 1.4636 | 1.5198 | 1.5738 | 1.4691 | 1.3512 | 1.2634 | 1.3566 | 1.3046 | 1.3115 |
| MUT.6 | 1 | 6 | OTB | 3 | 1.419 | 1.4426 | 1.6033 | 1.5476 | 1.3624 | 1.3777 | 1.2705 | 1.3441 | 1.2574 | 1.2021 |
| MUT.6 | 1 | 6 | OTB | 4 | 1.4259 | 1.4205 | 1.4183 | 1.5315 | 1.307 | 1.4441 | 1.2188 | 1.3625 | 1.2876 | 1.2061 |

### 3.2.2.4 Vector of partial F for MUT EMU1-GSA7

The vector of partial *F* for red mullet corresponding to the stock assessment unit in EMU1 GSA 1 is shown in the following figure and, for the time series 2013-2021, in the table below.

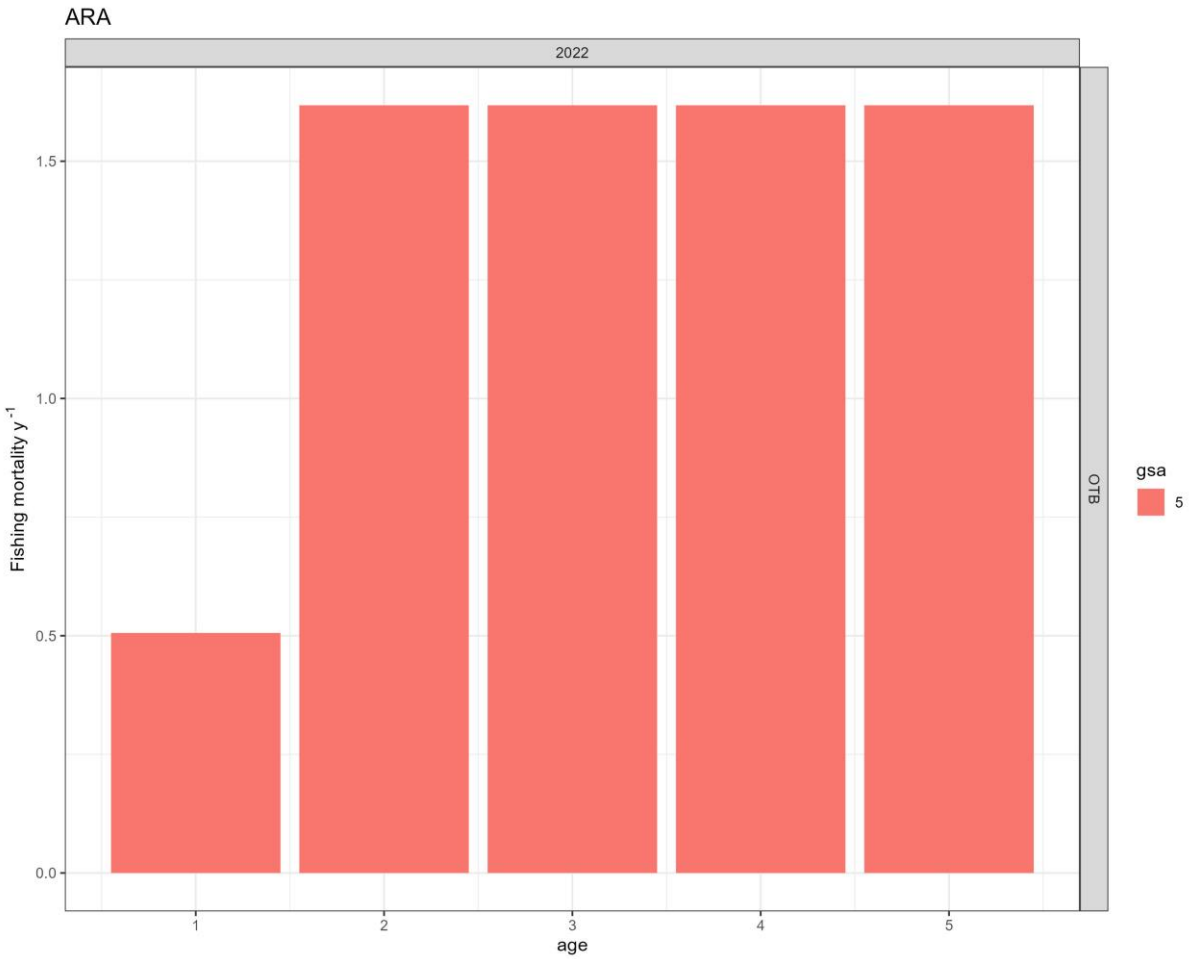



| EMU | stock | species | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MUT.7 | MUT | 7 | GNS | 0 | 0 | 0 | NA | 0 | 0 | 1.00E-04 | 0 | 0 | 0.0033 |
| 1 | MUT.7 | MUT | 7 | GNS | 1 | 0.0175 | 0.0249 | NA | 0.0133 | 0.0334 | 0.0198 | 0.0028 | 0.026 | 0.0661 |
| 1 | MUT.7 | MUT | 7 | GNS | 2 | 0.147 | 0.1491 | NA | 0.1151 | 0.2417 | 0.1226 | 0.0975 | 0.2334 | 0.132 |
| 1 | MUT.7 | MUT | 7 | GNS | 3 | 0.1831 | 0.1176 | NA | 0.1912 | 0.1469 | 0.0874 | 0.2167 | 0.2089 | 0.0924 |
| 1 | MUT.7 | MUT | 7 | GNS | 4 | 0.0829 | 0.0413 | NA | 0.1398 | 0.034 | 0.0325 | 0.1514 | 0.0927 | 0.0315 |
| 1 | MUT.7 | MUT | 7 | GTR | 0 | 0 | 0 | NA | 0 | 0 | 0 | 0 | 0 | 0.0025 |
| 1 | MUT.7 | MUT | 7 | GTR | 1 | 3.00E-04 | 0.002 | NA | 4.00E-04 | 9.00E-04 | 0.001 | 5.00E-04 | 0.0045 | 0.0474 |
| 1 | MUT.7 | MUT | 7 | GTR | 2 | 0.0025 | 0.013 | NA | 0.0036 | 0.0067 | 0.0062 | 0.0187 | 0.0403 | 0.0735 |
| 1 | MUT.7 | MUT | 7 | GTR | 3 | 0.0031 | 0.0114 | NA | 0.006 | 0.0041 | 0.0045 | 0.0415 | 0.0354 | 0.0463 |
| 1 | MUT.7 | MUT | 7 | GTR | 4 | 0.0014 | 0.0042 | NA | 0.0044 | 9.00E-04 | 0.0017 | 0.029 | 0.0137 | 0.0153 |
| 1 | MUT.7 | MUT | 7 | OTB | 0 | 0.0172 | 0.0183 | 0.0179 | 0.0143 | 0.0114 | 0.0088 | 0.0088 | 0.0078 | 0.0044 |

| EMU | stock | species | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MUT.7 | MUT | 7 | OTB | 1 | 0.4134 | 0.424 | 0.4454 | 0.3429 | 0.2532 | 0.2169 | 0.2101 | 0.1746 | 0.1227 |
| 1 | MUT.7 | MUT | 7 | OTB | 2 | 0.9876 | 1.013 | 1.1618 | 0.8312 | 0.5549 | 0.5518 | 0.4863 | 0.3441 | 0.3672 |
| 1 | MUT.7 | MUT | 7 | OTB | 3 | 0.7241 | 0.8053 | 0.9269 | 0.597 | 0.5027 | 0.4544 | 0.2901 | 0.2568 | 0.3047 |
| 1 | MUT.7 | MUT | 7 | OTB | 4 | 0.3008 | 0.348 | 0.3924 | 0.2052 | 0.26 | 0.1928 | 0.0795 | 0.1055 | 0.1346 |
| 1 | MUT.7 | MUT | 7 | OTT | 0 | 0.0019 | 0.0011 | 0.0011 | 0.0034 | 0.0049 | 0.0062 | 0.0055 | 0.006 | 0.0034 |
| 1 | MUT.7 | MUT | 7 | OTT | 1 | 0.0397 | 0.0295 | 0.0223 | 0.0812 | 0.115 | 0.1349 | 0.1394 | 0.1373 | 0.1007 |
| 1 | MUT.7 | MUT | 7 | OTT | 2 | 0.0823 | 0.069 | 0.0494 | 0.1838 | 0.2392 | 0.2843 | 0.3114 | 0.2688 | 0.3 |
| 1 | MUT.7 | MUT | 7 | OTT | 3 | 0.0575 | 0.053 | 0.0344 | 0.1056 | 0.1737 | 0.2196 | 0.1769 | 0.2026 | 0.2492 |
| 1 | MUT.7 | MUT | 7 | OTT | 4 | 0.0226 | 0.0225 | 0.0125 | 0.0296 | 0.0537 | 0.0956 | 0.0457 | 0.0846 | 0.1104 |

### 3.2.2.5 Vector of partial F for ARA EMU1-GSA 5

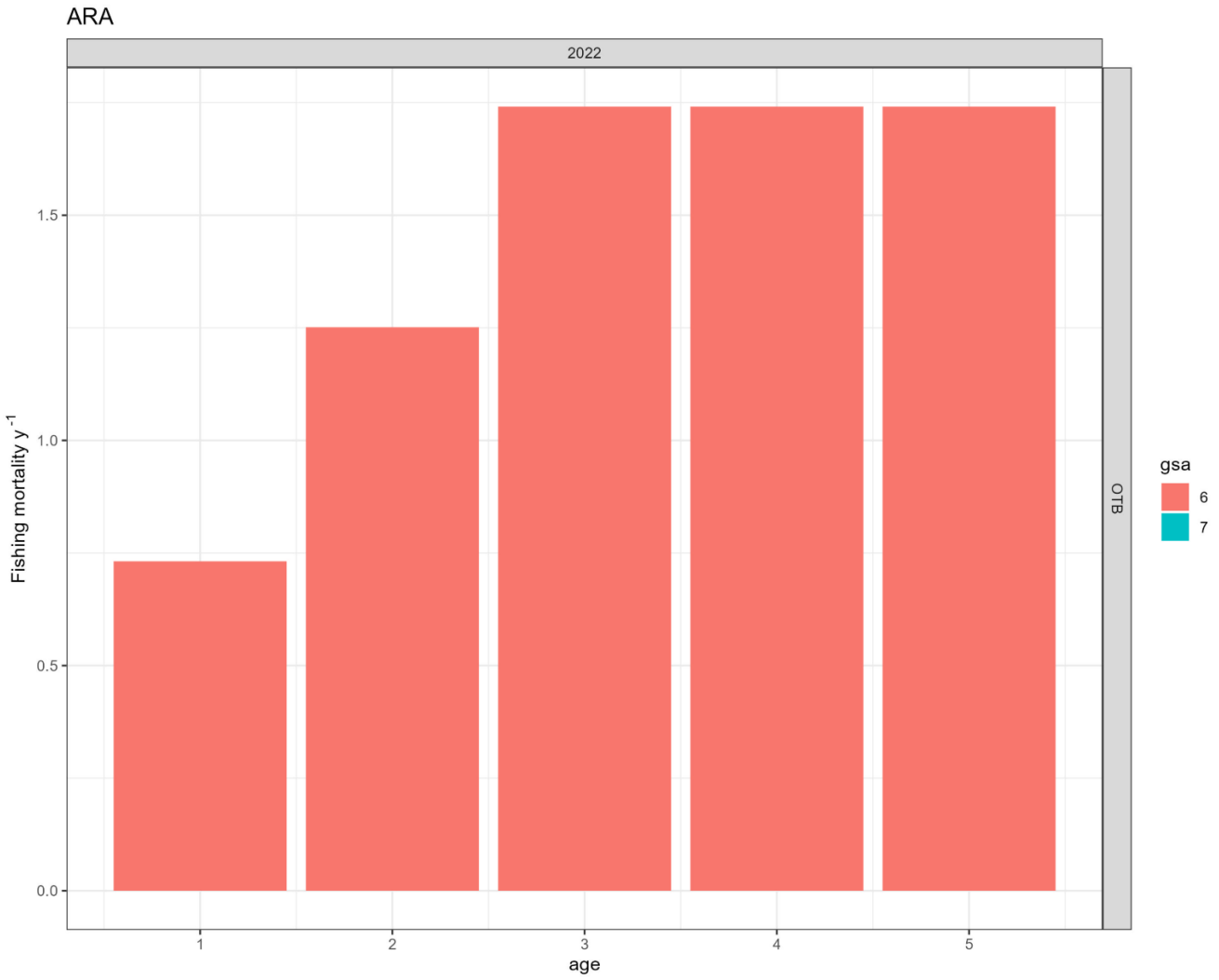
The vector of partial *F* for Red and blue shrimp for OTB, corresponding to the stock assessment in unit EMU1, GSA 5 is shown in the following figure and, for the time series 2013-2022, in the table below.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARA.5 | 1 | 5 | OTB | 1 | 0.7165 | 0.6561 | 0.6341 | 0.6681 | 0.7538 | 0.854 | 0.8964 | 0.8261 | 0.6703 | 0.5059 |
| ARA.5 | 1 | 5 | OTB | 2 | 2.2915 | 2.0982 | 2.0279 | 2.1366 | 2.4107 | 2.7311 | 2.8667 | 2.642 | 2.1437 | 1.6179 |
| ARA.5 | 1 | 5 | OTB | 3 | 2.2915 | 2.0982 | 2.0279 | 2.1366 | 2.4107 | 2.7311 | 2.8667 | 2.642 | 2.1437 | 1.6179 |
| ARA.5 | 1 | 5 | OTB | 4 | 2.2915 | 2.0982 | 2.0279 | 2.1366 | 2.4107 | 2.7311 | 2.8667 | 2.642 | 2.1437 | 1.6179 |
| ARA.5 | 1 | 5 | OTB | 5 | 2.2915 | 2.0982 | 2.0279 | 2.1366 | 2.4107 | 2.7311 | 2.8667 | 2.642 | 2.1437 | 1.6179 |

### 3.2.2.6 Vector of partial F for ARA EMU1-GSAs 6 and 7

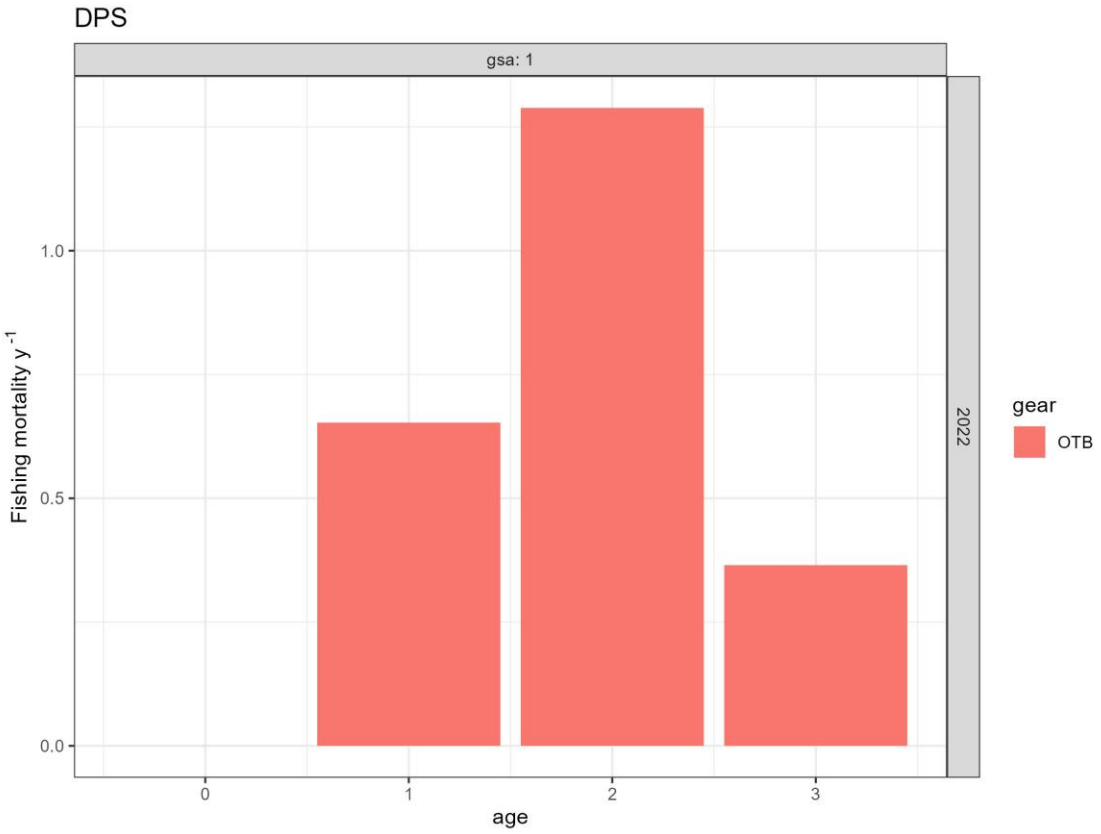
The vector of partial *F* for Red and blue shrimp for OTB, corresponding to the stock assessment unit in EMU1 GSA 1 and 2 is shown in the following figure and, for the time series 2013-2021, in the table below.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARA.67 | 1 | 6 | OTB | 1 | 0.8038 | 0.7787 | 0.7438 | 0.7402 | 0.7779 | 0.8007 | 0.8381 | 0.8233 | 0.7806 | 0.7315 |
| ARA.67 | 1 | 6 | OTB | 2 | 1.1857 | 1.0561 | 1.0098 | 1.1203 | 1.1923 | 1.2565 | 1.3413 | 1.4083 | 1.3354 | 1.2513 |
| ARA.67 | 1 | 6 | OTB | 3 | 1.9219 | 1.6729 | 1.4409 | 1.6076 | 1.6446 | 1.7954 | 1.908 | 1.9595 | 1.858 | 1.741 |
| ARA.67 | 1 | 6 | OTB | 4 | NA | 1.8953 | 1.8679 | 1.7794 | 1.8573 | 1.998 | 2.0155 | 1.9595 | 1.858 | 1.741 |
| ARA.67 | 1 | 6 | OTB | 5 | NA | 1.9201 | 1.8679 | 1.8886 | 1.9289 | 2.0082 | NA | NA | NA | 1.741 |
| ARA.67 | 1 | 7 | OTB | 1 | 0.054 | 0.0281 | 0.041 | 0.0533 | 0.042 | 0.043 | 0.0087 | 0 | 0 | 0 |
| ARA.67 | 1 | 7 | OTB | 2 | 0.2818 | 0.3239 | 0.3327 | 0.2371 | 0.2103 | 0.1868 | 0.1072 | 0 | 0 | 0 |
| ARA.67 | 1 | 7 | OTB | 3 | 0.1198 | 0.2472 | 0.427 | 0.281 | 0.307 | 0.2127 | 0.1075 | 0 | 0 | 0 |
| ARA.67 | 1 | 7 | OTB | 4 | NA | 0.0248 | 0 | 0.1092 | 0.0943 | 0.0102 | 0 | 0 | 0 | 0 |
| ARA.67 | 1 | 7 | OTB | 5 | NA | 0 | 0 | 0 | 0.0226 | 0 | NA | NA | NA | 0 |

### 3.2.2.7 Vector of partial F for DPS EMU1-GSA 1

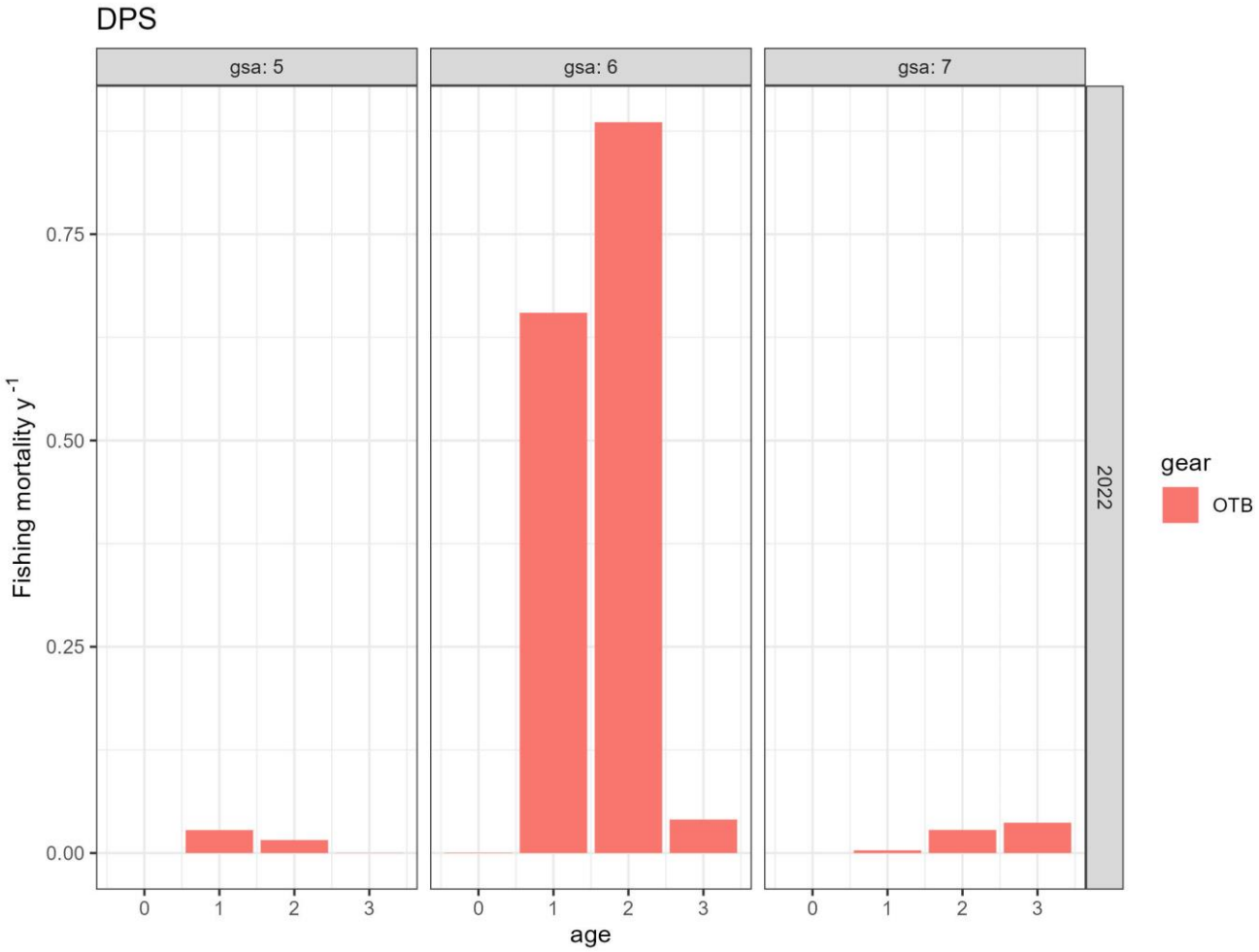
The vector of partial F for the deep-water rose shrimp for OTB, corresponding to the stock assessment unit in EMU1 GSA 1 is shown in the following figure and, for the time series 2013-2022, in the table below.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPS.1 | 1 | 1 | OTB | 0 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| DPS.1 | 1 | 1 | OTB | 1 | 1.0228 | 0.9538 | 0.8599 | 0.7624 | 0.6817 | 0.6333 | 0.6194 | 0.6281 | 0.6423 | 0.6528 |
| DPS.1 | 1 | 1 | OTB | 2 | 2.0187 | 1.8824 | 1.6971 | 1.5046 | 1.3455 | 1.25 | 1.2224 | 1.2396 | 1.2676 | 1.2884 |
| DPS.1 | 1 | 1 | OTB | 3 | 0.5719 | 0.5333 | 0.4808 | 0.4262 | 0.3812 | 0.3541 | 0.3463 | 0.3512 | 0.3591 | 0.365 |
| DPS.1 | 1 | 1 | OTB | 0 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| DPS.1 | 1 | 1 | OTB | 1 | 1.0228 | 0.9538 | 0.8599 | 0.7624 | 0.6817 | 0.6333 | 0.6194 | 0.6281 | 0.6423 | 0.6528 |

### 3.2.2.8 Vector of partial F for DPS EMU1-GSAs 5-6-7

The vector of partial F for the deep-water rose shrimp for OTB, corresponding to the stock assessment unit in EMU1 GSAs 5,6 and 7 is shown in the following figure and, for the time series 2013-2022, in the table below.

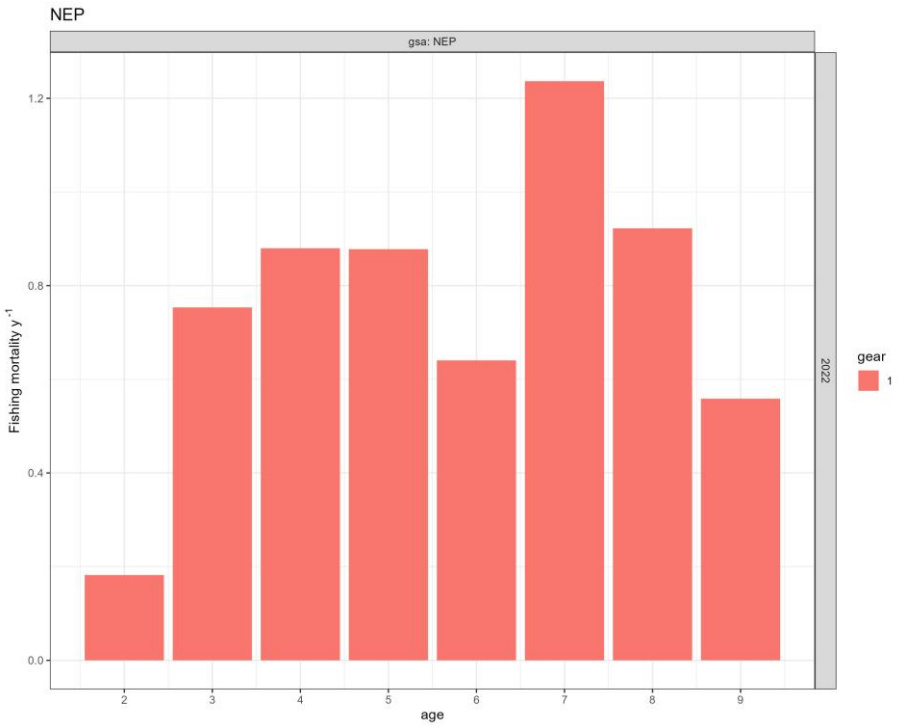



| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPS.567 | 1 | 5 | OTB | 0 | 0 | 0 | 0 | 0 | 0.0001 | 0 | 0 | 0 | 0 | 0 |
| DPS.567 | 1 | 5 | OTB | 1 | 0.0272 | 0.0154 | 0.0135 | 0.0167 | 0.1103 | 0.1319 | 0.07 | 0.0704 | 0.0537 | 0.0278 |
| DPS.567 | 1 | 5 | OTB | 2 | 0.0372 | 0.0207 | 0.0299 | 0.0078 | 0.0267 | 0.0032 | 0.1941 | 0.0308 | 0.0529 | 0.0158 |
| DPS.567 | 1 | 5 | OTB | 3 | 0.0001 | 0 | 0.0018 | 0 | 0 | 0.0001 | 0.0007 | 0 | 0.0002 | 0.0003 |
| DPS.567 | 1 | 6 | OTB | 0 | 0.0003 | 0.0003 | 0.0004 | 0.0005 | 0.0006 | 0.0008 | 0.0009 | 0.0009 | 0.0007 | 0.0005 |
| DPS.567 | 1 | 6 | OTB | 1 | 0.3802 | 0.3899 | 0.4418 | 0.5485 | 0.6695 | 0.9198 | 1.1456 | 1.0861 | 0.874 | 0.6548 |
| DPS.567 | 1 | 6 | OTB | 2 | 0.5005 | 0.5118 | 0.5753 | 0.7474 | 0.9972 | 1.3818 | 1.3054 | 1.5049 | 1.1633 | 0.8857 |
| DPS.567 | 1 | 6 | OTB | 3 | 0.0377 | 0.034 | 0.044 | 0.0527 | 0.0832 | 0.0938 | 0.1052 | 0.1243 | 0.0359 | 0.0407 |
| DPS.567 | 1 | 7 | OTB | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DPS.567 | 1 | 7 | OTB | 1 | 0.0048 | 0.0039 | 0.0066 | 0.0262 | 0.0267 | 0.0083 | 0.0024 | 0.0049 | 0.0074 | 0.0034 |
| DPS.567 | 1 | 7 | OTB | 2 | 0.021 | 0.022 | 0.0208 | 0.0463 | 0.0691 | 0.0515 | 0.151 | 0.0381 | 0.051 | 0.028 |
| DPS.567 | 1 | 7 | OTB | 3 | 0.0089 | 0.0123 | 0.0065 | 0.0142 | 0.0082 | 0.0262 | 0.0321 | 0.0072 | 0.0699 | 0.0368 |
| DPS.567 | 1 | 5 | OTB | 0 | 0 | 0 | 0 | 0 | 0.0001 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPS.567 | 1 | 5 | OTB | 1 | 0.0272 | 0.0154 | 0.0135 | 0.0167 | 0.1103 | 0.1319 | 0.07 | 0.0704 | 0.0537 | 0.0278 |
| DPS.567 | 1 | 5 | OTB | 2 | 0.0372 | 0.0207 | 0.0299 | 0.0078 | 0.0267 | 0.0032 | 0.1941 | 0.0308 | 0.0529 | 0.0158 |
| DPS.567 | 1 | 5 | OTB | 3 | 0.0001 | 0 | 0.0018 | 0 | 0 | 0.0001 | 0.0007 | 0 | 0.0002 | 0.0003 |

### 3.2.2.9 Vector of partial F for NEP EMU1-GSA

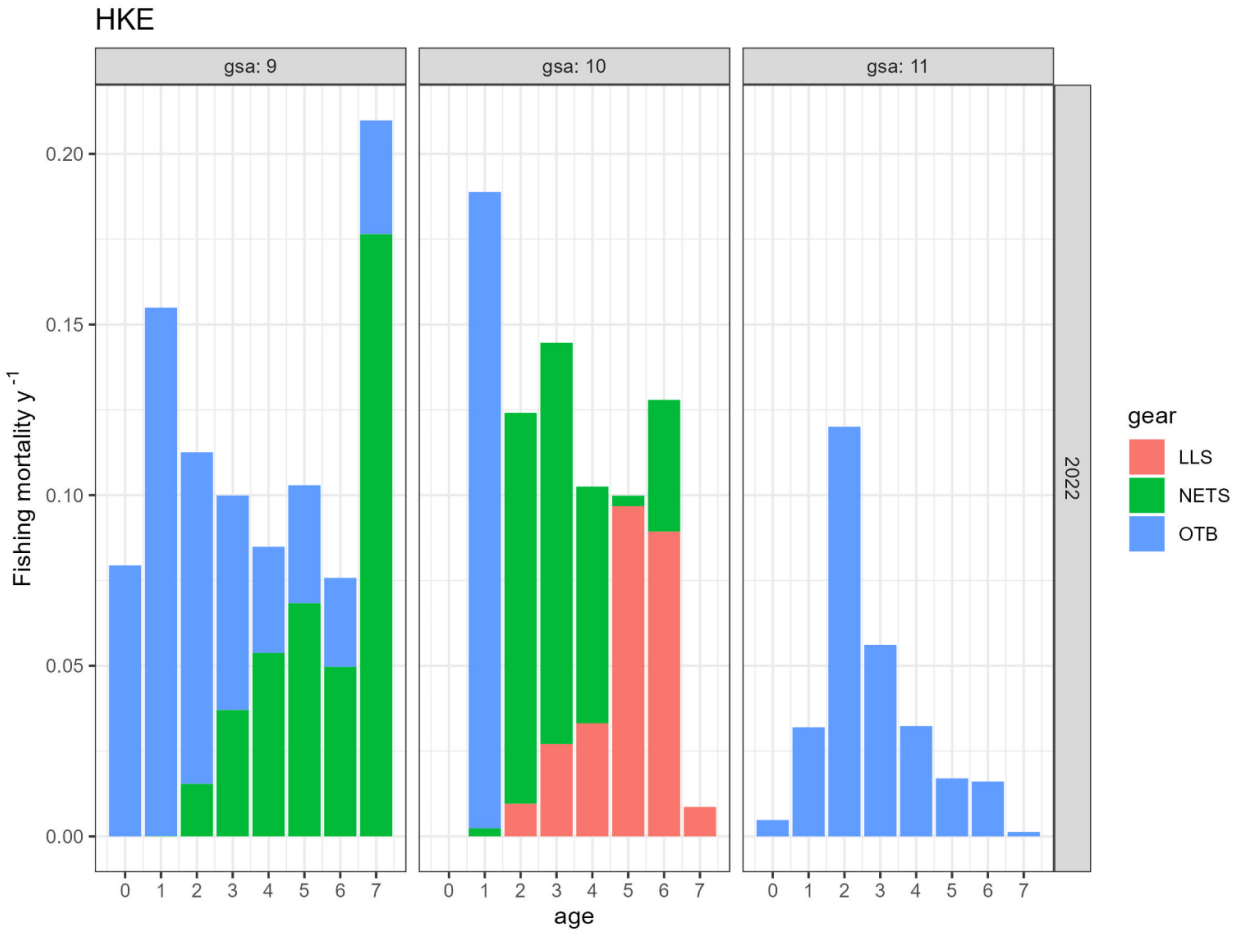
The vector of partial F for norway lobster for OTB, corresponding to the stock assessment in unit EMU1 GSA 6 is shown in the following figures and table.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEP.6 | 1 | 6 | OTB | 2 | 0.207 | 0.2495 | 0.2361 | 0.1907 | 0.214 | 0.22 | 0.2577 | 0.1601 | 0.1645 | 0.1821 |
| NEP.6 | 1 | 6 | OTB | 3 | 0.8564 | 1.0323 | 0.9769 | 0.7892 | 0.8855 | 0.9105 | 1.0664 | 0.6625 | 0.6805 | 0.7535 |
| NEP.6 | 1 | 6 | OTB | 4 | 0.9999 | 1.2054 | 1.1406 | 0.9214 | 1.0339 | 1.0631 | 1.2452 | 0.7735 | 0.7945 | 0.8798 |
| NEP.6 | 1 | 6 | OTB | 5 | 0.9978 | 1.2028 | 1.1382 | 0.9195 | 1.0317 | 1.0609 | 1.2425 | 0.7719 | 0.7928 | 0.878 |
| NEP.6 | 1 | 6 | OTB | 6 | 0.7278 | 0.8774 | 0.8302 | 0.6707 | 0.7526 | 0.7738 | 0.9063 | 0.563 | 0.5783 | 0.6404 |
| NEP.6 | 1 | 6 | OTB | 7 | 1.4054 | 1.6941 | 1.6031 | 1.2951 | 1.4532 | 1.4942 | 1.7501 | 1.0872 | 1.1167 | 1.2366 |
| NEP.6 | 1 | 6 | OTB | 8 | 1.0483 | 1.2637 | 1.1959 | 0.966 | 1.084 | 1.1146 | 1.3054 | 0.811 | 0.833 | 0.9224 |
| NEP.6 | 1 | 6 | OTB | 9 | 0.6349 | 0.7653 | 0.7242 | 0.5851 | 0.6565 | 0.675 | 0.7906 | 0.4911 | 0.5045 | 0.5586 |

### 3.2.2.10 Vector of partial F for HKE EMU2-GSAs 8-9-10-11

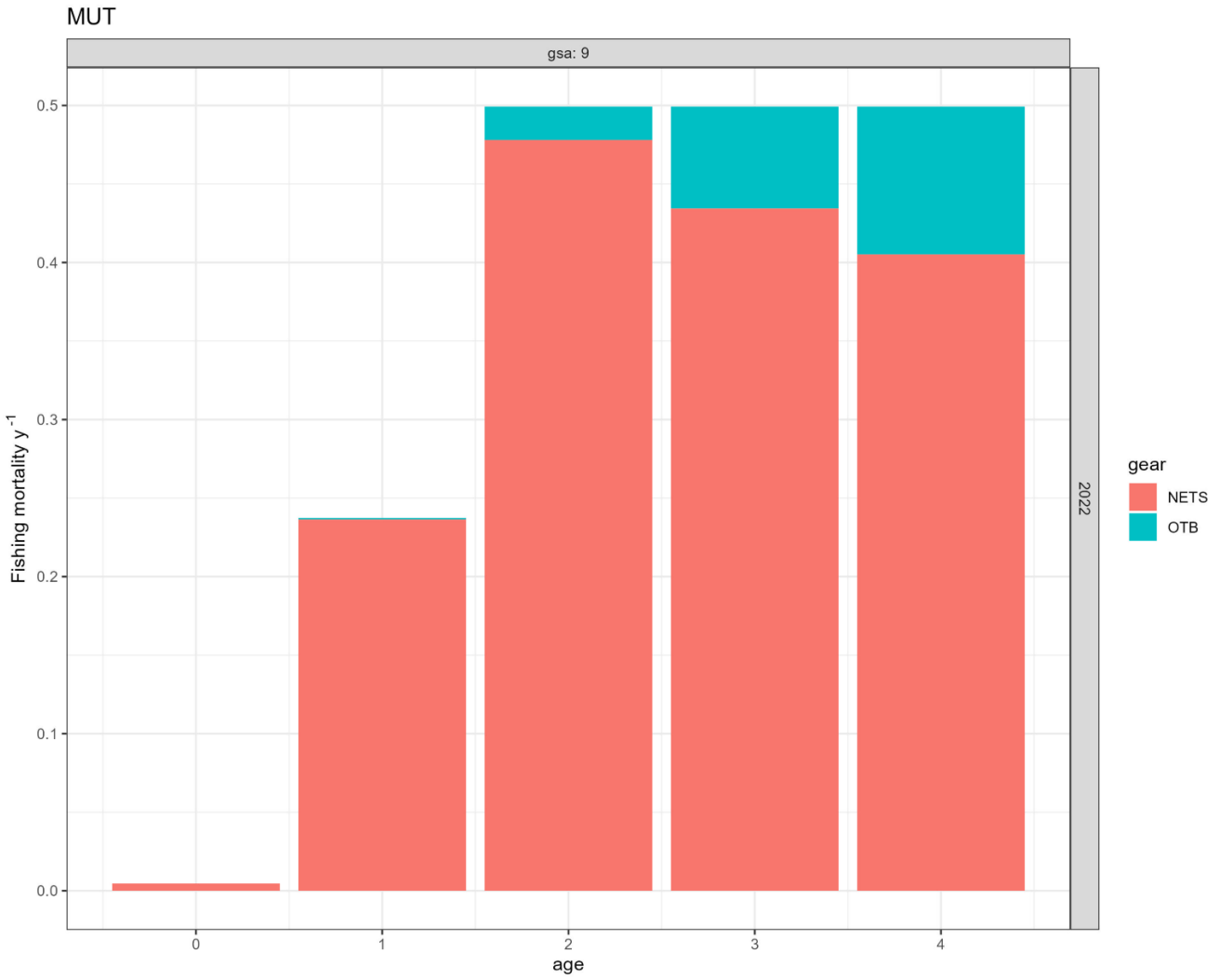
The vector of partial *F* by gears for European hake corresponding to the stock assessment in unit EMU2 (GSAs 8, 9, 10, 11) is shown for 2022 the following figure, and for the time series 2013-2022 in the table below. For GSA10 it is evident that OTB data are unreliable showing only the age class 1. EWG 23_11 deeply check the row data and highlight that the problem is the length structure of OTB landings in GSA10 which is poor and inconsistent with the time series. It is worth of note that this bug affects the structure of catches at age and thus all the procedure to partition the harvest estimates by the assessment is biased.



| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HKE.891011 | 2 | 10 | LLS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| HKE.891011 | 2 | 10 | LLS | 1 | 0 | 0 | 1.00E-04 | 0 | 0 | 0 | NA | 0.0014 | 0 | 0 |
| HKE.891011 | 2 | 10 | LLS | 2 | 0.01 | 0.0037 | 0.0113 | 0.0231 | 0.0092 | 0.0119 | NA | 0.0357 | 0 | 0.0096 |
| HKE.891011 | 2 | 10 | LLS | 3 | 0.0926 | 0.0268 | 0.043 | 0.133 | 0.0471 | 0.0806 | NA | 0.1133 | 0.0107 | 0.0271 |
| HKE.891011 | 2 | 10 | LLS | 4 | 0.1478 | 0.0793 | 0.1714 | 0.1828 | 0.1082 | 0 | NA | 0.1315 | 0.0742 | 0.0332 |
| HKE.891011 | 2 | 10 | LLS | 5 | 0.2439 | 0.2738 | 0.2259 | 0.2333 | 0.1288 | 0.2095 | NA | 0.1215 | 0.1038 | 0.0968 |
| HKE.891011 | 2 | 10 | LLS | 6 | 0.1891 | 0.2462 | 0.1352 | 0.2479 | 0.148 | 0 | NA | 0.1649 | 0.2284 | 0.0893 |
| HKE.891011 | 2 | 10 | LLS | 7 | 0.1722 | 0.4398 | 0.3125 | 0.3796 | 0.2957 | 0 | NA | 0.0179 | 0.211 | 0.0087 |
| HKE.891011 | 2 | 10 | NETS | 0 | 0 | 0 | 0 | NA | 0 | 1.00E-04 | 0 | 0.0279 | 0 | 0 |
| HKE.891011 | 2 | 10 | NETS | 1 | 0.077 | 0.0194 | 0.0194 | NA | 0.001 | 0.0032 | 0.0078 | 0.0035 | 0 | 0.0024 |
| HKE.891011 | 2 | 10 | NETS | 2 | 0.4194 | 0.4186 | 0.34 | NA | 0.1056 | 0.183 | 0.1352 | 0.1543 | 0.1032 | 0.1145 |
| HKE.891011 | 2 | 10 | NETS | 3 | 0 | 0 | 0.2868 | NA | 0.4191 | 0.2545 | 0.2376 | 0.1709 | 0.2836 | 0.1176 |
| HKE.891011 | 2 | 10 | NETS | 4 | 0 | 0 | 0 | NA | 0.2459 | 0.1176 | 0.1791 | 0.0662 | 0 | 0.0694 |
| HKE.891011 | 2 | 10 | NETS | 5 | 0 | 0 | 0 | NA | 0.1987 | 0.0728 | 0.0604 | 0.0648 | 0 | 0.003 |
| HKE.891011 | 2 | 10 | NETS | 6 | 0 | 0 | 0 | NA | 0.2012 | 0 | 0.0223 | 0.0367 | 0 | 0.0386 |
| HKE.891011 | 2 | 10 | NETS | 7 | 0 | 0 | 0 | NA | 0.0878 | 0 | 0.0024 | 0.0043 | 0 | 0 |
| HKE.891011 | 2 | 10 | OTB | 0 | 0.1229 | 0.0256 | 0.0544 | 0.0462 | 0.0143 | 7.00E-04 | 0.0012 | 0 | 1.00E-04 | 0 |
| HKE.891011 | 2 | 10 | OTB | 1 | 0.1939 | 0.1917 | 0.2006 | 0.2217 | 0.1095 | 0.0268 | 0.1122 | 0.0093 | 0.027 | 0.1865 |
| HKE.891011 | 2 | 10 | OTB | 2 | 0.0309 | 0.0832 | 0.0694 | 0.1715 | 0.1311 | 0.1358 | 0.1278 | 0.1366 | 0.0589 | 0 |
| HKE.891011 | 2 | 10 | OTB | 3 | 0.0201 | 0.1144 | 0.02 | 0.0784 | 0.0201 | 0.1296 | 0.0579 | 0.0773 | 0.1124 | 0 |
| HKE.891011 | 2 | 10 | OTB | 4 | 0.0198 | 0.0596 | 0.0205 | 0.0315 | 0.0221 | 0.0895 | 0.0091 | 0.0151 | 0.116 | 0 |
| HKE.891011 | 2 | 10 | OTB | 5 | 0.0042 | 0 | 0.0127 | 0.0044 | 0.0415 | 0.0418 | 0.0298 | 9.00E-04 | 0.0231 | 0 |
| HKE.891011 | 2 | 10 | OTB | 6 | 0.0281 | 0.0301 | 0.0043 | 0.0426 | 0.0156 | 0.0688 | 0 | 0.0051 | 0 | 0 |
| HKE.891011 | 2 | 10 | OTB | 7 | 0.0015 | 0 | 0 | 0.001 | 0.0021 | 0.0043 | 0.0021 | 0 | 0 | 0 |
| HKE.891011 | 2 | 11 | OTB | 0 | 0.0174 | 0.0033 | 0.0127 | 0.0167 | 0.0393 | 0.0298 | 0.0035 | 0.0015 | 0.0014 | 0.0048 |
| HKE.891011 | 2 | 11 | OTB | 1 | 0.0731 | 0.0739 | 0.1843 | 0.2336 | 0.4555 | 0.4441 | 0.2118 | 0.2603 | 0.1748 | 0.032 |
| HKE.891011 | 2 | 11 | OTB | 2 | 0.0387 | 0.0343 | 0.0742 | 0.1519 | 0.2544 | 0.2325 | 0.2041 | 0.0827 | 0.1517 | 0.1201 |
| HKE.891011 | 2 | 11 | OTB | 3 | 0.1239 | 0.0828 | 0.1382 | 0.165 | 0.1213 | 0.0293 | 0.0987 | 0.0301 | 0.0317 | 0.0561 |
| HKE.891011 | 2 | 11 | OTB | 4 | 0.0952 | 0.0288 | 0.0983 | 0.095 | 0.053 | 0.0075 | 0.0374 | 0.0275 | 0.0183 | 0.0323 |
| HKE.891011 | 2 | 11 | OTB | 5 | 0.0832 | 0.0128 | 0.0686 | 0.115 | 0.0406 | 0.004 | 0.006 | 0.0273 | 0.0228 | 0.017 |
| HKE.891011 | 2 | 11 | OTB | 6 | 0.1113 | 0.0492 | 0.1786 | 0.0329 | 0.0444 | 0 | 9.00E-04 | 8.00E-04 | 5.00E-04 | 0.0161 |
| HKE.891011 | 2 | 11 | OTB | 7 | 0.1034 | 1.00E-04 | 0.0537 | 0.0145 | 7.00E-04 | 0.0477 | 0.0015 | 0.0459 | 0.0122 | 0.0013 |
| HKE.891011 | 2 | 9 | NETS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HKE.891011 | 2 | 9 | NETS | 1 | 0.0089 | 0.0051 | 5.00E-04 | 0.0027 | 4.00E-04 | 0.001 | 0.0026 | 0.0015 | 8.00E-04 | 1.00E-04 |
| HKE.891011 | 2 | 9 | NETS | 2 | 0.1138 | 0.0686 | 0.0403 | 0.0616 | 0.0507 | 0.025 | 0.0235 | 0.0318 | 0.0481 | 0.0154 |
| HKE.891011 | 2 | 9 | NETS | 3 | 0.217 | 0.2038 | 0.0902 | 0.073 | 0.0509 | 0.0516 | 0.0795 | 0.0613 | 0.0286 | 0.037 |
| HKE.891011 | 2 | 9 | NETS | 4 | 0.1378 | 0.0506 | 0.1399 | 0.0871 | 0.0401 | 0.1356 | 0.1272 | 0.0955 | 0.1125 | 0.0538 |
| HKE.891011 | 2 | 9 | NETS | 5 | 0.1283 | 0.0611 | 0.1215 | 0.1274 | 0.0488 | 0.0763 | 0.2295 | 0.1176 | 0.1775 | 0.0683 |
| HKE.891011 | 2 | 9 | NETS | 6 | 0.0987 | 0.1509 | 0.1154 | 0.1044 | 0.0559 | 0.2311 | 0.2598 | 0.1378 | 0.1232 | 0.0497 |
| HKE.891011 | 2 | 9 | NETS | 7 | 0.0508 | 0.0405 | 0.0983 | 0.0402 | 0.0581 | 0.3075 | 0.31 | 0.2831 | 0.146 | 0.1765 |
| HKE.891011 | 2 | 9 | OTB | 0 | 0.0698 | 0.1732 | 0.141 | 0.1525 | 0.1511 | 0.1462 | 0.1475 | 0.1147 | 0.1482 | 0.0794 |
| HKE.891011 | 2 | 9 | OTB | 1 | 0.5843 | 0.6116 | 0.5239 | 0.5036 | 0.3472 | 0.3132 | 0.3442 | 0.3669 | 0.4656 | 0.1549 |
| HKE.891011 | 2 | 9 | OTB | 2 | 0.277 | 0.2475 | 0.3463 | 0.5048 | 0.3162 | 0.1602 | 0.1536 | 0.1692 | 0.2723 | 0.0971 |
| HKE.891011 | 2 | 9 | OTB | 3 | 0.2964 | 0.2937 | 0.1649 | 0.3201 | 0.0726 | 0.0852 | 0.0694 | 0.0615 | 0.0676 | 0.0629 |
| HKE.891011 | 2 | 9 | OTB | 4 | 0.1474 | 0.3089 | 0.113 | 0.166 | 0.0649 | 0.1108 | 0.044 | 0.0402 | 0.0697 | 0.0311 |
| HKE.891011 | 2 | 9 | OTB | 5 | 0.0883 | 0.1795 | 0.1144 | 0.0823 | 0.0758 | 0.0564 | 0.0712 | 0.0439 | 0.0635 | 0.0346 |
| HKE.891011 | 2 | 9 | OTB | 6 | 0.1209 | 0.0509 | 0.1096 | 0.1345 | 0.0692 | 0.1611 | 0.1138 | 0.0306 | 0.0387 | 0.0261 |
| HKE.891011 | 2 | 9 | OTB | 7 | 0.2201 | 0.0468 | 0.0786 | 0.1269 | 0.0898 | 0.1014 | 0.0808 | 0.0248 | 0.0215 | 0.0333 |

### 3.2.2.11 Vector of partial F for MUT EMU2-GSA9

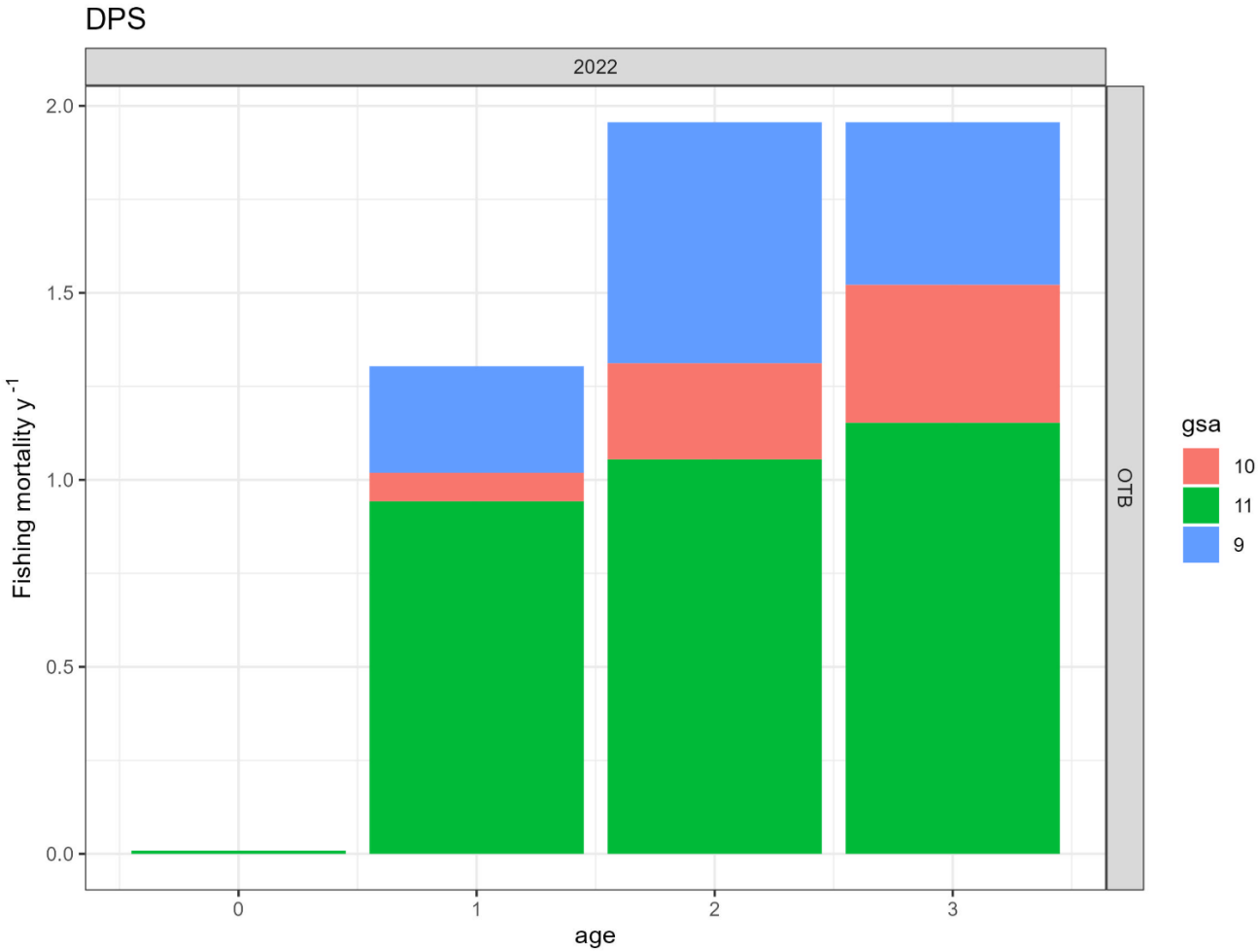
The vector of partial *F* for red mullet corresponding to the stock assessment unit in EMU2 GSA9 is shown in the following figures and table.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MUT.9 | 2 | 9 | NETS | 0 | 0.0146 | 0.0152 | 0.0153 | 0.0154 | 0.0158 | 0.0155 | 0.0133 | 0.0095 | 0.006 | 0.0046 |
| MUT.9 | 2 | 9 | NETS | 1 | 0.7483 | 0.783 | 0.7863 | 0.7842 | 0.8136 | 0.7974 | 0.6534 | 0.4873 | 0.309 | 0.2364 |
| MUT.9 | 2 | 9 | NETS | 2 | 1.3437 | 1.4912 | 1.5377 | 1.527 | 1.6438 | 1.5994 | 1.2972 | 0.9861 | 0.6283 | 0.478 |
| MUT.9 | 2 | 9 | NETS | 3 | 1.1533 | 1.3612 | 1.4154 | 1.4521 | 1.5738 | 1.4816 | 1.2828 | 0.971 | 0.5952 | 0.4344 |
| MUT.9 | 2 | 9 | NETS | 4 | 1.0222 | 1.4404 | 1.3729 | 1.5037 | 1.6297 | 1.4869 | 0.7186 | 0.9576 | 0.5226 | 0.4052 |
| MUT.9 | 2 | 9 | OTB | 0 | 1.00E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MUT.9 | 2 | 9 | OTB | 1 | 0.0112 | 0.006 | 0.0055 | 0.0138 | 0.0048 | 0.0078 | 0.0366 | 0.006 | 0.0038 | 9.00E-04 |
| MUT.9 | 2 | 9 | OTB | 2 | 0.2541 | 0.1685 | 0.1279 | 0.1517 | 0.0779 | 0.0944 | 0.1543 | 0.0518 | 0.0297 | 0.0212 |
| MUT.9 | 2 | 9 | OTB | 3 | 0.4445 | 0.2984 | 0.2502 | 0.2266 | 0.1479 | 0.2122 | 0.1687 | 0.0669 | 0.0628 | 0.0649 |
| MUT.9 | 2 | 9 | OTB | 4 | 0.5756 | 0.2192 | 0.2926 | 0.175 | 0.092 | 0.2069 | 0.7329 | 0.0803 | 0.1354 | 0.094 |

### 3.2.2.12 Vector of partial F for DPS EMU2-GSAs 9, 10 and 11

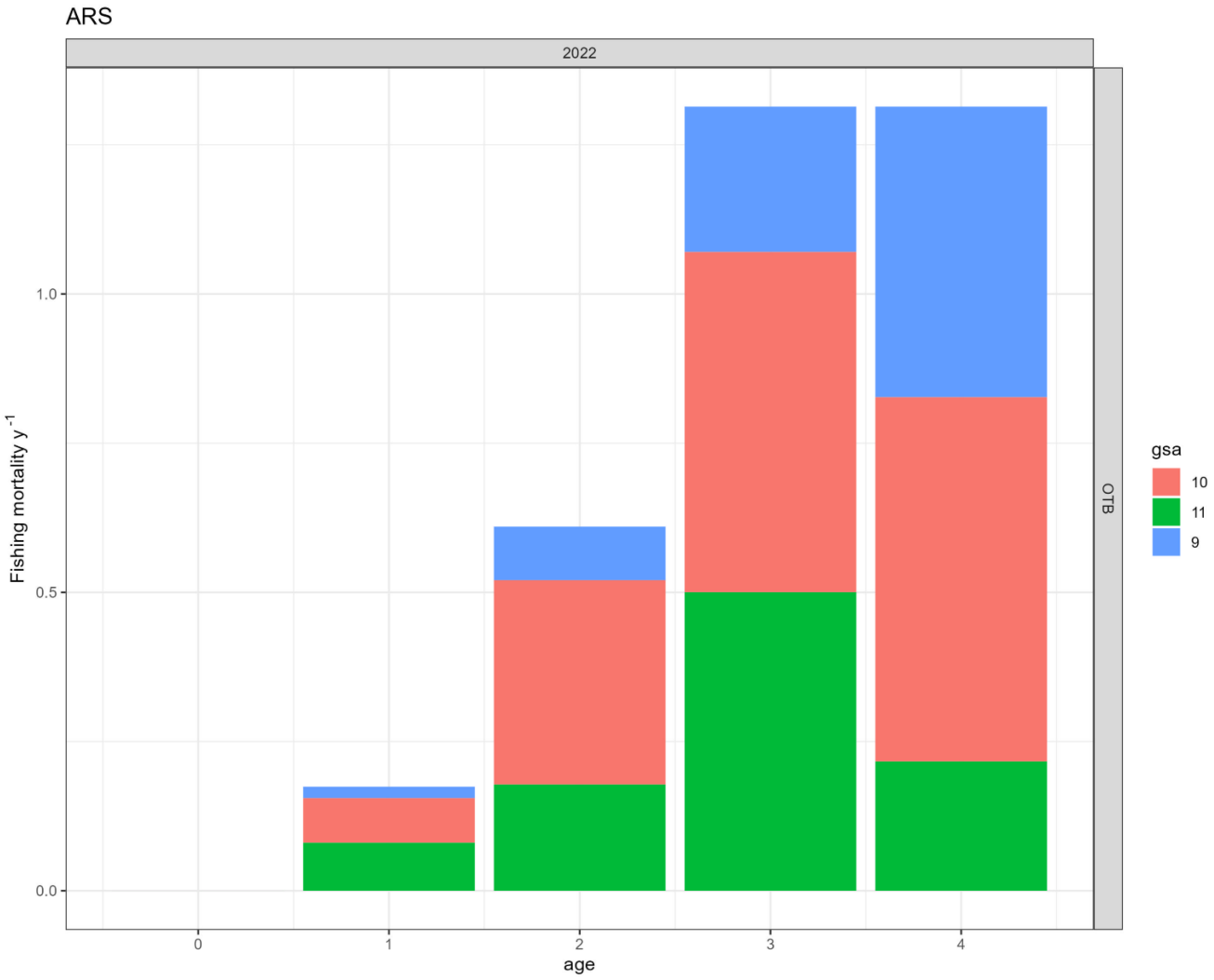
The vector of partial *F* for Deep-water rose shrimp for OTB corresponding to the stock assessment in unit EMU2, GSAs 9, 10 and 11 is shown in the following figures and table.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPS.891011 | 2 | 10 | OTB | 0 | 0 | 0 | 0 | 0 | 0 | 4.00E-04 | 0 | 0 | 0 | 0 |
| DPS.891011 | 2 | 10 | OTB | 1 | 0.0085 | 0.0095 | 0.0118 | 0.0123 | 0.0187 | 0.1028 | 0.0848 | 0.0774 | 0.052 | 0.0766 |
| DPS.891011 | 2 | 10 | OTB | 2 | 0.0381 | 0.0575 | 0.0606 | 0.0896 | 0.0732 | 0.2032 | 0.1523 | 0.2229 | 0.1951 | 0.2572 |
| DPS.891011 | 2 | 10 | OTB | 3 | 0.0351 | 0.0597 | 0.0705 | 0.0672 | 0.0561 | 0.2563 | 0.1873 | 0.3336 | 0.1384 | 0.3688 |
| DPS.891011 | 2 | 11 | OTB | 0 | 7.00E-04 | 0.0012 | 0.0021 | 8.00E-04 | 0.0028 | 0.0049 | 0.0062 | 0.0065 | 0.0063 | 0.0086 |
| DPS.891011 | 2 | 11 | OTB | 1 | 0.2141 | 0.3055 | 0.3761 | 0.3706 | 0.4552 | 0.4733 | 0.6088 | 0.7642 | 0.7813 | 0.9424 |
| DPS.891011 | 2 | 11 | OTB | 2 | 0.9183 | 0.8082 | 0.9981 | 1.0291 | 0.9726 | 0.8524 | 0.7926 | 0.9991 | 1.2084 | 1.0545 |
| DPS.891011 | 2 | 11 | OTB | 3 | 1.132 | 1.0982 | 1.116 | 1.1765 | 1.1459 | 1.0428 | 0.925 | 0.9317 | 0.7964 | 1.1525 |
| DPS.891011 | 2 | 9 | OTB | 0 | 0.0048 | 0.0044 | 0.0036 | 0.0049 | 0.0031 | 0.001 | 4.00E-04 | 5.00E-04 | 0.0013 | 2.00E-04 |
| DPS.891011 | 2 | 9 | OTB | 1 | 0.5934 | 0.5181 | 0.4516 | 0.468 | 0.4035 | 0.3457 | 0.2871 | 0.2072 | 0.2888 | 0.2848 |
| DPS.891011 | 2 | 9 | OTB | 2 | 0.2677 | 0.3841 | 0.2008 | 0.1579 | 0.2705 | 0.3273 | 0.5265 | 0.3514 | 0.2799 | 0.6443 |
| DPS.891011 | 2 | 9 | OTB | 3 | 0.0569 | 0.0919 | 0.0729 | 0.0328 | 0.1145 | 0.0839 | 0.3591 | 0.308 | 0.7487 | 0.4348 |

### 3.2.2.13 Vector of partial F for ARS EMU2-GSAs 8, 9 and 10

The vector of partial *F* for Red and blue shrimp for OTB, corresponding to the stock assessment in unit EMU1 GSA 1 and 2 is shown in the following figures and table.




| stock | EMU | gsa | gear | age | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARS.91011 | 2 | 10 | GNS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | GNS | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | GNS | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | GNS | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | GNS | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | OTB | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 10 | OTB | 1 | 0.129 | 0.1014 | 0.1145 | 0.1074 | 0.1058 | 0.0948 | 0.0135 | 0.0495 | 0.0023 | 0.0749 |
| ARS.91011 | 2 | 10 | OTB | 2 | 0.431 | 0.3893 | 0.4092 | 0.3971 | 0.2859 | 0.3571 | 0.064 | 0.1403 | 0.0173 | 0.3425 |
| ARS.91011 | 2 | 10 | OTB | 3 | 0.7719 | 0.9147 | 0.8447 | 0.7392 | 0.4052 | 0.7572 | 0.2507 | 0.5892 | 0.0021 | 0.5702 |
| ARS.91011 | 2 | 10 | OTB | 4 | 0.8546 | 0.8326 | 0.4423 | 0.7077 | 0.4834 | 0.643 | 0.068 | 0.204 | 0 | 0.6105 |
| ARS.91011 | 2 | 11 | OTB | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 11 | OTB | 1 | 0.01 | 0.0405 | 0.0317 | 0.0434 | 0.0521 | 0.0617 | 0.1437 | 0.1074 | 0.1471 | 0.0803 |
| ARS.91011 | 2 | 11 | OTB | 2 | 0.0484 | 0.1046 | 0.1001 | 0.1263 | 0.2469 | 0.1708 | 0.4476 | 0.3446 | 0.4945 | 0.1779 |
| ARS.91011 | 2 | 11 | OTB | 3 | 0.2072 | 0.1624 | 0.2175 | 0.3646 | 0.6751 | 0.2947 | 0.7133 | 0.2187 | 0.9945 | 0.5002 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ARS.91011 | 2 | 11 OTB | 4 | 0.138 | 0.2146 | 0.4534 | 0.3808 | 0.5452 | 0.1595 | 0.8071 | 0.3485 | 0.8067 | 0.2166 |
| ARS.91011 | 2 | 9 OTB | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ARS.91011 | 2 | 9 OTB | 1 | 0.0031 | 0.0035 | 0.0032 | 0.0044 | 0.005 | 0.0148 | 0.0216 | 0.0276 | 0.0397 | 0.019 |
| ARS.91011 | 2 | 9 OTB | 2 | 0.018 | 0.0151 | 0.0137 | 0.0201 | 0.0376 | 0.0719 | 0.1142 | 0.1612 | 0.1506 | 0.0896 |
| ARS.91011 | 2 | 9 OTB | 3 | 0.0921 | 0.0192 | 0.0641 | 0.0666 | 0.1482 | 0.2398 | 0.3838 | 0.5835 | 0.43 | 0.2435 |
| ARS.91011 | 2 | 9 OTB | 4 | 0.0786 | 0.0491 | 0.2307 | 0.0819 | 0.1999 | 0.4892 | 0.4727 | 0.8389 | 0.6199 | 0.4868 |

## 4 FUEL PRICES AND OTHER COSTS CHANGES IN 2022-2023 (TOR 2)

Analysing fuel prices in the fishing fleet is a complex endeavour that requires considering a wide range of economic, environmental, and regulatory factors.

These factors can be broadly categorized into supply and demand dynamics, geopolitical events, environmental regulations and global economic conditions. Marine fuel prices are significantly influenced by global oil prices. Any fluctuations in global oil prices, driven by factors like international agreements, supply disruptions, or changes in demand, can directly impact marine fuel costs. Geopolitical tensions and conflicts in major oil-producing regions can disrupt oil supplies and lead to spikes in fuel prices. Additionally, sanctions or embargoes on certain countries can affect the availability and cost of marine fuels. Technology and efficiency improvements can impact fuel efficiency and investments in energy-efficient vessels and propulsion systems can lead to cost savings. Also, environmental concerns, such as reducing carbon emissions and promoting sustainable fishing practices, are affecting fuel usage and prices.

It's also important to consider that marine fuel prices can vary significantly by region and port, depending on local factors, taxes, subsidies, transportation costs and regulations. In particular, governments may provide subsidies or financial incentives to the fishing industry to mitigate the impact of high fuel prices or promote environmentally friendly practices.

In this context, make projections about the future of fuel prices in the European fishing fleet is complex.

To get the most up-to-date information and analysis on marine fuel price trends, the EUMOFA database has been queried. Figure 1 reports the fluctuations of the average marine fuel oil prices (in euro) for EU-27. The fluctuations are large, with the lowest levels (0.25 euro/litre) in the spring of 2020. From October 2020 the fuel price steadily increased, until June 2022. In the last month for which data are available (August 2023), the average value is still well above the average value of the series. Figures 2 represents the fluctuations of the average marine fuel oil prices for Spain, Italy, France. The trends are similar to the ones for the EU-27, but for Italy fluctuations are more frequently observed.

Figure 4.1 Fluctuations of the average marine fuel oil prices (in euro) for EU-27 - Data source: EUMOFA database

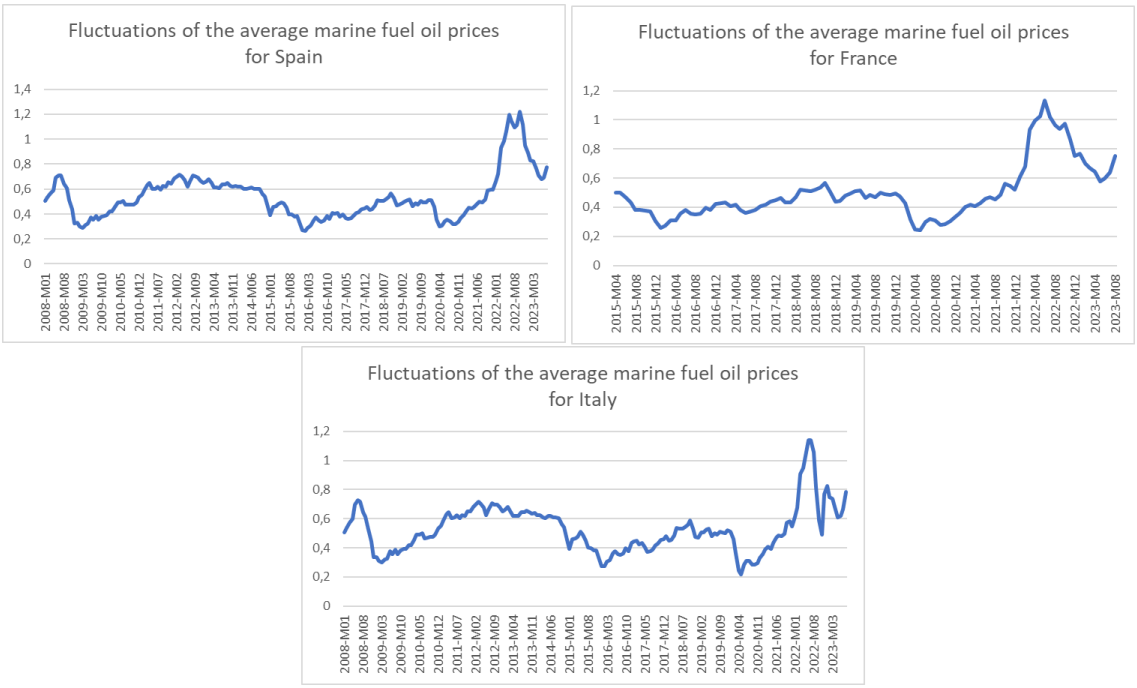



Figure 4.2 Fluctuations of the average marine fuel oil prices for Spain, Italy, France (2008 – August 2023) - Data source: EUMOFA database

Given the uncertainty on fuel prices and its impact on the socio-economic results, EWG 22-11 was requested that each scenario should had to be run with 2 fuel options: the actual fuel price and a potentially higher value (1.16 Euros/liter, 120% of the actual value). But the fuel cost in the second half of 2022 showed a reducing trend compared to the first half of 2022[7], therefore the economic deterioration was not as severe as that one predicted in the second option.

In the models applied by the EWG 23-11, AER data are used for Spanish and French EMUs. These data include the official data sets provided by the Member States till the year 2021 and projections for the year 2022 and 2023. AER projections are based on fuel prices that are obtained from EUMOFA website for each MS[8].
The AER method to estimate the fuel price in year+1 (i.e., 2022 in this AER) is to apply to year (2021) AER fuel prices the percentage change between years 2021 and 2022 of the fuel prices reported by EUMOFA.

***Energy costs (All fleet segments)***

$$Energy_costs_{t+1,f} = Energy_costs_{t,f} \frac{Energy_consumption_{t+1,f}}{Energy_consumption_{t,f}} \times \frac{Fuel_price_{t+1,m}}{Fuel_price_{t,m}} \quad ($$

$$Energy_costs_{t+2,f} = Energy_costs_{t+1,f} \frac{Energy_consumption_{t+2,f}}{Energy_consumption_{t+1,f}} \times \frac{Fuel_price_{t+2,m}}{Fuel_price_{t+1,m}}$$

[7] 0,93 was the actual average fuel price at EU level in 2022
[8] 2022 Annex to the Annual Economic Report on the EU Fishing Fleet - AER NOWCAST METHODOLOGY

For all scenarios, fuel prices are differentiated by fleet segment. AER fuel price estimates in 2021 are used in 2021, and AER projections for fuel price in 2022 are used in 2022 and onwards.

The Italian dataset is not retrieved by the AER because in the AER data are available only by the whole country and not by GSA. Therefore, it was considered appropriate to apply the changes in fuel prices estimated for the whole Italian segments to the GSA covered by the WestMedPlan (table 1).

**Table 4.1** Fuel price (2019-2021), AER projections (2021 and 2022) and percentage changes for the Italian fleet segments

| FUEL PRICE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **fs_name** | **2019** | **2020** | **2021** | **2022** | **2023** | **2022/2021** | **2023/2021** |
| ITA MBS DTS0612 NGI | 0,67 | 0,50 | 0,69 | 0,96 | 0,68 | 1,39 | 0,98 |
| ITA MBS DTS2440 NGI | 0,57 | 0,42 | 0,57 | 0,94 | 0,66 | 1,65 | 1,16 |
| ITA MBS DTS1824 NGI | 0,57 | 0,50 | 0,55 | 0,89 | 0,63 | 1,61 | 1,13 |
| ITA MBS DTS1218 NGI | 0,56 | 0,53 | 0,63 | 1,04 | 0,73 | 1,66 | 1,17 |
| ITA MBS PGP0006 NGI | 0,91 | 0,76 | 0,89 | 1,43 | 1,01 | 1,61 | 1,13 |
| ITA MBS PGP0612 NGI | 0,65 | 0,55 | 0,71 | 1,09 | 0,77 | 1,55 | 1,09 |
| ITA MBS HOK1218 NGI | 0,60 | 0,53 | 0,60 | 1,17 | 0,82 | 1,95 | 1,37 |

Economic results for 2023 are driven by the **inflation rate** (increase in operative costs, but also real increase in ex-vessel prices) and fuel price increases.

In the AER, all monetary values have been adjusted for inflation to 2020 constant prices. However, the Italian dataset is not retrieved by the AER because in the AER data are available only by the whole country and not by GSA. The Italian data are those provided by the national administration for the EWG 23-11 and the economic variables are reported at nominal values. The EWG 23-11 considered that it would be appropriate to adjust also the monetary values of the Italian dataset because it is more correct from an economic perspective and in order to increase the homogeneity with the outputs of the results of the other EMUs. The adjustment was implemented using the EUROSTAT harmonised index of consumer prices (HICP) as reported in table 4 of the annex of the 2022 Annual Economic Report on the EU Fishing Fleet (STECF 22-06).

The EWG 23-11 pointed out two issues for a correct interpretation of the model results:

1. The financial situation which the bio-economic models present for the year 2022 and beyond depend a lot on the assumptions regarding the development of fuel prices but include no mitigation measures for the fishing companies (like de minimis payments to cover parts of the increase in fuel costs 2022).
   Since 2020, most governments have provided direct financial support in the COVID crisis, and countries including France, Spain and Italy have also provided additional support in 2022 to mitigate against the raise of fuel costs (like de minimis payments). STECF plenary (22-03) agreed not to include those support payments to allow distinguishing between the impacts of the MAP from external economic shocks.

2. STECF PLEN (22-03) observed that the nowcast for 2023 (that are now used as input data for the models) should be interpreted with caution due to the fact that the development in the second half of the year (energy and fish prices, inflation, interest rates etc.) is unknown and highly uncertain. In addition, the nowcast results presented in the AER are based only on the number of vessels, and fuel and landing prices of a subset of the

species. Also, where no 2022 data was reported by Member States, and for all 2023 data, explanatory variables for the year 2021 are used to generate nowcasts and this would affect the final estimates as they are strongly related to the 2021 results. In addition, the methodology does not consider possible strategic changes in fleet behaviour, based on optimizing the trips and confidence intervals of the estimations performed are not available in the AER report to be able to evaluate the reliability of the mean values obtained.

### 4.1 References

Scientific, Technical and Economic Committee for Fisheries (STECF) - The 2022 Annual Economic Report on the EU Fishing Fleet (STECF 22-06), Prellezo, R., Sabatella, E., Virtanen, J. and Guillen, J. editors, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/120462, JRC130578

Scientific, Technical and Economic Committee for Fisheries (STECF) – Evaluation of the fishing effort and catch regime for demersal fisheries in the western Mediterranean Sea – PART IX (STECF-22-11). Publications Office of the European Union, Luxembourg, 2022,

## 5 PROGRESS IN OPERATIONAL MIXED-FISHERIES MODELS (TOR 3)

### 5.1 IAM in EMU 1

#### 5.1.1 Recall on the main issues and conclusions from EWG 23-01

In EMU1, the implementation of the IAM model for GSAs 1-2-5-6-7 carried out during the STECF meeting is still in development. During EWG 23-01, socio-economic indicators such as employment, gross profit and gross profit margin were not available. It was pointed out that to compute employment indicator, the relationship between Full-Time Equivalents (FTE) and fishing effort and the calculation of salary/crew costs needed to be discussed.

In EMU1, the implementation of the IAM model for GSAs 1-2-5-6-7 carried out during the STECF meeting is still in development. The addition of socio-economic indicators such as employment in terms of Full Time Equivalent (FTE), gross profit and gross profit margin was discussed during EWG 22-11 and EWG 23-01 and is added in this version of IAM, such as Gross Profit and Gross Profit Margin.

#### 5.1.2 Implementation progress in EWG 23-11

IAM (Impact Assessment Model), a bioeconomic mixed fishery simulation model, was implemented in EMU1, following the experiences gained in EWG 19-14, EWG 20-13, EWG 21-13, EWG 22-01, and EWG 22-11. The IAM model is documented in the webpage: https://ifremer-iam.github.io/IAM/.

The data sources used for the French and Spanish update are the FDI data, the Annual Economic Report (AER) data, the landings and discards data from the Med and Black sea data call (MBSDC), the outputs of the EWG 23-09 group on the Mediterranean Stock Assessment, and for prices by commercial categories, French data from the Fishery Information System (SIH) of Ifremer.

### 5.1.3 Stocks

The stocks taken into consideration in IAM-Med simulations are those for which analytic stock assessment results from EWG 23-09 were available:

- HKE1567: Hake (*Merluccius merluccius*) in GSAs 1-5-6-7,
- MUT1: Red mullet (*Mullus barbatus*) in GSA 1,
- MUT6: Red mullet (*Mullus barbatus*) in GSA 6,
- MUT7: Red mullet (*Mullus barbatus*) in GSA 7,
- NEP6: Norway Lobster (*Nephrops norvegicus*) in GSA 6,
- ARA5: Blue and red shrimp (*Aristeus antennatus*) in GSA 5,
- ARA67: Blue and red shrimp (*Aristeus antennatus*) in GSAs 6-7,
- DPS1: Deep-water rose shrimp (*Parapenaeus longirostris*) in GSA 1,
- DPS567: Deep-water rose shrimp (*Parapenaeus longirostris*) in GSAs 5-6-7.

**Stochastic recruitment** has been explicitly considered for those stocks, as in EWG 21-13, EWG 22-01, and EWG 22-11. To build a random succession of recruitments for stocks to be applied on the 2023-2030 projection period, 8 years are randomly drawned with replacement from the historical period that ensures the availability of recruitment data on all considered stocks (2009-2022). Each draw will determine for each projection year the annual recruitment combinations to be applied for each stock. **250 such trajectories** are simulated and used to build confidence intervals. The same set of recruitments are used for each management scenario assessed. Simulations run from 2022 to 2030.

Furthermore, catches of the following species from the management plan are simulated in the IAM model, however the dynamics of these species are not explicitly represented, due to lack of analytical or accepted stock assessments. They are referenced hereafter as "static species", and associated catches are simulated as a linear function of the simulated fishing effort, assuming a constant value of Landings Per Unit of Effort (LPUE). LPUE data are based on the 2022 values from FDI data.

- Blue and red shrimp (*Aristeus antennatus*) in GSAs 1 and 2,
- Red mullet (*Mullus barbatus*) in GSA 5,
- Norway lobster (*Nephrops norvegicus*) in GSAs 1, 5 and 7.

The other « static species » considered in the model and that are not included in the management plan are: stripped red mullet (MUR), anchovy (ANE), sardine (PIL), Atlantic mackerel (MAC), monkfish (MNZ), common octopus (OCC), octopuses (OCT), Atlantic bluefin tuna (BFT), and « ZZZ » (which stands for all other remaining species caught per fleet).

Table 5.1.3.1. Summary of the stocks in the Western Mediterranean management plan and how they are integrated in the IAM model in EWG 2311.

| **Stocks in management plan** | **Dynamic or static in IAM** | **Comment** |
|---|---|---|
| blue and red shrimp (*Aristeus antennatus*) in GFCM subareas 1, 2, 5, 6 and 7 | Dynamic: stocks, ARA5 (GSA 5), and ARA67 (GSAs 6-7) | Compared to last year, no population dynamics was available from the stock |

| | | |
|---|---|---|
| | Static: stock ARA12 (GSAs 1-2) | assessments EWG23-09 for ARA12. |
| deep-water rose shrimp (*Parapenaeus longirostris*) in GFCM subareas 1, 5, 6 and 7 | Dynamic: stocks DPS1 (GSA1), DPS567 (GSAs 5-6-7) | |
| European hake (*Merluccius merluccius*) in GFCM subareas 1-5-6-7 | Dynamic: stock HKE1567 (GSAs 1-5-6-7) | |
| Norway lobster (*Nephrops norvegicus*) in GFCM subareas 5 and 6 | Dynamic: stocks NEP6 (GSA6)<br>Static: stocks NEP1 (GSA1), NEP5 (GSA 5), and NEP6 (GSA6) | No population dynamics available from the stock assessments for NEP1, NEP5 and NEP6. |
| red mullet (*Mullus barbatus*) in GFCM subareas 1, 5, 6 and 7 | Dynamic: stocks MUT 1 (GSA 1), MUT 6 (GSA 6), and MUT 7 (GSA 7)<br>Static: stock MUT 5 (GSA 5) | Stock assessment are not available for *Mullus barbatus* in GSA 5. |

### 5.1.4 Fleets

The fleet typology used is based on the fleet segmentation of the Data Collection Framework (DCF). A fleet segment is the combination of a particular fishing technique category and a vessel length category. Spanish and French fleet segments were slightly modified from the previous implementation in EWG 22-11. Modifications concern only netters and vessels using hooks fleet segments and were made to be relevant with the economic data available in the AER (EWG 23-07).

The seven French fleets explicitly modelled are French demersal trawlers 18-24m, French demersal trawlers >=24m, French netters <06m, French netters 06-12m, French vessels using hooks <06m, French vessels using hooks 06-12m and French vessels using hooks 12-18m.

Regarding the Spanish fleets, nine Spanish fleet segments are considered: Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, Spanish trawlers >24m, Spanish netters 06-12m, Spanish netters 12-18m, Spanish vessels using hooks 06-12m, Spanish vessels using hooks 12-18m, and Spanish vessels using hooks 18-24m.

Vessels using hooks are assimilated to longliners and netters to gillnetters by discriminating between two of the dominant gears - since all vessels are operating a number of different gears through the year.

As in EWG 22-01 and EWG 22-11, the IAM model has been adapted to **differentiate between coastal and deep-sea trawling**. This concerns the three Spanish fleet segments: Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m where a distinction between fishing effort toward deep-sea trawling and coastal trawling has been made. The entry "Target-assemblage=DWS" in the FDI database has been used to parametrized the IAM model. The fishing efforts within the IAM fleet segments are also differentiated by gear (see Table 5.1.4.1 for more details).

Table 5.1.4.1. Modelled fleets in the IAM application in EMU1 and correspondence with FDI and AER fleets. "!= " means different. DFN stands for Drift and/or fixed netters, DTS for Demersal trawlers and/or demersal seiners, HOK for Vessels using hooks, and DWS for deep water species. For the gear types OTB stands for Bottom otter trawl, OTT for Multi-rig otter trawl, OTM for Midwater otter trawl, GNS for Set gillnet, GTN for Combined gillnets-trammel nets, GTR for Trammel net, LLS for Set longlines and LLD for Drifting longlines.

| **IAM Fleet segment names** | **Names in the report figures** | **Fleet segments in AER** | **Fishing techniques in FDI**<br>sub_region= GSA1, GSA5 , GSA6 and GSA7 | **"Metier" or gear explicitly modelled**<br>*(if there is not a category « other », it means that no other gears than the one listed are used by the fleet)*<br>***For each fleet, gears are listed by order of importance in terms of fishing days in 2022 (FDI)*** |
|---|---|---|---|---|
| French demersal trawlers 18-24m | FR_DTS 1824m | fs_name => FRA MBS DTS1824 NGI*<br>cluster_name=> MBS DTS VL1824 | country_code =FRA<br>fishing tech = DTS<br>vessel_length = VL1824 | OTB, OTT *(no OTM, because no fishing days in 2022 with this gear)*<br>To note: no distinction between coastal and deep trawling, as no effort and catches for DWS target assemblage in FDI database |
| French demersal trawlers 24-40m | FR_DTS >=24m | fs_name => FRA MBS DTS2440 NGI*<br>cluster_name=> MBS DTS VL2440 | country_code =FRA<br>fishing tech = DTS<br>vessel_length = VL2440 | OTT, OTB, OTM<br>To note: no distinction between coastal and deep trawling, as no effort and catches for DWS target assemblage in FDI database |
| French netters < 06m | FR_DFN < <6m | fs_name => FRA MBS DFN0006 NGI A | country_code =FRA<br>fishing tech = DFN<br>vessel_length = VL0006 | GTR, GNS, "other" , GTN |
| French netters 06-12m | FR_DFN > 612m | fs_name => FRA MBS DFN0612 NGI A | country_code =FRA | GTR, GNS, "other" , GTN |

| **IAM Fleet segment names** | **Names in the report figures** | **Fleet segments in AER** | **Fishing techniques in FDI**<br>sub_region= GSA1, GSA5 , GSA6 and GSA7 | **"Metier" or gear explicitly modelled**<br>*(if there is not a category « other », it means that no other gears than the one listed are used by the fleet)*<br>***For each fleet, gears are listed by order of importance in terms of fishing days in 2022 (FDI)*** |
|---|---|---|---|---|
| | | | fishing tech = DFN<br>vessel_length = VL0612 | |
| French vessels using hooks < 06m | FR_HOK < 6 m | fs_name => FRA MBS HOK0006 NGI A | country_code =FRA<br>fishing tech = HOK<br>vessel_length = VL0006 | "other", LLS |
| French vessels using hooks 06-12m | FR_HOK < 612 m | fs_name => FRA MBS HOK0612 NGI A | country_code =FRA<br>fishing tech = HOK<br>vessel_length = VL0612 | "other", LLS, LLD, |
| French vessels using hooks 12-18m | FR_HOK > 1218 m | fs_name => FRA MBS DFN1218 NGI A *<br>cluster_name=> MBS DFN VL1218<br>*"DFN" in the name of the cluster, however in 2021 HOK make up the majority of this cluster)* | country_code =FRA<br>fishing tech = HOK<br>vessel_length = VL1218, VL1824, and VL2440 | LLD, "other" |
| Spanish trawlers < 12m | SP_DTS < 12m | fs_name => ESP MBS DTS0612 NGI | country_code =ESP<br>fishing tech = DTS<br>vessel_length = VL0006, and VL0612 | OTB, "other"<br>To note: no distinction between coastal and deep trawling, as no effort and catches for DWS target assemblage in FDI database |
| | | | country_code =ESP | OTB_DWS |

| **IAM Fleet segment names** | **Names in the report figures** | **Fleet segments in AER** | **Fishing techniques in FDI**<br>sub_region= GSA1, GSA5 , GSA6 and GSA7 | **"Metier" or gear explicitly modelled**<br>*(if there is not a category « other », it means that no other gears than the one listed are used by the fleet)*<br>***For each fleet, gears are listed by order of importance in terms of fishing days in 2022 (FDI)*** |
|---|---|---|---|---|
| Spanish trawlers 12-18m | SP_DTS 1218m | fs_name => ESP MBS DTS1218 NGI | fishing tech = DTS<br>vessel_length = VL1218<br>target_assemblage = DWS | |
| | | | fishing tech = DTS<br>vessel_length = VL1218<br>target_assemblage != DWS | OTB_other |
| Spanish trawlers 18-24m | SP_DTS 1824m | fs_name => ESP MBS DTS1824 NGI | country_code =ESP<br>fishing tech = DTS<br>vessel_length = VL1824<br>target_assemblage = DWS | OTB_DWS |
| | | | fishing tech = DTS<br>vessel_length = VL1824<br>target_assemblage != DWS | OTB_other |
| Spanish trawlers >=24m | SP_DTS >=24m | fs_name => ESP MBS DTS2440 NGI | country_code =ESP<br>fishing tech = DTS<br>vessel_length = VL2440<br>target_assemblage = DWS | OTB_DWS |
| | | | fishing tech = DTS<br>vessel_length = VL2440 | OTB_other |

| **IAM Fleet segment names** | **Names in the report figures** | **Fleet segments in AER** | **Fishing techniques in FDI**<br>sub_region= GSA1, GSA5 , GSA6 and GSA7 | **"Metier" or gear explicitly modelled**<br>*(if there is not a category « other », it means that no other gears than the one listed are used by the fleet)*<br>***For each fleet, gears are listed by order of importance in terms of fishing days in 2022 (FDI)*** |
|---|---|---|---|---|
| | | | target_assemblage != DWS | |
| Spanish netters 06-12m | SP_DFN 612m | fs_name => ESP MBS DFN0612 NGI | country_code =ESP<br>fishing tech = DFN<br>vessel_length = VL0612 | GTR, "other", GNS |
| Spanish netters 12-18m | SP_DFN 1218m | fs_name => ESP MBS DFN1218 NGI | country_code =ESP<br>fishing tech = DFN<br>vessel_length = VL1218 | GTR, "other", GNS |
| Spanish vessels using hooks 06-12m | SP_HOK 612 m | fs_name => ESP MBS HOK0612 NGI | country_code =ESP<br>fishing tech = HOK<br>vessel_length = VL0612 | LLS, "other", LLD |
| Spanish vessels using hooks 12-18m | SP_HOK 1218 m | fs_name => ESP MBS HOK1218 LLD *<br>cluster_name=> MBSHOKVL1218NGILLD | country_code =ESP<br>fishing tech = HOK<br>vessel_length = VL1218 | LLD, LLS, "other" |
| Spanish vessels using hooks 18-24m | SP_HOK 1824 m | fs_name => ESP MBS HOK1824 LLD *<br>cluster_name=> MBSHOKVL1824NGILLD | country_code =ESP<br>fishing tech = HOK<br>vessel_length = VL1824 | LLD |

On the basis of this segmentation, the FDI data (table A) have been used to represent the proportions of gears employed by each IAM fleet segment (Fig. 5.1.4.1). The fishing gear classification is the FAO classification, that can be consulted here: https://www.fao.org/cwp-on-fishery-statistics/handbook/capture-fisheries-statistics/fishing-gear-classification/en/. Figure

5.1.4.2 shows the proportion, in terms of landings in value, of the species of the plan per IAM fleet segment. We can thus deduct the economic dependency on the species of the plan for the different fleet segments in 2022. Figure 5.1.4.2 shows the proportion, in terms of 2022 landings in value, of the species of the plan for each IAM fleet segment.

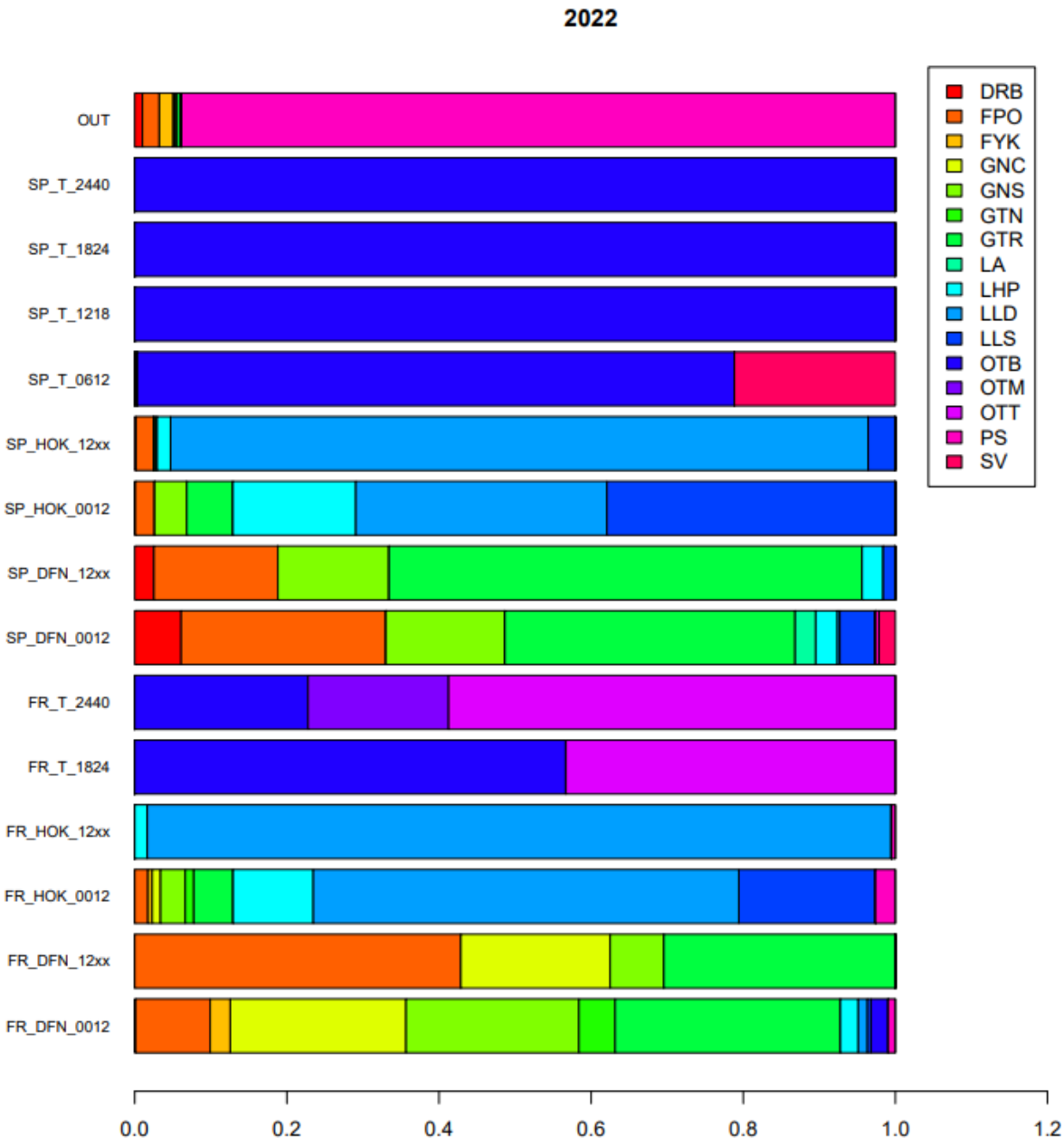



Figure 5.1.4.1. Proportion of gear usage (computed in terms of % of 2022 landings issued from each gear, source : FDI) among current IAM fleet segments (in row). The "OUT" segment cumulates all fleet segments left out. T is short for DTS and stands for demersal trawlers and/or demersal seiners, DFN for drift and/or fixed netters, and HOK for vessels using hooks. For the gear types, DRB stands for boat dredge, FPO for pots and traps, FYK for fyke nets, GNC for Encircling gillnets, GNS for Set gillnet, GTN for Combined gillnets-trammel nets, GTR for Trammel net, LA for Lampara nets, LHP for Hand and Pole lines, LLD for Drifting longlines, LLS for Set longlines, OTB for Bottom otter trawl, OTM for Midwater otter trawl, OTT for Multi-rig otter trawl, PS for Purse seine, SV for

Beach and boat seine, and NK and NO for unknown gear. Roughly, red to orange colors corresponds to dredges and traps (DRB – FPO – FYK), yellow to green corresponds to various gillnets (GNC – GNS - GTN – GTR), green to lightblue corresponds to longlines (LA -LHP – LLD – LLS), darkblue to purple corresponds to trawls (OTB – OTM – OTT), and purple/pink to red corresponds to seines (PS – SV).

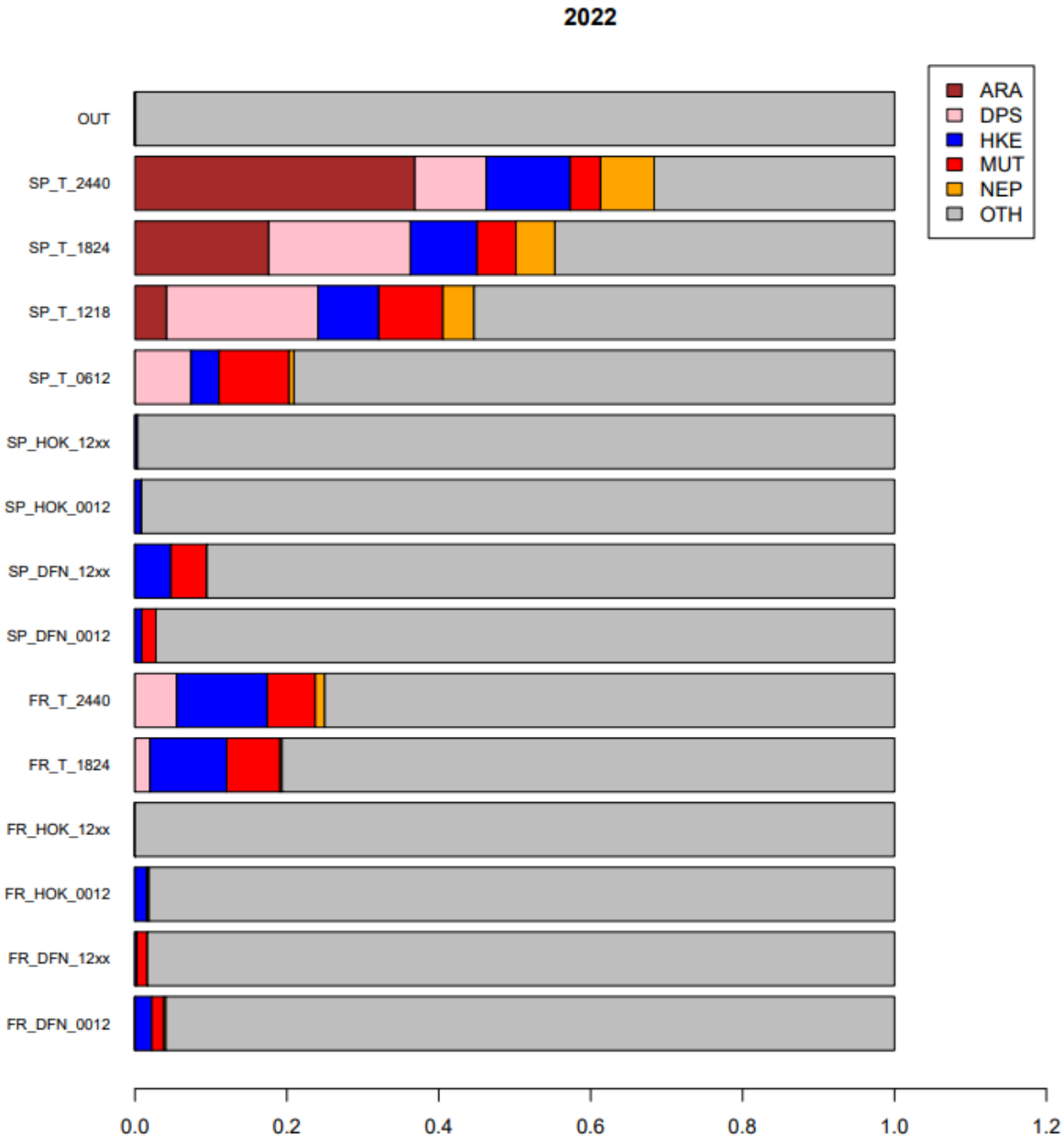



Figure 5.1.4.2. Proportion of species of the plan landed (landings in value) by IAM fleet segments (in row) based on 2022 FDI data. The "OUT" segment cumulates all fleet segments left out. T is short for DTS and stands for demersal trawlers and/or demersal seiners, DFN for drift and/or fixed netters, and HOK for vessels using hooks. The vessel length class 12xx means all vessels superior to 12 meters. Coloured space represents species targeted by the westmed management plan (ARA: Aristeus antennatus, DPS: Parapeneus longirostris, HKE: Merluccis merluccius, MUT: Mullus

barbatus, NEP: Nephrops norvegicus), and grey areas (OTH) represents all other species cumulated.

### 5.1.5 Economic indicators

Economic indicators are produced for the French and Spanish fleets. The latest year of available AER data (i.e. 2021) was used to parameterise the model. The economic indicators produced are revenue per fleet (gross value of landings), gross value added (GVA) per fleet and per vessel, gross profit per fleet and per vessel, Full time Equivalent (FTE) per fleet and per vessel, gross profit margin, current revenues on break-even revenues, etc.

Revenues, or hereafter referred to as gross value of landings (GVL), is based on estimates of landings multiplied by market prices. As landings are a function of the biomasses of the stocks modelled, a change in these biomasses will therefore affect landings and therefore fleet revenues. It is important to note that in this version of IAM, landings of "static" species are based on LPUEs that are assumed to be constant throughout the simulation. This is an important assumption, as it means that the sources of revenue from species that are not explicitly modelled in IAM depend solely on fishing effort. This means that if fishing effort decreases, this source of income decreases in proportion to the decrease in fishing effort. The model therefore does not take into account a potential positive effect of a decrease in fishing effort on the non-modelled species. Therefore, in scenarios where fishing effort is reduced and non-modelled stocks would increase, revenues (or GVL) would be underestimated.

Catches and landings are calculated as in equations (5.1.5.1) and (5.1.5.2):

$$C_{s,a,f,t} = \frac{F_{s,a,f,t}}{Z_{s,a,t}} * N_{s,a,t} * (1 - e^{-Z_{s,a,t}}) \qquad (5.1.5.1)$$

$$\text{with } Z_{s,a,t} = M_{s,a} + \sum_{f} F_{s,a,f,t}$$

$C_{s,a,f,t}$ stands for the catches in abundance at time $t$ of stock $s$ at age $a$ by fleet $f$; $N_{s,a,t}$ is the abundance of stock $s$ at age $a$ at time $t$, $F_{s,a,f,t}$ is the fishing mortality of stock $s$ at age $a$ at time $t$ coming from fleet $f$ (related to fishing effort of fleet $f$ at time t), and $M_{s,a}$ is the natural mortality of stock $s$ at age $a$.

The landings (in weight) of stock $s$ at age $a$ by fleet $f$ at time $t$ ($L_{s,a,f,t}$) is calculated from the catches, such as:

$$L_{s,a,f,t} = C_{s,a,f,t} * w_{s,a} - d_{s,a,f,t} \qquad (5.1.5.2)$$

with $w_{s,a}$ the weight at age $a$ of an individual of stock $s$ and $d_{s,a,f,t}$ the discards in weight of stock $s$ at age $a$ by fleet $f$ at time $t$.

For more details, see the IAM documentation, available here: https://ifremer-iam.github.io/IAM/.

Revenue by fleet corresponds to landings multiplied by market prices, such as in equation (5.1.5.3):

(5.1.5.3)

$$GVL_{f,t} = \sum_{s}\sum_{c} L_{s,c,f,t} p_{s,c,f} + \sum_{ss} LPUE_{ss,f} p_{ss,f} E_{f,t}$$

With $GVL_{f,t}$ the gross value of landings (or revenue) of fleet *f* at time *t*, $L_{s,c,f,t}$ the landings (in weight) of modelled stock *s* for commercial category *c* by fleet *f* at time *t*, $p_{s,c,f}$ the market price of stock *s* for commercial category *c* for fleet *f*, $LPUE_{ss,f}$ the landing per unit of effort of static species *ss* for fleet *f* (i.e. non explicitly modelled species, static species include all species caught by the fleet *f*), $p_{ss,f}$ the average market price of species *ss* for fleet *f*, and $E_{f,t}$ the fishing effort of fleet *f* at year *t*.

Landings per commercial category are estimated from landings per age-classes and using the commercial categories/ages matrices described in the EWG 20-13 report.

Calculation of the gross value added (GVA) by fleet for year *t* is described in equation (5.1.5.4):

$$GVA_{f,t} = GVL_{f,t} - \left(fuelv_f * fuelp_{f,t} + ovc_f\right)E_{f,t} - rep_f - Fixc_f \qquad (5.1.5.4)$$

Where $fuelv_f$ is the fuel consumption (in litre) by unit of effort of fleet *f*, $\boldsymbol{fuelp_{f,t}}$ the **fuel price** per litre (in €/l) for fleet *f* at time *t*, $ovc_f$ the other variable costs per unit of effort (including landing costs, oil, bait, gear, food and ice costs), $E_{f,t}$ the fishing effort of fleet *f* at time *t*, $rep_f$ the reparations and maintenance costs and $Fixc_f$ the other annual fixed costs of fleet *f* (including costs related to equipment, insurance and management costs).

Fishing effort is expressed in fishing days.

Gross profit is calculated and correspond to Gross Value Added (GVA) minus crew cost. Crew costs are estimated based on a percentage of the "what remains to be shared" (i.e. GVL less exploitation costs). As it was discussed in EWG 22-11 and 23-01, as with some simulations, some fleet segments can had a negative "what remains to be shared", Gross Profit estimates were not correct. Therefore, crew costs have been discussed extensively during EWG 23-01, and during this group. It was decided that by lack of information, crew cost was still estimated as a percentage of the "what remains to be shared", but with a minimum set at 0. A more realistic option could have been to set a minimum salary based on national minimum (e.g. estimate crew costs based on a minimum wage per FTE calculated from national minimum wages), but as said in EWG 22-11, it would have been possible only if French and Spanish minimum wages were provided prior to the group, which was not the case.

Crew cost by fleet *f* at year *t* ($ccw_{f,t}$) is estimated as follow:

$$ccw_{f,t} = cshr_f\left(GVL_{f,t} - \left(fuelv_f * fuelp_f + ovc_f\right)E_{f,t}\right) \qquad (5.1.5.5)$$

with $cshr_f$ the crew share by fleet.

In this application of IAM, by lack of other information, it is calculated based on AER last available, i.e. 2021 data, (EWG23-07); with $cshr_f$=Personnel costs $_f$/(Gross value of landings$_f$ -Other variable costs$_f$ -Energy costs$_f$).

The values of the estimated cshr are given by fleet in Table 5.1.5.1.

Table 5.1.5.1 Values of crew share by fleet ($cshr_f$) estimated from AER (EWG23-07) data, year 2021.

| **IAM Fleet segment names** | **Names in the figures and** | ***cshr*$_f$ (crew share by fleet), from AER data** |
|---|---|---|

| | **tables of the report** | |
|---|---|---|
| French demersal trawlers 18-24m | FR_DTS 1824m | 0,587 |
| French demersal trawlers 24-40m | FR_DTS >=24m | 0,617 |
| French netters < 06m | FR_DFN <6m | 0,582 |
| French netters 06-12m | FR_DFN 612m | 0,606 |
| French vessels using hooks < 06m | FR_HOK < 6 m | 0,566 |
| French vessels using hooks 06-12m | FR_HOK < 612 m | 0,703 |
| French vessels using hooks 12-18m | FR_HOK > 1218 m | 0,768 |
| Spanish trawlers < 12m | SP_DTS < 12m | 0,302 |
| Spanish trawlers 12-18m | SP_DTS 1218m | 0,443 |
| Spanish trawlers 18-24m | SP_DTS 1824m | 0,514 |
| Spanish trawlers >=24m | SP_DTS >=24m | 0,610 |
| Spanish netters 06-12m | SP_DFN 612m | 0,241 |
| Spanish netters 12-18m | SP_DFN 1218m | 0,339 |
| Spanish vessels using hooks 06-12m | SP_HOK 612 m | 0,286 |
| Spanish vessels using hooks 12-18m | SP_HOK 1218 m | 0,409 |
| Spanish vessels using hooks 18-24m | SP_HOK 1824 m | 0,553 |

Then Gross Profit by fleet *f* at time *t* ($GP_{f,t}$) is calculated as in equation (5.1.5.6):

$$GP_{f,t} = GVA_{f,t} - ccw_{f,t} \quad (5.1.5.6)$$

Gross Profit Margin per fleet segment ($GPmargin_f$) is calculated as in equation (5.1.5.7):

$$GPmargin_f = \frac{GP_f}{GVL_f} \quad (5.1.5.7)$$

As discussed during EWG 23-01, Full Time Equivalent (FTE) is used here as a proxy for employment. FTE is estimated using the same methodology than the one used in AER reports, meaning estimating an average FTE per day at sea by fleet and then multiplying this value with the total annual days at sea of the fleet. As IAM is parametrized using fishing days, instead of days at sea, as it was requested, estimates of FTE in IAM in EMU1 is described in equation (5.1.5.8):

(5.1.5.8)

$$FTE_{f,t} = \sum_{m} \frac{FTE_{ref,f,m}}{E_{ref,f,m}} * E_{f,m,t}$$

With $FTE_{f,t}$ the full time equivalent estimate of fleet *f* at time *t*, $FTE_{ref,\ f,m}$ the FTE of reference of metier *m* of fleet *f* (here FTE of the reference year 2022), $Eref_{,f,m}$ the total fishing effort of metier *m* of fleet *f* of reference year – 2022- (in fishing days), and $E_{f,m,t}$ the total fishing effort of metier *m* of fleet *f* at time *t.*

As discussed in EWG 23_01, current revenues on break-even revenues (CR/BER) is one of the most used indicator to know if profitability is enough to consider the economic activity sustainable along the time. The ratio of current revenues to break-even revenues (BER) measures the economic capacity of the fleet segment needed to continue fishing on a daily basis. Break-even revenues correspond to the revenues necessary to cover both fixed and variable costs, which are therefore neither such as to entail losses nor to generate profits. Current revenues are given by the total revenues deriving from landings.

Calculation of CR/BER as thus been implemented in IAM, and is calculated as described in equation (5.1.5.9):

$$\mathrm{CR/BER}_{f,t} = \frac{GVL_{\ f,t}}{BER_{f,t}} \qquad (5.1.5.9)$$

with $BER_{f,t} = \frac{GVL_{f,t}(Fixc_f + dep_f + ic_f)}{GVL_{f,t} - (ccw_{f,t} + (fuelv_f * fuelp_{f,t} + ovc_f)E_{f,t} + rep_f)}$

where $dep_f$ stands for the annual depreciation by fleet *f*, and $ic_f$ for the opportunity cost of capital of fleet *f*.

Regarding the engaged crew per vessel, it is assumed constant through the simulation and equal to the values of engaged crew per vessel and per fleet segment from the AER data (last year available used, i.e. 2021). Therefore the number of engaged crew for a fleet segment vary only if the number of vessels of the fleet segment vary.

### *5.1.6 Sources of data*

The source of the data used to parameterize the IAM model during EWG 23-11 are summarized in Table 5.1.6.1.

Table 5.1.6.1. Variables type, data source and year period used to parameterised and calibrate the IAM model during EWG 23-11.

| VARIABLES | DATA SOURCE | YEAR USED IN EWG2311 IAM MODEL |
|---|---|---|
| Biological parameters for dynamic stocks | EWG 23-09 | 2022 |
| Catches by species and fleet-metier segment | FDI (EWG23-10) | 2022 |
| Catch at age by gear | EWG 23-09 (from Med and Black Sea data) | 2022 |
| Effort by fleet-metier | FDI (EWG23-10) | 2022 |
| Number of vessels of Spanish trawlers | EWG 2311 ToR (same than FDI data for 2022) | 2022 and 2023 |
| Number of vessels of French trawlers | EWG 2311 ToR | 2022 and 2023 |
| Cost structures by fleet segment | AER (EWG 23-07) | 2021 (assumption : 2022 equal to 2021, except for fuel price) |
| Fuel prices by fleet segment (€/l) | Projections from AER | Projections values for 2022 and 2023 (assumption : 2024-2030 equal to 2023) |
| Prices by commercial categories for HKE1567 and MUT7 for French fleet segments | SIH, SACROIS, Ifremer | 2022 |
| Average prices by stock and fleet segments (for other stocks and Spanish fleets) | FDI (EWG23-10) | 2022 |

## 5.2 BEMTOOL in EMU 2

### 5.2.1 Recall on the main issues and conclusions from EWG 23-01

EWG 23-01 pointed out the lack for EMU2 of an updated stock assessment for red mullet in GSA 10 (reference year 2020) and of an analytical stock assessment for blue and red shrimp in GSAs 9-10-11 (currently under index advice). For both stocks the situation is not improved and, additionally, EWG 23-09 was able only to update the assessment to 2022 on the basis of the catch, being missing the MEDITS information for 2022.

During EWG 23-01 the harmonization of the socio-economic indicators provided by the different bio-economic models was discussed and a selection of indicators was commonly agreed to be provided by all the models. The most part of the selected indicators were already estimated by BEMTOOL, except the FTE and the gross profit margin. These two indicators have been implemented and estimated for EWG 23-11.

Finally, the linear dependence of FTE on the change in total fishing days by fleet segment, that was discussed and agreed during EWG 23-01, was also implemented for EWG 23-11 in order to estimate the wage/FTE.

### 5.2.2 Implementation progress in EWG 23-11

BEMTOOL bio-economic simulation model was implemented for EMU2, following the experiences gained in the previous EWGs. DCF data (FDI and MED&BS Data Call on landings, discards, fishing effort, biological and economic parameters) and results from the assessments carried out during the EWG 23-09 were analysed, to allow the parameterization of BEMTOOL during EWG 23-11. The model included the seven stocks covered by the Multiannual Management Plan (MAP) in the EMU2 (GSAs 9-10-11).

Red mullet in GSA 10 stock assessment was not updated to 2022, due to the lack of an analytical stock assessment, performed during STECF EWG, since 2021. Thus, the assessment carried out in EWG 21-09 with reference year 2020 was used.

As for EWG 22-11, ARA9-10-11, for which an analytical stock assessment was not carried out in EWG 22-09 and 23-09, was reconstructed in BEMTOOL through the calibration option using the MEDITS data until 2021 to extract a recruitment index by year and a total mortality by year (from catch curve method).

During the EWG 23-11 the model used in EWG 22-11 was utilised, taking into account the different types of fishing activity exerted by each fleet segment at metier level. Assessed fishing mortality, spawning stock biomass and the observed catches were compared with the simulated ones where possible, as made also in the previous EWGs.

### 5.2.3 Stocks

The stocks taken into consideration in BEMTOOL simulations are, as in the EWG 22-11:

- European hake in GSAs 9, 10 and 11 (HKE);
- Red mullet in GSA9 (MUT9);
- Red mullet in GSA10 (MUT10) (last year assessment);
- Deep-water rose shrimp in GSAs 9, 10 and 11 (DPS);
- Giant red shrimp in GSAs 9, 10 and 11 (ARS);
- Norway lobster in GSA9 (NEP9);

- Blue and red shrimp GSA9, 10 and 11 (ARA) (MEDITS data used to reconstruct the stock in BEMTOOL, being missing a quantitative assessment).

For the 7 stocks the decisions made during the EWG 22-09 on recruitment to be used for the reference points estimation and for the short term forecast have been followed for the scenarios. In particular, for all the stocks the same constant recruitment level of the short term forecasts carried out by EWG 23-09 was used for the projections, perturbing with a multiplicative lognormal error with mean 0 and sd 0.3, as in the previous meetings.

Table 5.2.3.1 reports the recruitment used for the different stocks in the scenarios.

Table 5.2.3.1 Recruitment used for the different stocks in the projections. The recruits are in thousands.

| Area | Species | Recruits from 2023 | Comments |
|---|---|---|---|
| 8-9-10-11 | Hake | 274418.375 | |
| 9 | Red Mullet | 279683 | |
| 10 | Red Mullet | 151186 | GM from last year |
| 8_9_10_11 | Deep-water rose shrimp | 3146558 | |
| 9 | Norway lobster | 37602 | |
| 8_9_10_11 | Red and blue shrimp | 22275 | GM from BEMTOOL (calibration) |
| 9_10_11 | Giant red shrimp | 534526 | |

The relevant results of the assessment for the model parameterization, i.e. the current fishing mortality ($F_{curr}$) and the reference point ($F_{0.1}$) are reported in the Table 5.2.3.2.

The upper and lower range of $F_{MSY}$ were also estimated according to the formulas used in EWG 23-09:

$F_{low} = 0.00296635 + 0.66021447 \times F_{0.1}$

$F_{upp} = 0.007801555 + 1.349401721 \times F_{0.1}$

where $F_{0.1}$ is a proxy of $F_{MSY}$.

and the needed reduction to reach $F_{0.1}$ for each stock.

Considering the ratio between the current fishing mortality and the reference point ($F_{curr}/F_{0.1}$), the stocks more at risk are European hake (HKE; ratio=2) and Giant red shrimp (ARS; ratio=1.63). Red mullet in GSA9, Norway lobster in GSA 9 and Deep-water rose shrimp 9-10-11 are sustainably exploited. In Table 5.2.3.3 are reported, when available the biomass reference points by stock.

5.2.3.2 Results of the assessments from EWG 23-09 relevant for BEMTOOL parameterization. The computation of the reduction by stock to reach F0.1 is also reported.

| Stock | Fcurrent | F0.1 | Change in F | Fupper | Flower |
|---|---|---|---|---|---|
| Hake 8-9-10-11 | 0.34 | 0.17 | -50% | 0.2372 | 0.115203 |
| Red mullet 9 | 0.41 | 0.5 | - | 0.6825 | 0.333074 |
| Red mullet 10 | NA | NA | NA | NA | NA |
| Deep-water rose shrimp9-10-11 | 1.08 | 1.26 | - | 1.708 | 0.8348 |
| Giant red shrimp 9-10-11 | 0.7 | 0.43 | -39% | 0.588 | 0.286859 |
| Nephrops 9 | 0.14 | 0.127 | - | 0.1792 | 0.086814 |
| Blue and red shrimp 9-10-11 | NA | NA | NA | NA | NA |

5.2.3.3 Biomass reference points considered in EWG 23-09.

| Stock | Blim | Bpa |
|---|---|---|
| **HKE91011** | 5132 | 10264 |
| **MUT10** | NA | NA |
| **MUT9** | 461.5 | 923 |
| **ARS91011** | 191 | 381 |
| **ARA91011** | NA | NA |
| **NEP9** | 232 | 463 |
| **DPS91011** | 213 | 427 |

The results of the stock assessment for the 7 considered stocks have been replicated in BEMTOOL, considering the effort by metier for each fleet segment. The comparison of F, SSB and Catch showed a good level of agreement between BEMTOOL and the stock assessment results, where present (Figure 5.2.3.2 and 5.2.3.3).

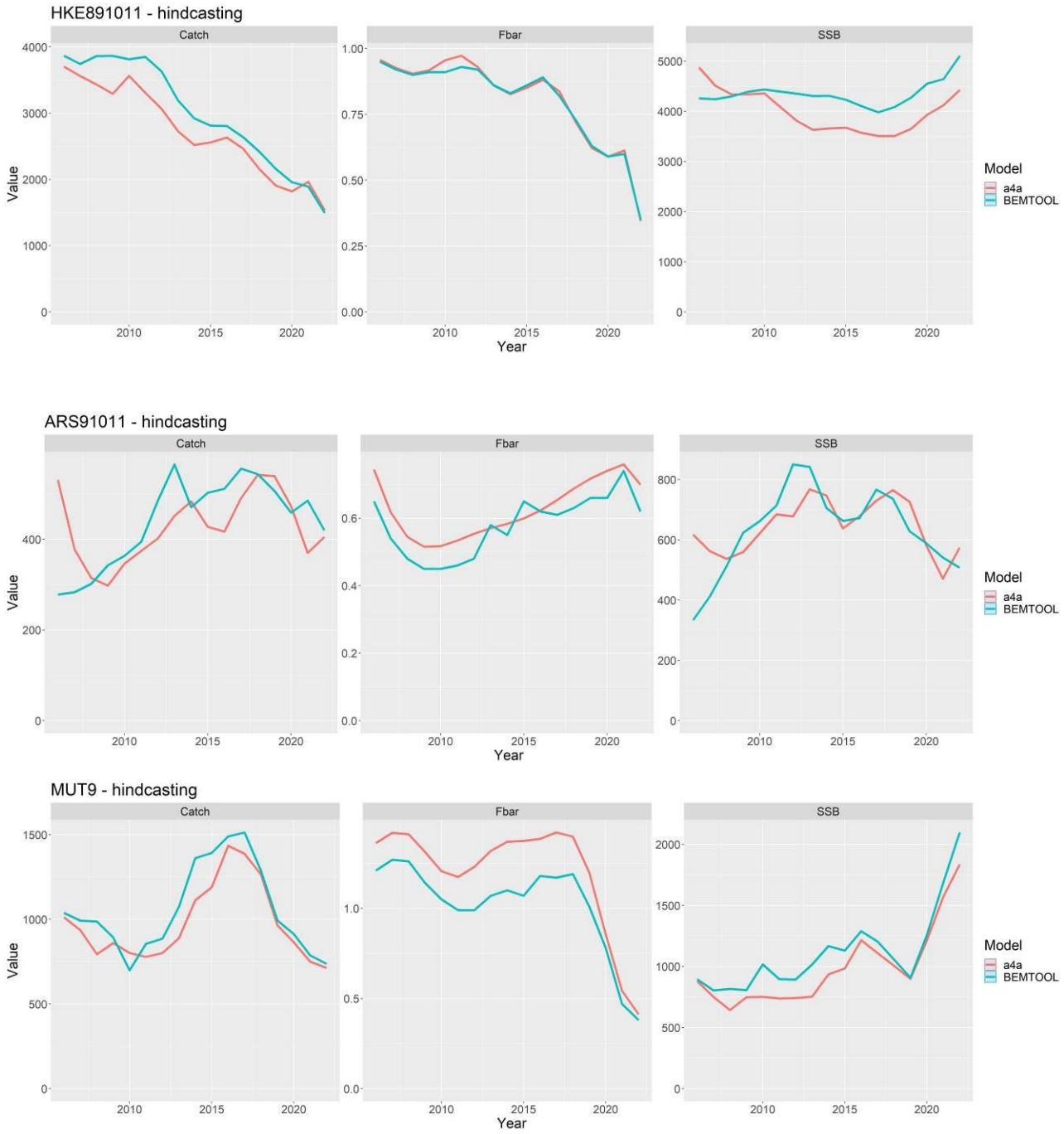



Figure 5.2.3.2 – Comparison between stock assessment results with 95% confidence interval (pink) and BEMTOOL estimates (blue dots) on F, SSB and Catch for HKE 8-9-10-11, ARS 9-10-11 and MUT9.

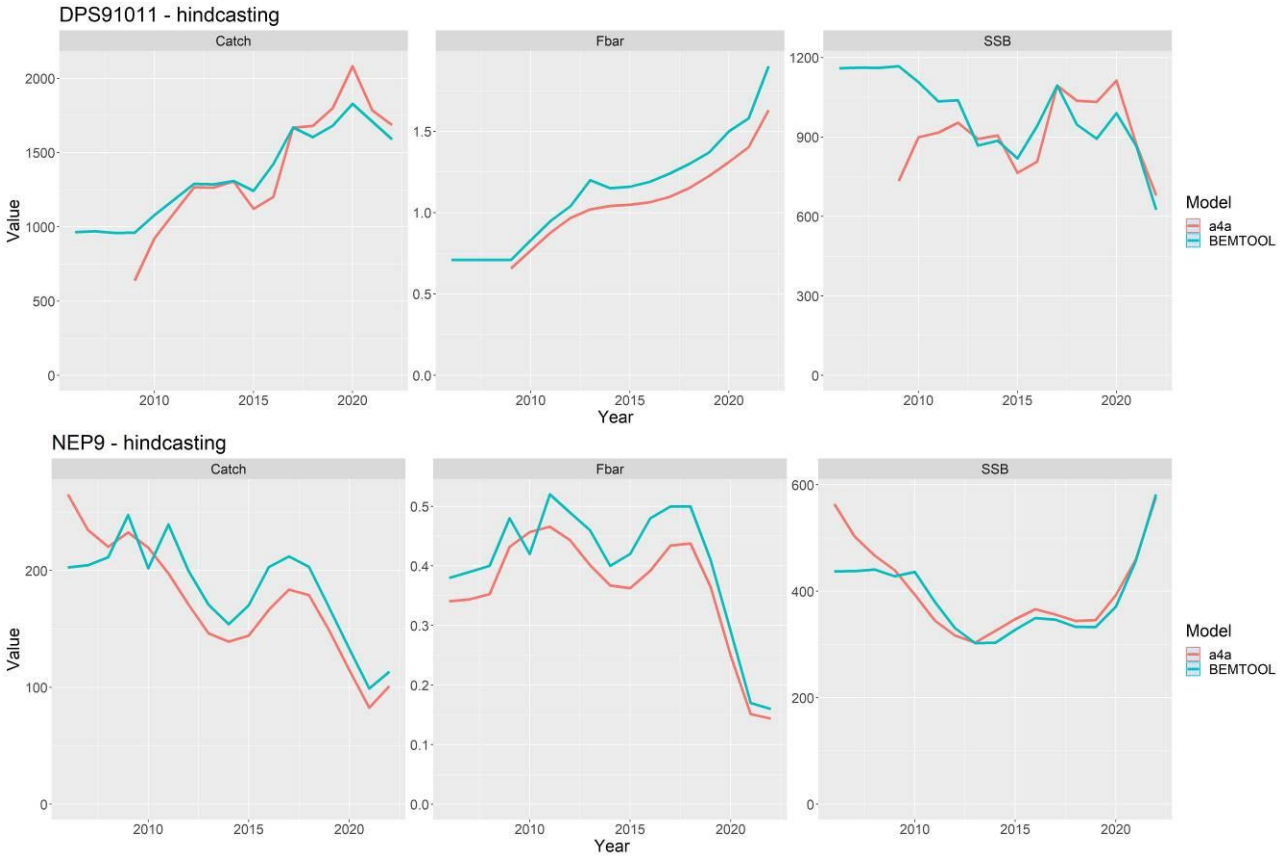



Figure 5.2.3.3 – Comparison between stock assessment results with 95% confidence interval (pink) and BEMTOOL estimates (blue dots) on F, SSB and Catch for NEP9, DPS 9-10-11.

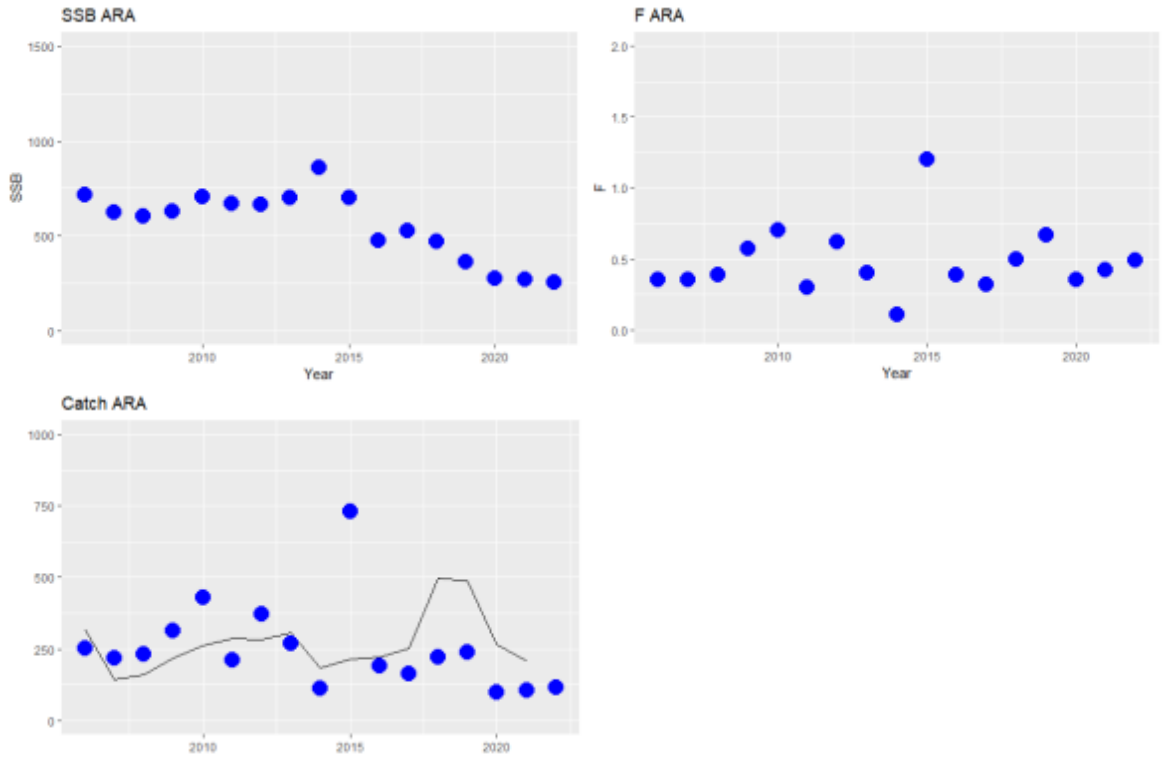



Figure 5.2.3.4– Comparison between observed landing (black line) and BEMTOOL estimates (blue dots) on for ARA 9-10-11. The F and SSB reconstructed by BEMTOOL are also reported.

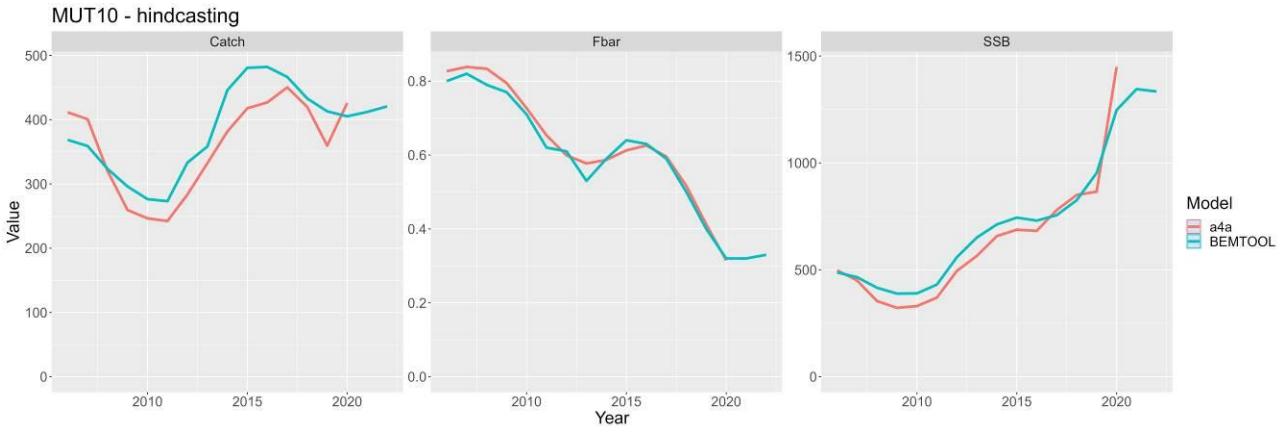



Figure 5.2.3.5– Comparison between stock assessment results with 95% confidence interval (pink) and BEMTOOL estimates (blue dots) on F, SSB and Catch for MUT10 (reference year 2020).

### 5.2.4 Fleets

In the simulation and forecast scenarios 18 fleet segments have been analysed. Trawlers have been disaggregated by fishing activity at metier level (OTB_DEF, OTB_DWS and OTB_MDD) as shown in table 5.2.4.1. FDI data from 2013 to 2022 were used for the revenues, number of vessels, the number of fishing days, GT and KW. STECF 18-07 EU Fleet Economic and Transversal data from 2008 to 2013 were used for the fishing effort by metier. All data include both active and passive demersal gears operated by fleet segments that rely on, and influence, some or all the stocks

included in the MAP. Six fleets are allocated to GSA9 and to GSA11 and seven fleets to GSA10, overall 12 fleets are trawlers and 6 fleets use passive gears.

The fuel costs, the other variable costs and the labour costs have been disaggregated at metier level following the methodology to disaggregate economic variables by activity developed in SECFISH project (MARE/2016/22- SI2.768889, https://datacollection.jrc.ec.europa.eu/docs/regional-grants) and described in Bitetto et al. (2022). This methodology allows to take into account the difference in the variable costs associated to the activity of each metier as well as the difference in the labour costs as depending on the revenues and, thus, indirectly by the metier. The methodology is divided into two steps: the first based on the individual vessel costs, effort and revenues data, to derive the relationships between costs and transversal variables; the second step is represented by the disaggregation of the costs times series through the relationships (step 1) and the transversal variables. For this application, the relationships related to the Italian fleet were used to derive the costs at metier level.

For 2023 the fishing effort was set equal to the fishing opportunities and the revenues were assumed changing depending on the number of total fishing days by fleet segment.

Socio-economic data on costs and employment at GSA level requested by the EWG to the Italian Ministry until 2021 (nominal values); all monetary values have been adjusted for inflation to 2020 constant prices, using the EUROSTAT harmonised index of consumer prices (HICP) as reported in table 4 of the annex of the 2022 Annual Economic Report on the EU Fishing Fleet (STECF 22-06).

The economic data from 2022 were estimated assuming:

1. Fuel costs linearly depending on the change in total fishing days and fuel price (projections from AER for Italy by fleet segment) by fleet segment and metier;
2. Other variable costs linearly depending on the change in total fishing days by fleet segment and metier;
3. Crew (employment) per vessel, fixed and capital costs linearly depending on change in number of vessels;
4. Labour costs estimated with the crew share ratio of 2021 on the estimated difference between total revenues and total variable costs;
5. FTE were assumed varying linearly on the total fishing days;
6. Fixed costs, maintenance costs and capital costs have been associated to the vessels and, thus, were assumed constant in the projections (equal to 2021).

Table 5.2.4.1–Combinations fleet segments-metier included in the BEMTOOL simulations and forecast scenarios by GSA, gear type, including demersal trawlers (DTS) and polyvalent passive gears (PGP), and vessel length (VL).

| GSA | Fleet segment | Metier |
|---|---|---|
| 10 | DTS_VL0612 | OTB_DEF |
| 10 | DTS_VL1218 | OTB_DEF and OTB_DWS/MDD |
| 10 | DTS_VL1824 | OTB_DEF and OTB_DWS/MDD |
| 10 | DTS_VL2440 | OTB_DEF and OTB_DWS/MDD |
| 10 | PGP_VL0012 | GNS-GTR-LLS |
| 10 | PGP_VL1218 | GNS-GTR-LLS |
| 11 | DTS_VL0612 | OTB_DEF |
| 11 | DTS_VL1218 | OTB_DEF and OTB_DWS/MDD |
| 11 | DTS_VL1824 | OTB_DEF and OTB_DWS/MDD |
| 11 | DTS_VL2440 | OTB_DEF and OTB_DWS/MDD |
| 11 | PGP_VL0012 | GNS-GTR-LLS |
| 11 | PGP_VL1218 | GNS-GTR-LLS |
| 9 | DTS_VL0612 | OTB_DEF |
| 9 | DTS_VL1218 | OTB_DEF and OTB_DWS/MDD |
| 9 | DTS_VL1824 | OTB_DEF and OTB_DWS/MDD |
| 9 | DTS_VL2440 | OTB_DEF and OTB_MDD |
| 9 | PGP_VL0012 | GNS-GTR-LLS |
| 9 | PGP_VL1218 | GNS-GTR-LLS |

### 5.2.5 Economic indicators

The common list of the socio-economic indicators agreed during EWG 23-01 was followed to provide the final outcomes of the simulations. The formulations of AER were used to estimate the indicators.

- Gross Value Added (GVA): Revenues-total var costs- repair costs-other fixed costs;
- Gross profit: Revenues-total var costs- repair costs-other fixed costs-labour costs;
- Gross profit margin: Gross profit/revenues;
- Employment: FTE;
- Employment: engaged crew;
- Average salary: Crew cost/FTE;
- CR/BER: Revenues/BER, where BER = (Fixed costs + opportunity costs of capital +depreciation) / (1-(crew costs + unpaid labour + energy costs + repair and maintenance costs + other variable costs)/Revenue).

The FTE was assumed linearly dependent on the total fishing days, while the engaged crew was assumed constant and equal to 2021.

## 5.3 ISIS-Fish in EMU 1

### 5.3.1 Recall on the main issues and conclusions from EWG 23-01

An ISIS-Fish application has been developed for the evaluation of the management measures in EMU1 on hake and fleets dynamics. It was the first time that it was used for the evaluation of scenarios. In previous EWG (23-01 & 22-01), an application limited to GSA7 was used to simulate the impact of several closures and maximum catch limits (STECF 22-01, STECF 23-01).

### 5.3.2 Implementation progress in EWG 23-11

ISIS-Fish is a spatially explit fishery dynamics simulation model (Mahevas et al. 2009). An ISIS-Fish application was first developped in the Gulf of Lion for EWG 21-13 and following groups (Leforestier et al. 2019). Following EWG 22-01, it was agreed to expand it to EMU1. The EMU1 model was developped in course of 2022 but not fully operationnal for EWG 23-01. It comprises GSA 1, 5, 6, and 7. It was first used during EWG 23-11. According to EWG 23-01 conclusions, a module was further developped in order to compute several economic indicators as output of ISIS-Fish simulations. The equations were borrowed from the IAM model and parameters estimated on both FDI (prices, value of non modeled stocks) and AER data.

The model was conditionned on 2020 and 2022 data and calibrated on catches at age per country in 2022.

### 5.3.3 Stocks

The EMU1 ISIS-Fish model only describes hake stock. The population dynamics model is similar to the assessment model with regard to population age structure and maturity assumption. It uses VBGF growth function from Mellon et al. 2008 and length-weight relationship (STECF 21-11). Recruitment is forced to assessment results for the hindcasted period then equal to 2018-2022 average in projection. It enters the fishery at age 0, progressively along the years as defined in previous work (Q1: 16%, Q2: 42%, Q3: 33%, Q4: 9%) (Leforestier et al. 2019). Based on the estimations of population spatial distribution (EWG 22-01, updated in 2023), population zones have been defined for juveniles (<29cm or December age 1) and adults and the variability of the density was assessed and characterised. The method relied on a clustering with continuity constraints of spatial cells applied simultaneously on all year x month maps. It resulted in a grouping of cells into clusters (per stage) that share similar density and are close by. Cluster were relatively stable in time leading to the definition of populations zones (habitats) per stage with constant boundaries, each cell belonged to the cluster to which it was the most frequently assigned by the clustering (Annex). The variations of fish biomass within each population zone were analysed to evidenced i) the share of population between French and Spanish coast, ii) the inter-annual variability of biomass per zone and iii) the seasonal variability of biomass per zone.

The other stocks caught by the fleets are not explicitly modelled. To account for the effect of the management plan on the revenues generated by these species, values per unit of effort (VPUE) of the species other than hake were computed based on 2022 FDI data at the scale of the country, gear, gsa, vessel length and target assemblage (DEF/DWS). They were used to estimate the revenues associated to other species in the different scenarios accounting for changes in effort levels. It assumes that these species biomass and catchability remains constant during the time of the simulation. An implementation that uses VPUEs disagregated in space is under development but requires fine scale data of effort and landings available through VMS and logbooks.

### 5.3.4 Fleets

The EMU1 model comprises GSA 1, 5, 6, and 7. It is spatially explicit and therefore the FDI segmentation is further refined to consider home harbour and strategy (main métiers) of the vessel

and to account for fishing zones. Trawler fleets are defined by main gear, vessel length and home region (6 regions in France, 9 in Spain). Two strategies were distinguished for Spanish trawlers, namely « nearshore » gathering vessels operating close to coast, practicing métiers TB_DEF and OTB_MDD ; and « offshore » for the boats that also practice métier OTB_DWS. Netters and long-liners fleets are more roughly defined, by main gear and GSA. According to this segmentation ISIS-Fish comprises 51 fleets and 71 strategies. Results are however reported at the scale of regulatory segments when possible, by country, main geat and length class otherwise.

For each trawler fleet, fishing zones for the main métiers (%of hake or red mullet above a threshold), have been identified and a core zone (where most of the effort concentrates) was distinguished from a secondary zone using clustering with continuity constraints. For netters and long-liners fleet, fishing zones were roughly defined along the coast of each GSA according to expert knowledge.

Two of the catchability coefficients, gear and fleet efficiency, were estimated outside the model by fitting a glm to CPUE computed on FDI data. Selectivity is approximated by a catch curve fitted on catch at length data per gear made available during EWG 22-11.

The EMU1-ISIS-Fish model used for EWG 23-11 is parameterised based on a diversity of data sources : FDI data provide total fishing effort (fishing days) and number of vessels per fleet segment. Logbook and VMS data inform on how to further distribute trawler fishing effort among fleets (FDI cluster x home harbour x strategy (nearshore/offshore)). The model was conditionned using 2020 VMS-logbook data during EWG 23-01.

2020-2022 FDI data were available to condition the model for EWG23-11. VMS-Logbooks were made available for the French fleets (2015-2022) and the Spanish fleets (2018-2021) during EWG 23-01. Because of a lack of time and incompatibilities between earlier and later data format, the VMS-logbook data could not be exploited in the timeframe of EWG 23-11. Total effort by FDI segment is informed by 2022 FDI data, however the spatial spread is according to 2020 VMS-logbook data.

Table 5.3.4.1: List of fleets and fishing strategies considered in ISIS-Fish with the corresponding regulatory segment. « VL » stands for vessel length. Vessels are organised by home harbor indicated by a harbour code in the fleet and strategy names (ex. esTAR for Spanish fleets, frXST for French fleets). Spanish fleets are further stratified by strategies namely "nearshore" for exclusive coastal vessels and "offshore" for those practicing a mix of OTB_DEF and OTB_DWS.

| **country** | **length** | **segment** | **fleetISIS** | **strategy** |
|---|---|---|---|---|
| ESP | VL0612 | ESP_DEF_VL0612 | esBAR_VL0612 | esBAR_VL0612 @ nearshore |
| | | | esLEI_VL0612 | esLEI_VL0612 @ nearshore |
| | | | esRSA_VL0612 | esRSA_VL0612 @ nearshore |
| | | | esTAR_VL0612 | esTAR_VL0612 @ nearshore |
| | | | esVMG_VL0612 | esVMG_VL0612 @ nearshore |

| | | | | |
|---|---|---|---|---|
| | VL1218 | ESP_DEF_VL1218 | esBAR_VL1218 | esBAR_VL1218 @ nearshore |
| | | | esGAR_VL1218 | esGAR_VL1218 @ nearshore |
| | | | esLEI_VL1218 | esLEI_VL1218 @ nearshore |
| | | | esPMI_VL1218 | esPMI_VL1218 @ nearshore |
| | | | esRSA_VL1218 | esRSA_VL1218 @ nearshore |
| | | | esSCR_VL1218 | esSCR_VL1218 @ nearshore |
| | | | esSPO_VL1218 | esSPO_VL1218 @ nearshore |
| | | | esTAR_VL1218 | esTAR_VL1218 @ nearshore |
| | | | esVMG_VL1218 | esVMG_VL1218 @ nearshore |
| | VL1824 | ESP_DEF_VL1824 | esBAR_VL1824 | esBAR_VL1824 @ nearshore |
| | | | esGAR_VL1824 | esGAR_VL1824 @ nearshore |
| | | | esLEI_VL1824 | esLEI_VL1824 @ nearshore |
| | | | esPMI_VL1824 | esPMI_VL1824 @ nearshore |
| | | | esRSA_VL1824 | esRSA_VL1824 @ nearshore |
| | | | esSCR_VL1824 | esSCR_VL1824 @ nearshore |
| | | | esSPO_VL1824 | esSPO_VL1824 @ nearshore |
| | | | esTAR_VL1824 | esTAR_VL1824 @ nearshore |

| | | | | |
|---|---|---|---|---|
| | | | esVMG_VL1824 | esVMG_VL1824 @ nearshore |
| | VL2440 | ESP_DEF_VL2440 | esBAR_VL2440 | esBAR_VL2440 @ nearshore |
| | | | esRSA_VL2440 | esRSA_VL2440 @ nearshore |
| | | | esSCR_VL2440 | esSCR_VL2440 @ nearshore |
| | | | esSPO_VL2440 | esSPO_VL2440 @ nearshore |
| | | | esTAR_VL2440 | esTAR_VL2440 @ nearshore |
| | | | esVMG_VL2440 | esVMG_VL2440 @ nearshore |
| | VL1218 | ESP_DWS_VL1218 | esBAR_VL1218 | esBAR_VL1218 @ offshore |
| | | | esGAR_VL1218 | esGAR_VL1218 @ offshore |
| | | | esPMI_VL1218 | esPMI_VL1218 @ offshore |
| | | | esRSA_VL1218 | esRSA_VL1218 @ offshore |
| | | | esSCR_VL1218 | esSCR_VL1218 @ offshore |
| | | | esVMG_VL1218 | esVMG_VL1218 @ offshore |
| | VL1824 | ESP_DWS_VL1824 | esBAR_VL1824 | esBAR_VL1824 @ offshore |
| | | | esGAR_VL1824 | esGAR_VL1824 @ offshore |
| | | | esLEI_VL1824 | esLEI_VL1824 @ offshore |
| | | | esPMI_VL1824 | esPMI_VL1824 @ offshore |
| | | | esRSA_VL1824 | esRSA_VL1824 @ offshore |
| | | | esSCR_VL1824 | esSCR_VL1824 @ offshore |
| | | | esSPO_VL1824 | esSPO_VL1824 @ offshore |
| | | | esTAR_VL1824 | esTAR_VL1824 @ offshore |
| | | | esVMG_VL1824 | esVMG_VL1824 @ offshore |

| | | | | |
|---|---|---|---|---|
| | | | esBAR_VL2440 | esBAR_VL2440 @ offshore |
| | | | esGAR_VL2440 | esGAR_VL2440 @ offshore |
| | | | esLEI_VL2440 | esLEI_VL2440 @ offshore |
| | | | esPMI_VL2440 | esPMI_VL2440 @ offshore |
| | | | esRSA_VL2440 | esRSA_VL2440 @ offshore |
| | | | esSCR_VL2440 | esSCR_VL2440 @ offshore |
| | | | esSPO_VL2440 | esSPO_VL2440 @ offshore |
| | VL2440 | ESP_DWS_VL2440 | esTAR_VL2440 | esTAR_VL2440 @ offshore |
| | | | GNS_ESP_GSA1 | GNS_ESP_GSA1 |
| | | | GNS_ESP_GSA5 | GNS_ESP_GSA5 |
| | all | ESP_GNS_all | GNS_ESP_GSA6 | GNS_ESP_GSA6 |
| | | | LLS_ESP_GSA1 | LLS_ESP_GSA1 |
| | | | LLS_ESP_GSA5 | LLS_ESP_GSA5 |
| | | | LLS_ESP_GSA6 | LLS_ESP_GSA6 |
| | all | ESP_LLS_all | LLS_ESP_GSA7 | LLS_ESP_GSA7 |
| | | | frCMT_VL1824 | frCMT_VL1824 |
| | | | frCST_VL1824 | frCST_VL1824 |
| | | | frGPV_VL1824 | frGPV_VL1824 |
| | | | frGST_VL1824 | frGST_VL1824 |
| | | | frXMA_VL1824 | frXMA_VL1824 |
| | VL1824 | | frXST_VL1824 | frXST_VL1824 |
| | | | frCMT_VL2440 | frCMT_VL2440 |
| | | | frCST_VL2440 | frCST_VL2440 |
| | | | frGPV_VL2440 | frGPV_VL2440 |
| FRA | VL2440 | FRA_DEF_VL1824 | frGST_VL2440 | frGST_VL2440 |

| | | | | |
|---|---|---|---|---|
| | | | frXST_VL2440 | frXST_VL2440 |
| | all | FRA_GNS_all | GNS_FRA | GNS_FRA |

### 5.3.5 Economic indicators

Economic indicators were computed based on ISIS-Fish outputs: effort, landings of hake and landed values of other species. The equations were borrowed from the IAM model and recalled in EWG 23-01 report. The parameters are differentiated by fleet segments. Most were estimated from 2022 AER data at the scale of the country, length, fishing technic and main gear. Values in projection are assumed equal to 2021 values, except for fuel price. Crew share are assumed constant equal to 2021 values per segment. AER fuel price estimates in 2022 are used in 2022, and AER projections for fuel price in 2023 are used in 2023 and onwards.

Hake prices at age for the French trawlers are derived from national data (sacrois, SIH, 2022) by converting prices per commercial categories into prices at age using an age-commercial category key. Hake prices for the other fleets are not differentiated by age and were computed using FDI data, for 2021, at the scale of the country, sub_region, vessel length, fishing tech, and gear type. Since only hake is explicitly modelled in ISIS-Fish, revenues from other species needed to be approximated as a function of effort by fleet and value per unit of effort computed on FDI data for 2021.

## 5.4 SMART in EMU 2

During the EWG 23-11, the input data sets were updated to incorporate the historical time-series from 1 January 2012, to 31 June 2022. The R package "smartR" (D'andrea et al., 2020) was employed to configure the SMART model and suit it to the requirements of the EMU2 case study. The SMART model, as well as the workflow of the smartR package, can be summarized in the following logical steps:

1. Use landings and catch data, combined with VMS data, to estimate the spatial/temporal productivity of each cell, in terms of aggregated LPUE by species;
2. Use survey data to estimate the Length-Frequency Distribution (LFD) and the Age-Frequency Distribution (AFD), by species, for each cell/time;
3. Use VMS data to assess the fishing effort by vessel/cell/time;
4. Combine LPUE, LFD/AFD, and VMS data to model the landings by vessel/species/length class/time;
5. Estimate the cost by vessel/time associated with a given effort pattern and the related revenues, which are a function of the landings by vessel/species/length class/time;
6. Combine costs and revenues by vessel, at the yearly scale, to obtain the incomes, which are the proxy of the vessel performance. Incomes could be aggregated at the fleet level to estimate the overall performance;
7. Use estimated landings by species/age, together with survey data, to run MICE model for the selected case of study in order to obtain a biological evaluation of the fisheries.

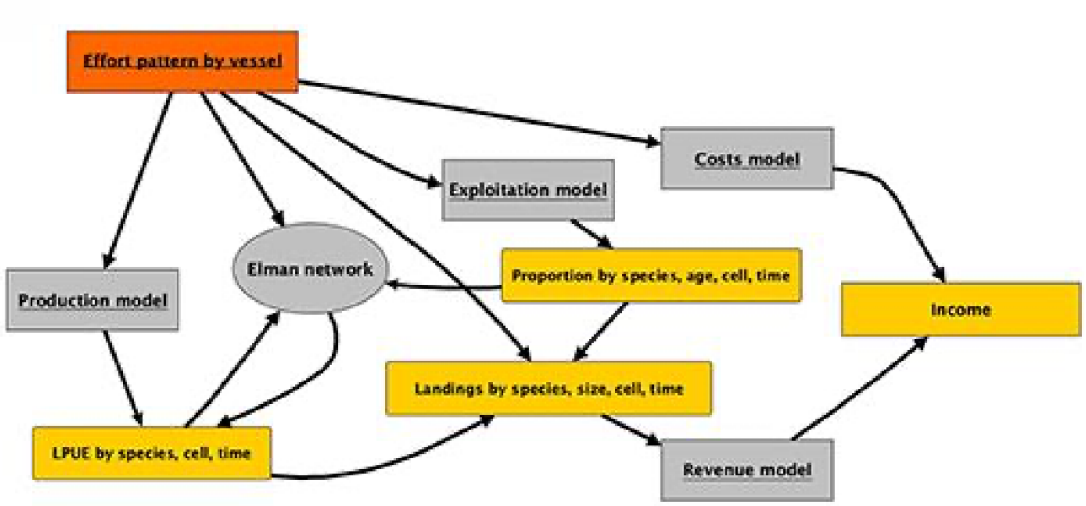



Figure 5.4.1 – Workflow of the Individual-Based Model used to optimize the effort pattern of each vessel

This workflow allows SMART to simulate the potential adaptation of fishers, in terms of fishing effort displacement in space and time, to different management measures including fisheries-restricted areas and temporal stops of the fishing activity. Given that a new fishing effort pattern corresponds to new catches and related revenues, cost and, ultimately, profits, SMART forecasts the biological and economic consequences of different management scenarios. Therefore, in SMART, the effort displacement resulting from the scenario simulation is obtained according to an individual based

optimization of the observed pattern of effort of each fishing vessel following a strategy of profit maximization (Fig. 5.4.1).

In essence, for each individual fishing unit, SMART tries to predict the new activity pattern (fishing effort per cell/time) based on the profit analysis (defined by the combination of revenues and costs) associated with each possible new effort pattern. Effort patterns are generated for each vessel using a Bayesian approach. The spatial productivity (monthly LPUE as grams of catch per meter of LOA and hour of fishing) was estimated using logbooks, landings and VMS data, according to the procedure of Russo et al., 2018 and Russo et al., 2019. After the estimation of the monthly LPUE by species, and the "historical" behaviour of each vessel (proportion of its effort for each cell of the spatial grid), SMART allows to predict the vessel-specific adaptation to different management scenarios, including the establishment of spatial closures, using a Bayesian approach. In practice, while the effort in closed areas (cells of the grid) is forbidden, a new effort patter is identified through the optimization of the total monthly profits. Monthly profits are, in turn, determined by the combination of effort and LPUE (by species), which gives the revenues, minus the cell-specific costs, which are mainly represented by fuel consumption. This optimization procedure is applied several times (e.g. 100 runs), in order to avoid local *maxima*. At the end of this procedure, the new effort pattern of the different vessels is aggregated to obtain the new exploitation pattern (monthly landings by species).

### 5.4.1 Recall on the main issues and conclusions from EWG 23-01

During the EWG 23-01, SMART was applied to estimate the potential benefits of different spatial and/or temporal based scenarios including Base Closures, Winter Ban by GSA, and MEDISEH-based spatial closures, together with some Effort-based scenarios. The results indicated that some of these options are promising but none of them is expect to allow reaching the desired targets in terms of reduction of catch for the juveniles of HKE and sustainability of the exploitation for all the stocks in the MAP.

In EMU2, the implementation of the SMART model for GSAs 9, 10 and 11 carried out during the STECF meeting is still in development. As noticed by the STECF, SMART has only a very limited economic module and, although in SMART we do not need to assume stability of economic parameters (fuel price, salaries, prices at market of the different species), the model is not devised to predict/optimize these parameters or explicitly address socio-economic consequences of the different management scenarios. Another limitation of SMART is that, lacking the ability to update spatial LPUEs based on stock fluctuations, it is not a useful model for predicting the long-term economic performance of fleets. To better illustrate this, consider the case of the deep-sea shrimps fishery (ARA and ARS): the application of SMART allows the reconstruction of spatial and monthly LPUEs related to the observed condition of the stocks. If, however, following the application of management measures (e.g. TACs), the state of the stocks improves, SMART is currently unable to predict any increase in catch due to stock recovery. On the contrary, SMART can be useful for estimating the 'cost' of measures at the entry into force of management measures.

### 5.4.2 Implementation progress in EWG 23-11

The scenarios simulated during EWG 23-11 were, conceptually, very different from those analysed in previous editions of the same working group. Indeed, although some features of the new scenarios (such as the presence of TACs on ARS and ARS catches or fishing effort) had already been modelled in previous SMART applications, the introduction of a very strong constraint such as fishing mortality (Post 2025 effort management column in all scenarios) posed a considerable challenge in applying the model. As outlined above, the rationale of SMART is to simulate the potential effects (in terms of new potential fishing footprint and corresponding catches/economic

performance of the fleets) of certain management measures such as: 1) the closure of certain areas; 2) the temporal cessation of activities; 3) the introduction of catch and/or effort quotas; 4) changes in fishing capacity. The new pattern of fishing effort in space and time (as predicted by the first module of SMART, which identifies it by optimizing profits using the Markov Chain-based Monte Carlo method - MCMC), determines the new vectors of fishing mortality for the various stocks. These vectors are then used, in the second module of SMART, to estimate the short to medium to long term effects of the new effort pattern. It is therefore evident that, in the case of the EWG23-11 scenarios, it was necessary to adapt this procedure to the fishing mortality constraint specified in the columns "Trawler effort reduction in 2022" (for the Status quo, A, and L scenarios) and "Post 2025 effort management" in all scenarios. This adaptation was done in the following way: for each of the scenarios, and after introducing all spatial, temporal, and TAC and selectivity constraints, the SMART optimizer was used to generate new potential fishing effort patterns that were then evaluated against two criteria at each step of the optimization process:

1. an improvement in economic performance (in essence profits), exactly as in the classical application of this module;
2. the consistency of the simulated scenario with the constraints of the aforementioned columns in terms of fishing mortality corresponding to the new pattern

Therefore, for each iteration of the optimization process, new "candidate" patterns were accepted only if they met both these criteria. Considering that the MCMC process "drives" in a semi-random manner each simulation carried out of the same scenario, and that many space/time configurations of the fishing effort can correspond to the same mortality values for the different stocks, they were carried out, for each of the EWG scenarios, 3 optimization runs. This value (3) has been identified as a minimum number to satisfy the need to have the results for all scenarios in a reasonable time, but in the future, it would be important to significantly expand this value.

### 5.4.3 Stocks

The model developed for the previous EWG has been updated in order to better represent the array of species exploited by trawlers in the EMU2. Namely, monthly LPUE were computed for the species in Table 5.4.3.1.

The mice model applied to predict the effect of this new exploitation pattern is represented in Fig. 5.4.3.1. It is important to notice that, while all the 12 species listed above were considered in the optimization phase, only the stocks in the MAP were considered. The stock objects of the EWG 23-11, for the species in MAP, were integrated and processed using the Elman network described in Russo et al., 2014. Actually, the Elman network was fed with the time series of catches in number of individuals by age class, SSB by year, and abundance at sea in number of individuals by age class and trained by species in order to fit the historical time series. Then, the trained Elman networks were used to predict the future trends of SSB and abundance at sea in number of individuals by age class using the new pattern of catch, as obtained after the estimation of fishing effort adaptation/displacement.

Table 5.4.3.1 Species considered within the model.

| Species | FAO 3-alpha code |
|---|---|
| ***Aristeus antennatus*** | **ARA** |
| ***Aristaeomorpha foliacea*** | **ARS** |
| ***Sepia officinalis*** | **CTC** |
| ***Parapenaeus longirostris*** | **DPS** |
| ***Eledone cirrhosa*** | **EOI** |
| ***Eledone moschata*** | **EDT** |
| ***Merluccius merluccius*** | **HKE** |
| ***Mullus surmuletus*** | **MUR** |
| ***Mullus barbatus*** | **MUT** |
| ***Nephrops norvegicus*** | **NEP** |
| ***Octopus vulgaris*** | **OCC** |
| ***Illex coindetii*** | **SQM** |
| ***Lophius piscatorius*** | **MON** |
| ***Squilla mantis*** | **MTS** |
| ***Boops boops*** | **BOG** |
| ***Trachurus trachurus*** | **HOM** |

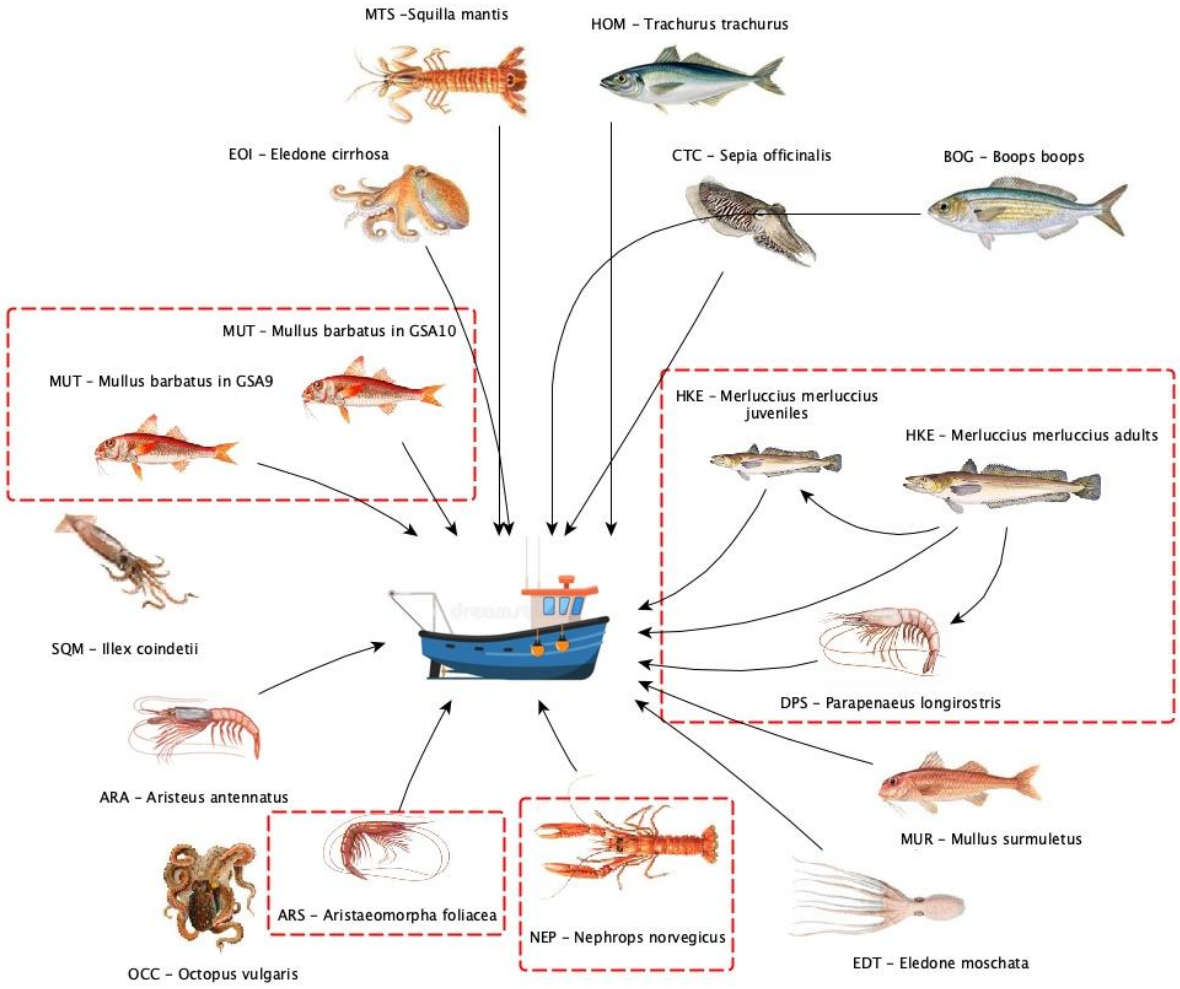



Figure 5.4.3.1 Representation of the trawl fishery model for EMU2. All species represented were considered in terms of contribution to the landings (and so the strategy adopted by fishers in selecting the fishing grounds), but the effects of the different scenarios were explored only for the ones within red-dashed boxes.

### 5.4.4 Space and time scale

The resolution of the square grid for the GSAs 9, 10, and 11 is the same as the EWG 19-14 with cells of 6 x 6 nm for this application of SMART to the case study of Western Mediterranean Effort Management Unit 2 (Figure 5.4.4.1). To make the simulations simpler and take less time to run, the cells covering the area below 800 meters of depth were omitted.

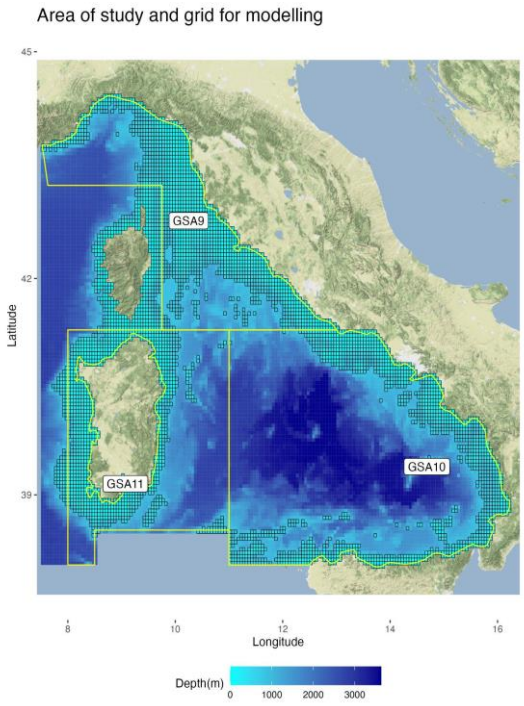



Figure 5.4.4.1 – Area of the EMU 2 case study considered in the Western Mediterranean EWG 23 11. The square grid of 6 x 6 nm used for the definition of the SMART model for the Italian GSAs in the Tyrrhenian Sea (9 – 10 - 11).

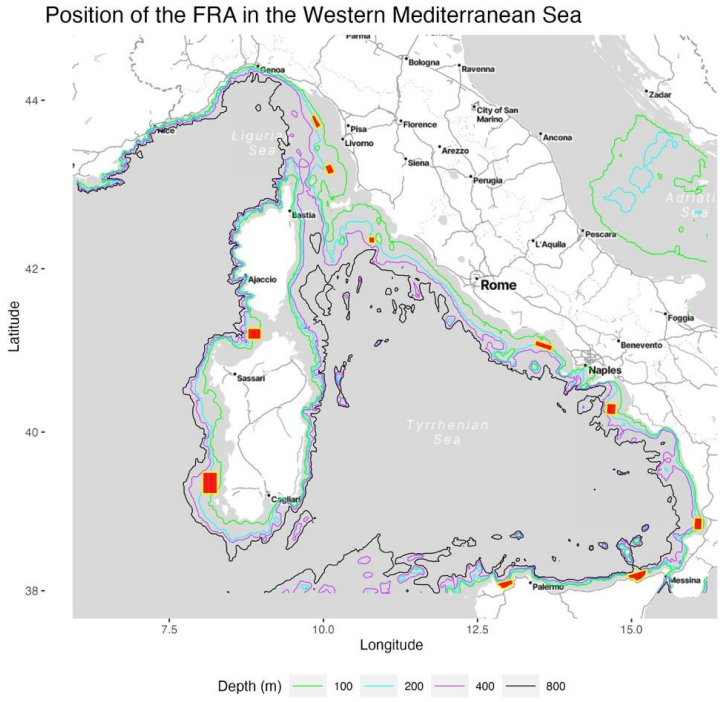



Figure 5.4.4.2 – Distribution of the closed area (red polygons) established by Italy in the EMU2

Following the work done in EWG 23-01, all space closures defined by Italy in EMU2 were considered as permanent (Figure 5.4.4.2)

### 5.4.5 References

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# 6 MANAGEMENT SCENARIOS AND RESULTS (TOR 4)

## 6.1 IAM in EMU 1

### 6.1.1 Management scenarios considered

The scenarios that were tested are based on table of scenarios from the TORs. The scenarios applied in IAM simulations are summarized in Table 6.1.1.1. Because the IAM model is not explicitly spatialized and is an annual-based model, scenarios related to spatial closures and weeks closure could not be implemented during this group. Due to time constraints, only the scenarios flagged "to do in priority", i.e. in grey in the ToR were simulated. It concerns scenarios Status Quo, scenario A, scenario D and scenario L.

For each scenario, the models are run with the management measures adopted at EU and national level in 2022 (and before), which include both effort and catch management measures; and this is reflected in the 2022 catch and fishing effort used to parameterise the model (FDI and AER).

For trawlers a succession of effort reduction were applied from 2020 to 2022: 10% reduction of effort applied in 2020, 7,5% reduction of effort applied in Spain and France in 2021, 6% reduction of effort applied in 2022, except for French and Spanish vessels active in GSA 7 in France where the reduction is of 4% from the compensation mechanism, and, in 2023, 3,5% for 90% of the fleet from France and Spain from the compensation mechanism (and 7% for the 10% left).

As in previous EWGs, the percentages of reduction of trawlers effort given in the scenarios are calculated in reference to the baseline period 2015-2017 (i.e. average value of FDI fishing effort by fleet between 2015 and 2017).

IAM simulations start in 2022, with the 2022 FDI fishing efforts and number of vessels.

For the year 2023, the IAM model initially implemented the compensation mechanisms for 90% of the trawler fleets as requested in the ToRs, but it was decided during EWG 23-11 week that for comparison purposes with the ISIS-Fish model results, the 90/10% distinction should not be made, but that we should model 100% of the fleet with compensation mechanisms in 2023. The fishing efforts by fleet segments in 2023, estimated from those compensation mechanisms are displayed when the scenarios are described in details Table 6.1.1.1.

Fishing mortalities coming from the non-modelled fleets are estimated constant (and based on 2022 values). As shown in figure 5.1.4.2, catches of the species of the plan by those non-modelled fleets is almost null, therefore they do not have an impact on the species of the plan.

As discussed and decided during the EWG 22-11 group, when a reduction in fishing effort of a gear within a fleet segment is simulated, there is no report of effort to other gears in the fleet segment.

Except for the scenarios with changes in selectivity (i.e. scenarios D and L), the catchability values are set to the 2022 values, reflecting the effects of the spatial closures already implemented in France and Spain.

Table 6.1.1.1 Management scenarios implemented in IAM model in EWG 23-11.

| Scenario | Trawler effort reduction in 2024** | Compensation mechanism for trawlers** | Post 2025 effort management | Combined catch limits (ARA and ARS) for 2024 | post 2025 for catch limits (ARA &ARS) |
|---|---|---|---|---|---|
| **Status Quo*** | E2024= E2023 | No Compensation mechanism | roll over effort in 2023 | roll over catch limit 2023 | roll over catch limit 2023 |
| **A*** | 2024: level of reduction to be at Fmsy of HKE1567 (to secure Fmsy for all stocks) | No Compensation mechanism | keep at Fmsy | roll over catch limit 2023 | roll over catch limit 2023 |
| **D*** | 9.50% | 4% [Selectivity improvement] 2024 (50% uptake in the fleet) & onwards | Effort to be set at Fmsy from 2025 | 2024: -5% | level of reduction that secures Fmsy from 2025 onwards for all stocks |
| **L*** | E2024=E2023 | 50% of the deep water trawling fleets with more selective gear (50mm square mesh) and they have 4% compensation mechanisms (i.e. -5.5% reduction instead of 9.5% reduction) | E2025 to E2030 = E2023<br>and 100% of the deep water trawling (OTB_DWS) fleet improving gear selectivity in 2025. | roll over catch limit 2023 | roll over catch limit 2023 |

**SCENARIO STATUS QUO (SQ) – EMU1 – IAM**

| | | | Level of effort | Maximum EFFORTS (in fishing days) | |
|---|---|---|---|---|---|
| **FLEET** | **FLEET abbreviation** | **METIER** | **2023** | **2024** | **2025 to 2030** |
| French demersal trawlers 18-24m | FR_DTS 1824m | all | 4 140 | 4 140 | 4 140 |
| French demersal trawlers 24-40m | FR_DTS >=24m | all | 5 048 | 5 048 | 5 048 |
| Spanish trawlers < 12m | SP_DTS < 12m | OTB_other | 1 840 | 1 840 | 1 840 |
| Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 19 631 | 19 631 | 19 631 |
| | | OTB_DWS | 879 | 879 | 879 |
| Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 36 981 | 36 981 | 36 981 |
| | | OTB_DWS | 8 908 | 8 908 | 8 908 |
| Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 13 068 | 13 068 | 13 068 |
| | | OTB_DWS | 7 151 | 7 151 | 7 151 |

| MAXIMUM CATCH LIMIT ARA 2023 (in tonnes) | | |
|---|---|---|
| **2023** | **2024** | **2025 to 2030** |
| **828** | **828** | **828** |

Estimation of catch limit by ARA stock that are modelled (based on 2022 landings from FDI)

| in tonnes | **2023** | **2024** | **2025 to 2030** |
|---|---|---|---|
| **ARA67** | **537,5** | **537,5** | **537,5** |
| **ARA5** | **176,5** | **176,5** | **176,5** |

**SCENARIO A – EMU1 – IAM**

| | | | EFFORTS (in fishing days) | | |
|---|---|---|---|---|---|
| **FLEET** | **FLEET abbreviation** | **METIER** | **2023** | **2024** | **2025 to 2030** |
| French demersal trawlers 18-24m | FR_DTS 1824m | all | 4 140 | effort to be at Fmsy HKE1567 | same effort than 2024 |
| French demersal trawlers 24-40m | FR_DTS >=24m | all | 5 048 | effort to be at Fmsy HKE1567 | same effort than 2024 |
| Spanish trawlers < 12m | SP_DTS < 12m | OTB_other | 1 840 | effort to be at Fmsy HKE1567 | same effort than 2024 |
| Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 19 631 | by fleet-metier : level of effort that is the minimum between the one to reach Fmsy HKE1567 and the one from catch limit 2023 on ARA | by fleet-metier : level of effort that is the minimum between the one to reach Fmsy HKE1567 and the one from catch limit 2023 on ARA |
| | | OTB_DWS | 879 | | |
| Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 36 981 | | |
| | | OTB_DWS | 8 908 | | |
| Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 13 068 | | |
| | | OTB_DWS | 7 151 | | |

| **2024** | **2025 to 2030** |
|---|---|
| **Fmsy HKE1567 = 0,41** | **Fmsy HKE1567 = 0,41** |

| MAXIMUM CATCH LIMIT ARA 2023 (in tonnes) | | |
|---|---|---|
| **2023** | **2024** | **2025 to 2030** |
| **828** | **828** | **828** |

Estimation of catch limit by ARA stock that are modelled (based on 2022 landings from FDI)

| in tonnes | **2023** | **2024** | **2025 to 2030** |
|---|---|---|---|
| **ARA67** | **537,5** | **537,5** | **537,5** |
| **ARA5** | **176,5** | **176,5** | **176,5** |

**SCENARIO D – EMU1 – IAM**

CM: compensation mechanisms

| | | | | | EFFORTS (in fishing days) | | |
|---|---|---|---|---|---|---|---|
| | | FLEET | FLEET abbreviation | METIER | 2023 | 2024 | 2025 to 2030 |
| | | French demersal trawlers 18-24m | FR_DTS 1824m | all | 4 140 | **3 684** | effort to be at Fmsy HKE1567 |
| | | French demersal trawlers 24-40m | FR_DTS >=24m | all | 5 048 | **4 464** | effort to be at Fmsy HKE1567 |
| | | Spanish trawlers < 12m | SP_DTS < 12m | OTB_other | 1 840 | **1 583** | effort to be at Fmsy HKE1567 |
| | | | | | | | |
| 50% of the fleet | CM | Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 9 816 | **8 622** | effort to be at Fmsy HKE1567 |
| | | | | OTB_DWS | 440 | **418** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| 50% of the fleet | CM | Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 18 490 | **16 052** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| | | | | OTB_DWS | 4 454 | **4 235** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| 50% of the fleet | CM | Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 6 534 | **5 616** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| | | | | OTB_DWS | 3 576 | **3 385** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| | | | | | | | |
| 50% of the fleet | no CM | Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 9 816 | **8 622** | effort to be at Fmsy HKE1567 |
| | | | | OTB_DWS | 440 | **402** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| 50% of the fleet | no CM | Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 18 490 | **16 052** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| | | | | OTB_DWS | 4 454 | **4 076** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| 50% of the fleet | no CM | Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 6 534 | **5 616** | effort to be at Fmsy HKE1567 and Fmsy ARA |
| | | | | OTB_DWS | 3 576 | **3 247** | effort to be at Fmsy HKE1567 and Fmsy ARA |

| MCL ARA (in tonnes) | | Fmsy |
|---|---|---|
| 2023 | 2024 | 2025 to 2030 |
| **828** | **786,6** | **Fmsy ARA5 = 0,338** |
| | | **Fmsy ARA67 = 0,258** |
| | | **Fmsy HKE1567 = 0,41** |

+ change in selectivity (for ARA5, ARA67, HKE1567, DPS1, DP567, NEP6, MUT1, MUT6 and MUT7) of OTB_DWS of the CM Spanish trawlers from 2024 to 2030.

**SCENARIO L – EMU1 – IAM**

CM: compensation mechanisms

| | | | | | MAX EFFORTS (in fishing days) | | |
|---|---|---|---|---|---|---|---|
| | | **FLEET** | **FLEET abbreviation** | **METIER** | **2023** | **2024** | **2025 to 2030** |
| | | French demersal trawlers 18-24m | FR_DTS 1824m | all | 4 140 | 4 140 | 4 140 |
| | | French demersal trawlers 24-40m | FR_DTS >=24m | all | 5 048 | 5 048 | 5 048 |
| | | Spanish trawlers < 12m | SP_DTS < 12m | OTB_other | 1 840 | 1 840 | 1 840 |
| | | | | | | | |
| 50% of the fleet | CM | Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 9 816 | 9 816 | 9 816 |
| | | | | OTB_DWS | 440 | **471** | 440 |
| 50% of the fleet | CM | Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 18 490 | 18 490 | 18 490 |
| | | | | OTB_DWS | 4 454 | **4 773** | 4 454 |
| 50% of the fleet | CM | Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 6 534 | 6 534 | 6 534 |
| | | | | OTB_DWS | 3 576 | **3 852** | 3 576 |
| | | | | | | | |
| 50% of the fleet | no CM | Spanish trawlers 12-18m | SP_DTS 1218m | OTB_other | 9 816 | 9 816 | 9 816 |
| | | | | OTB_DWS | 440 | 440 | 440 |
| 50% of the fleet | no CM | Spanish trawlers 18-24m | SP_DTS_1824m | OTB_other | 18 490 | 18 490 | 18 490 |
| | | | | OTB_DWS | 4 454 | 4 454 | 4 454 |
| 50% of the fleet | no CM | Spanish trawlers >=24m | SP_DTS >=24m | OTB_other | 6 534 | 6 534 | 6 534 |
| | | | | OTB_DWS | 3 576 | 3 576 | 3 576 |
| | | | | | | | |
| | | | | | MAXIMUM CATCH LIMIT ARA (in tonnes) | | |
| | | | | | **2023** | **2024** | **2025 to 2030** |
| | | | | | **828** | **828** | **828** |

+ change in selectivity (for ARA5, ARA67, HKE1567, DPS1, DP567, NEP6, MUT1, MUT6 and MUT7) of OTB_DWS of the CM Spanish trawlers in 2024; and change in selectivity for all OTB-DWS (i.e. also no CM fleets) from 2025 to 2030.

Scenario status Quo (SQ) corresponds to a scenario where parameters are constant and where fishing efforts by fleet are set to the fishing effort from 2023 regulation, along with the constraints of a maximum catch limit (MCL) on ARA, based on the value of the MCL of ARA set for 2023.

All scenarios simulate the implementation of a maximum catch limit (MCL) on ARA, from 2023 to 2030 for scenarios SQ, A and L, and only in 2023 and 2024 for scenario D. It should be noted that the implementation of the MCL, and therefore the associated changes in fishing effort, only affects the trawler fleets catching ARA in the FDI database (i.e. Spanish trawlers of 12-18m, Spanish trawlers of 18-24m and Spanish trawlers of >24m). The efforts of the OTB_DWS and OTB_other of these fleets are adjusted homogeneously (i.e., same proportion of reduction for each fleet). To note, that it was asked to do this homogeneously for this group, while in EWG22-11 effort were adjusted in proportion to ARA landings (in weight) by fleet.

Efforts of trawlers in scenarios A and D are adjusted to reach Fmsy of HKE1567 from 2024 to 2030 for scenario A and from 2025 to 2030 for scenario D.As requested, efforts are adjusted homogeneously between fleets segments.

Scenarios D and L simulate the implementation of a more selective 50mm square mesh for deep water trawls (so only for gear OTB_DWS of the 3 Spanish trawlers 12-18m, 18-24m and >=24m). To simulate the change in selectivity, we used the same delta in selectivity (at age) used in EWG 22-13 report (for ARA, HKE, MUT, DPS and NEP). The methodology used is described in EWG 21-13.

Scenario D simulate the improvement in selectivity for half of the concerned fleets from 2024 to 2030, with a compensation mechanism through additional effort in 2024. And scenario L simulate the improvement in selectivity for half of the concerned fleets in 2024 (with a compensation mechanisms) and then an improvement in selectivity for 100% of the vessels of the Spanish deep water trawl fleets, with the effort of all the fleet segments set to their fishing efforts in 2023.

For all scenarios, the number of vessels in 2022 are the one in the FDI data. Only the number of vessels of French trawlers are reduced between 2022 (FDI data) and 2023, as decommissioning schemes have been implemented in 2022 and 2023. The ToR asked to have 48 vessels (French trawlers) in 2023, even if it was registered that 14 vessels where getting out of the fishery. As in 2022, according to FDI data there was 55 vessels, we used information on the vessels getting out to adjust the number of vessels in 2023 (3 vessels in less in the FRA_DTS_1824m segment, and 4 vessels in less in the FRA_DTS_sup24m segment). Regarding the Spanish vessels, the number of vessels in the ToR (i.e. 571 vessels) corresponded to the number of vessels in 2022 (FDI). Table 6.1.1.2 summarizes the bumber of vessels by fleet segments in the IAM simulations.

Table 6.1.1.2. Number of vessels by fleet in 2022 and 2023-2030 in IAM model in EWG 23-11, for all scenarios.

| **IAM Fleet segment names** | **Names in the report figures** | **Number of vessels in 2022 (source : FDI)** | **Number of vessels from 2023 to 2030** |
|---|---|---|---|
| French demersal trawlers 18-24m | FR_DTS 1824m | 26 | 23 |
| French demersal trawlers 24-40m | FR_DTS >=24m | 29 | 25 |
| French netters < 06m | FR_DFN <6m | 132 | 132 |
| French netters 06-12m | FR_DFN 612m | 454 | 454 |

| IAM Fleet segment names | Names in the report figures | Number of vessels in 2022 (source : FDI) | Number of vessels from 2023 to 2030 |
|---|---|---|---|
| French vessels using hooks < 06m | FR_HOK < 6 m | 14 | 14 |
| French vessels using hooks 06-12m | FR_HOK < 612 m | 96 | 96 |
| French vessels using hooks 12-18m | FR_HOK > 1218 m | 12 | 12 |
| Spanish trawlers < 12m | SP_DTS < 12m | 24 | 24 |
| Spanish trawlers 12-18m | SP_DTS 1218m | 139 | 139 |
| Spanish trawlers 18-24m | SP_DTS 1824m | 284 | 284 |
| Spanish trawlers >=24m | SP_DTS >=24m | 124 | 124 |
| Spanish netters 06-12m | SP_DFN 612m | 93 | 93 |
| Spanish netters 12-18m | SP_DFN 1218m | 60 | 60 |
| Spanish vessels using hooks 06-12m | SP_HOK 612 m | 39 | 39 |
| Spanish vessels using hooks 12-18m | SP_HOK 1218 m | 40 | 40 |
| Spanish vessels using hooks 18-24m | SP_HOK 1824 m | 13 | 13 |

For all scenarios, fuel prices are differentiated by fleet segment. AER fuel price estimates in 2022 are used in 2022, and AER projections for fuel price in 2023 are used in 2023 and onwards. Table 6.1.1.3 displays the values of these fuel prices per IAM fleet segment.

Table 6.1.1.3. Fuel prices (in €/l) per fleet segment in 2021 (AER data) and AER projections for 2022 and 2023. Source: AER data and projections.

| | | | Fuel prices (€/l) | | |
|---|---|---|---|---|---|
| | | | AER EWG 23-07 | data source : projections from AER EWG23-07 | |
| IAM FLEET | Fleet abbreviation | fs_name in AER | 2021 | 2022 | 2023 |
| French demersal trawlers 18-24m | FR_DTS 1824m | FRA MBS DTS1824 NGI A * | 0,80 | 1,50 | 0,95 |
| French demersal trawlers 24-40m | FR_DTS >=24m | FRA MBS DTS2440 NGI A * | 0,77 | 1,43 | 0,90 |
| Spanish trawlers < 12m | SP_DTS < 12m | ESP MBS DTS0612 NGI | 0,52 | 1,67 | 1,17 |
| Spanish trawlers 12-18m | SP_DTS 1218m | ESP MBS DTS1218 NGI | 0,50 | 0,93 | 0,65 |
| Spanish trawlers 18-24m | SP_DTS 1824m | ESP MBS DTS1824 NGI | 0,50 | 0,91 | 0,64 |
| Spanish trawlers >=24m | SP_DTS >=24m | ESP MBS DTS2440 NGI | 0,50 | 0,92 | 0,64 |
| | | | | | |
| French netters < 06m | FR_DFN <6m | FRA MBS DFN0006 NGI A | 0,78 | 1,42 | 0,90 |
| French netters 06-12m | FR_DFN 612m | FRA MBS DFN0612 NGI A | 0,72 | 1,29 | 0,82 |
| French vessels using hooks < 06m | FR_HOK < 6 m | FRA MBS HOK0006 NGI A | 0,80 | 1,45 | 0,92 |
| French vessels using hooks 06-12m | FR_HOK < 612 m | FRA MBS HOK0612 NGI A | 0,71 | 1,26 | 0,80 |
| French vessels using hooks 12-18m | FR_HOK > 1218 m | FRA MBS DFN1218 NGI A * | 0,69 | 1,09 | 0,69 |
| Spanish netters 06-12m | SP_DFN 612m | ESP MBS DFN0612 NGI | 0,48 | 1,58 | 1,10 |
| Spanish netters 12-18m | SP_DFN 1218m | ESP MBS DFN1218 NGI | 0,51 | 1,45 | 1,02 |
| Spanish vessels using hooks 06- 12 | SP_HOK 612 m | ESP MBS HOK0612 NGI | 0,50 | 0,92 | 0,64 |
| Spanish vessels using hooks 12-18r | SP_HOK 1218 m | ESP MBS HOK1218 LLD * | 0,51 | 0,88 | 0,62 |
| Spanish vessels using hooks 18-24r | SP_HOK 1824 m | ESP MBS HOK1824 LLD * | 0,52 | 0,81 | 0,57 |

### 6.1.2 Results

The four alternative scenarios described in section 6.1.1. were investigated using the IAM model. Simulations of the IAM model starts in 2022 and run to 2030 (the year 2025 is represented in a vertical black line in each figure).

Results of IAM simulations regarding **fishing effort**, **number of vessels** per fleet segment, **total landings** of Hake in GSAs 1-5-6-7, blue and red shrimp in GSA 5 and in GSAs 6-7, Norway lobster in GSA6, red mullet in GSA1, GSA6 and GSA7, and deep-water rose shrimp in GSA 1, and in GSAs 5-6-7 by fleet segments, **Gross Value of Landings (GVL)** by fleet segment, **average Gross Value Added (GVA) per vessel** by fleet segment, **Gross Profit** (GP) by fleet, and **Gross Profit Margin** by fleet segment are, respectively, displayed in Figures 6.1.2.1 to 6.1.2.17.

For each stock, Figures 6.1.2.18 to 6.1.2.26 compares the evolutions of their Fbar, SSB and total landings according to the different scenarios. Figures 6.1.2.27 to 6.1.2.29 display the **landings at age of HKE1567** according to the four scenarios, by **trawler**, by **netter** and by **vessels using hooks** fleet segments, respectively. Figures 6.1.2.30 and 6.1.2.31 display **landings at age of ARA5, and ARA67, respectively**, by **trawler** fleet segments. For additional information, landings per age of the other stocks are displayed in ANNEX II.

Finally, tables 6.1.2.1 to 6.1.2.8. compares biological and economic performances of each scenario in terms of **Fbar**, **SSB**, **total landings per stock**, **GVA**, **Gross Profit**, **Gross Profit margin**, and **FTE per fleet segments, engaged crew, average salary (crew cost /FTE), and CR/BER**.

As a reminder, the fishing mortalities, SSBs and total Gross Value of Landings per fleet are displayed in section 1.2.

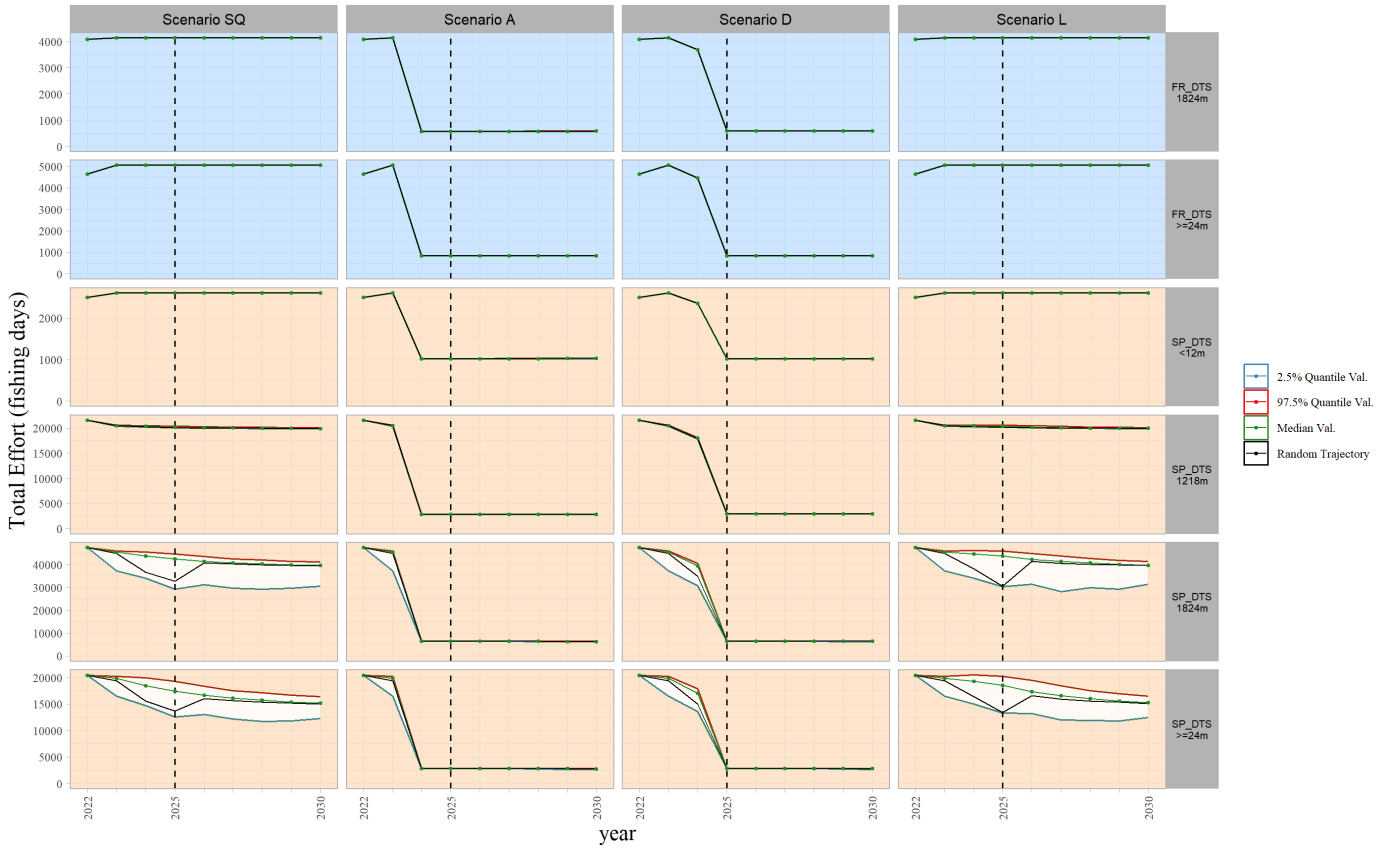


Figure 6.1.2.1. EMU1 (IAM model). Evolution of the annual fishing effort (in fishing days) by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

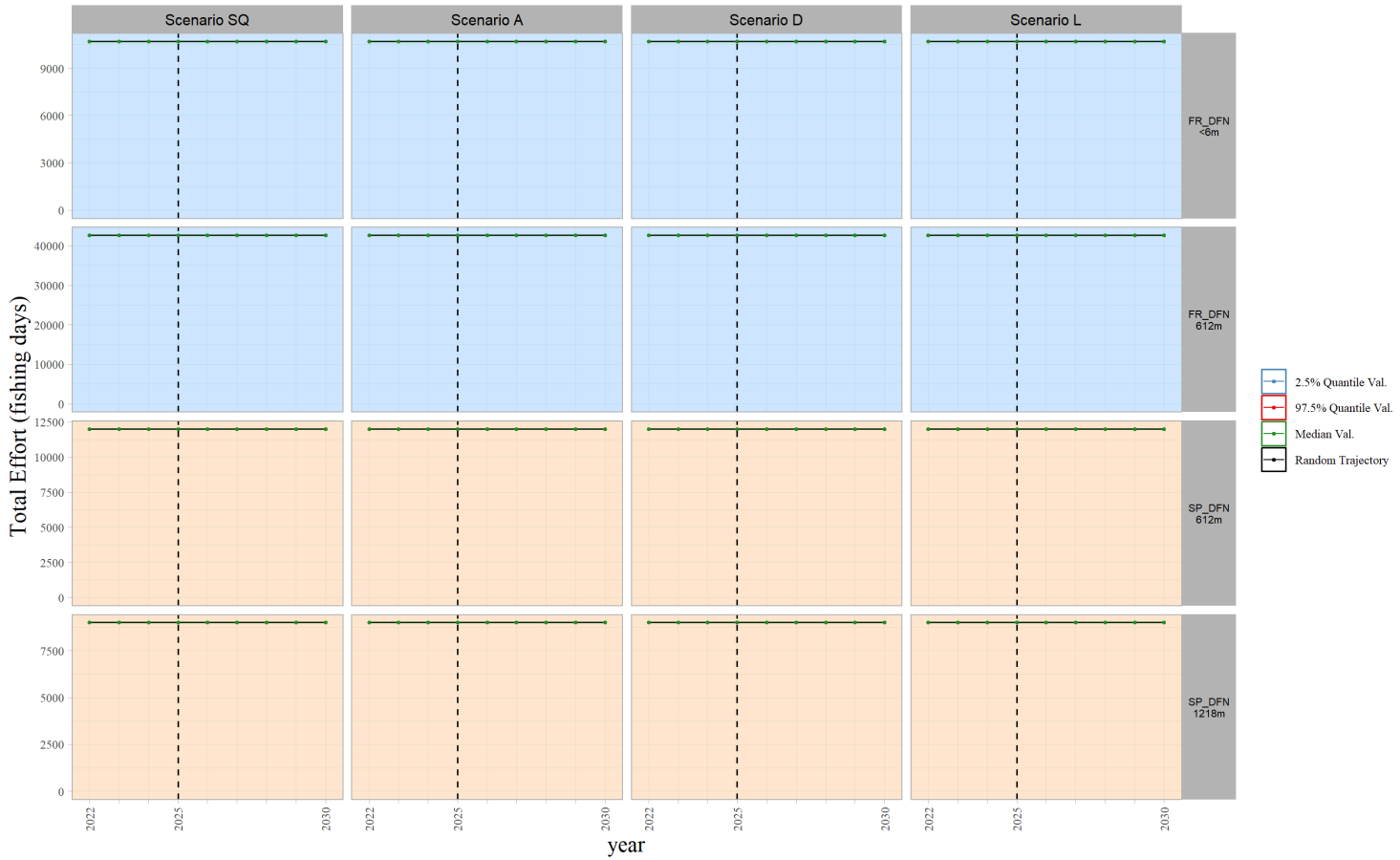


Figure 6.1.2.2. EMU1 (IAM model). Evolution of the annual fishing effort (in fishing days) by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

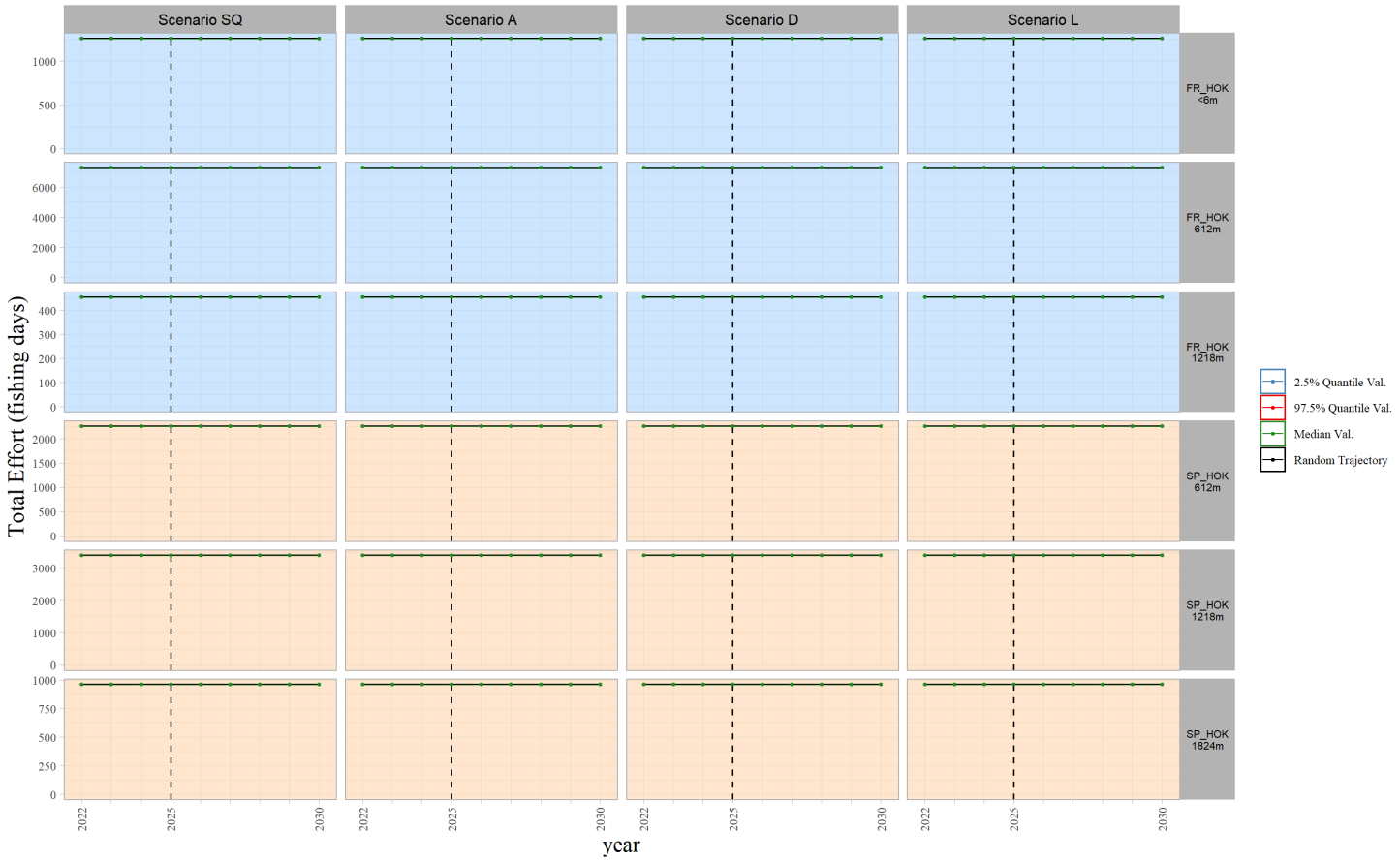


Figure 6.1.2.3. EMU1 (IAM model). Evolution of the annual fishing effort (in fishing days) by vessels using hooks fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m.

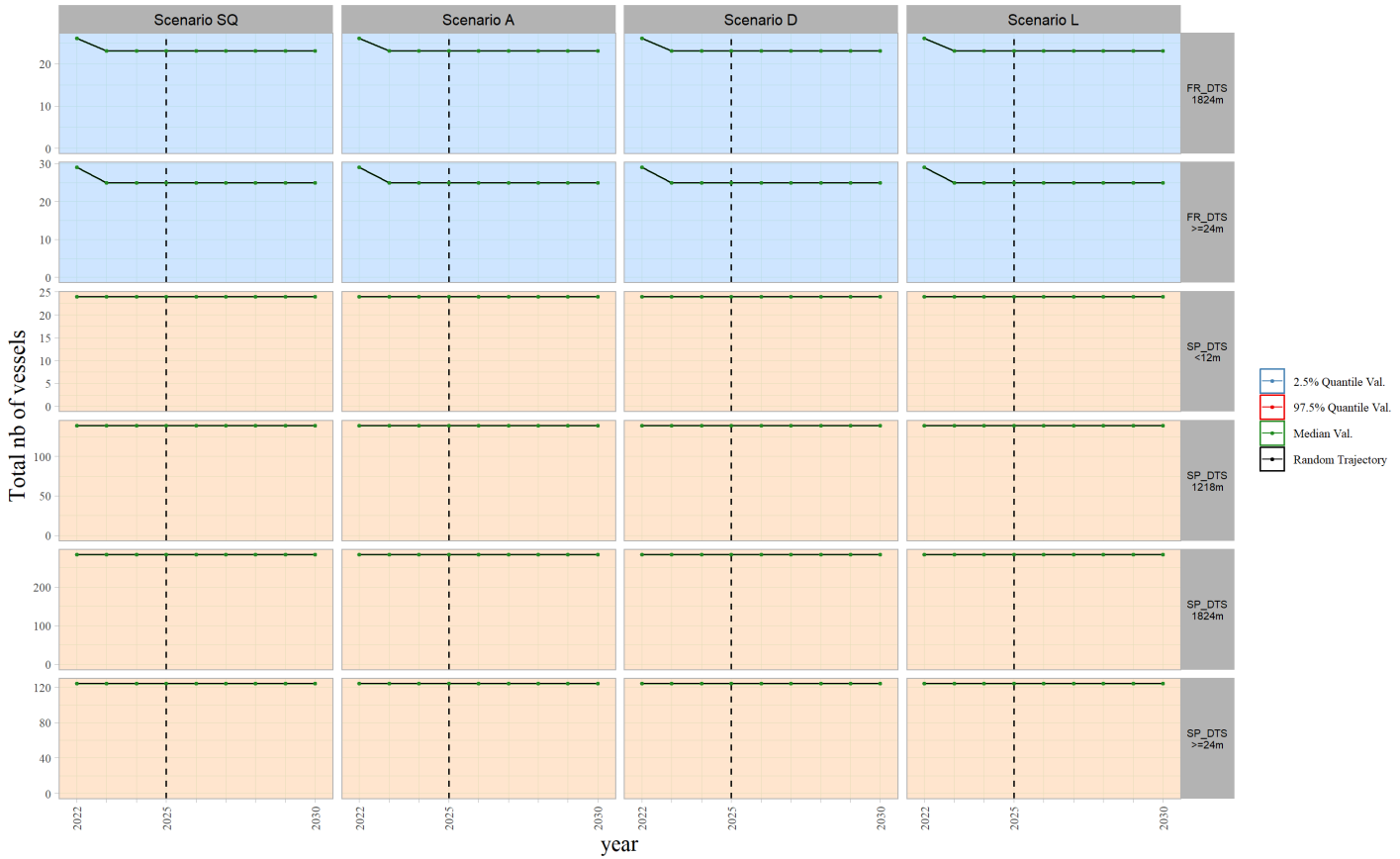


Figure 6.1.2.4. EMU1 (IAM model). Evolution of the annual number of vessels by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

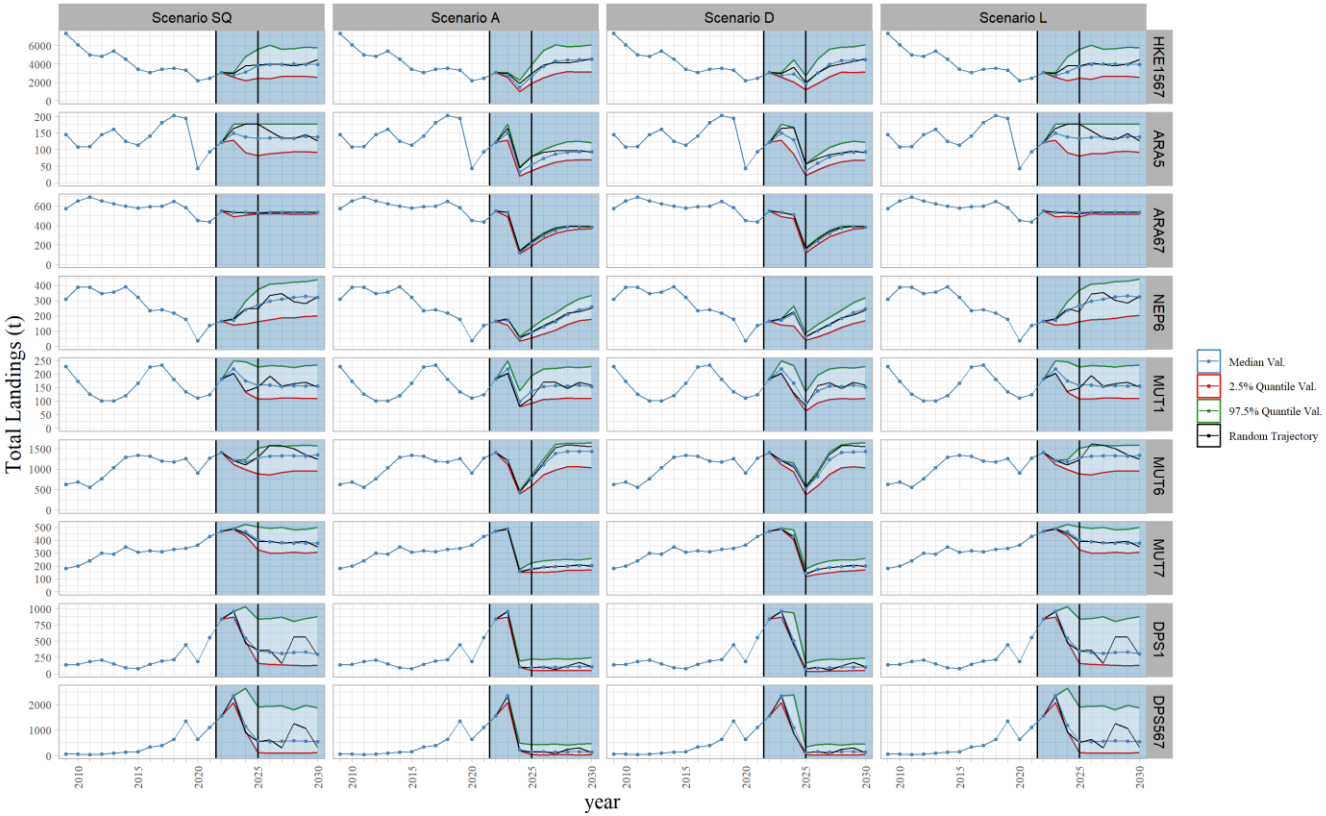


Figure 6.1.2.5. EMU1 (IAM model). Evolution of the total annual landings (in tonnes) of the modelled stocks under alternative scenarios up to 2030. Historical values of landings are given in the white areas and simulated values in the blue area. Vertical black lines indicate the year 2025. Scenarios are in column and stocks in row. The stocks are as follow (from top to bottom): hake GSAs1-5-6-7 (HKE1567), blue and red shrimp GSA5 (ARA5), blue and red shrimp GSAs6-7 (ARA67), Norway lobster GSA6 (NEP6), red mullet GSA1 (MUT1), red mullet GSA6 (MUT6), red mullet GSA7 (MUT7), deep-water rose shrimp GSA1 (DPS1), and deep-water rose shrimp GSAs5-6-7 (DPS567).

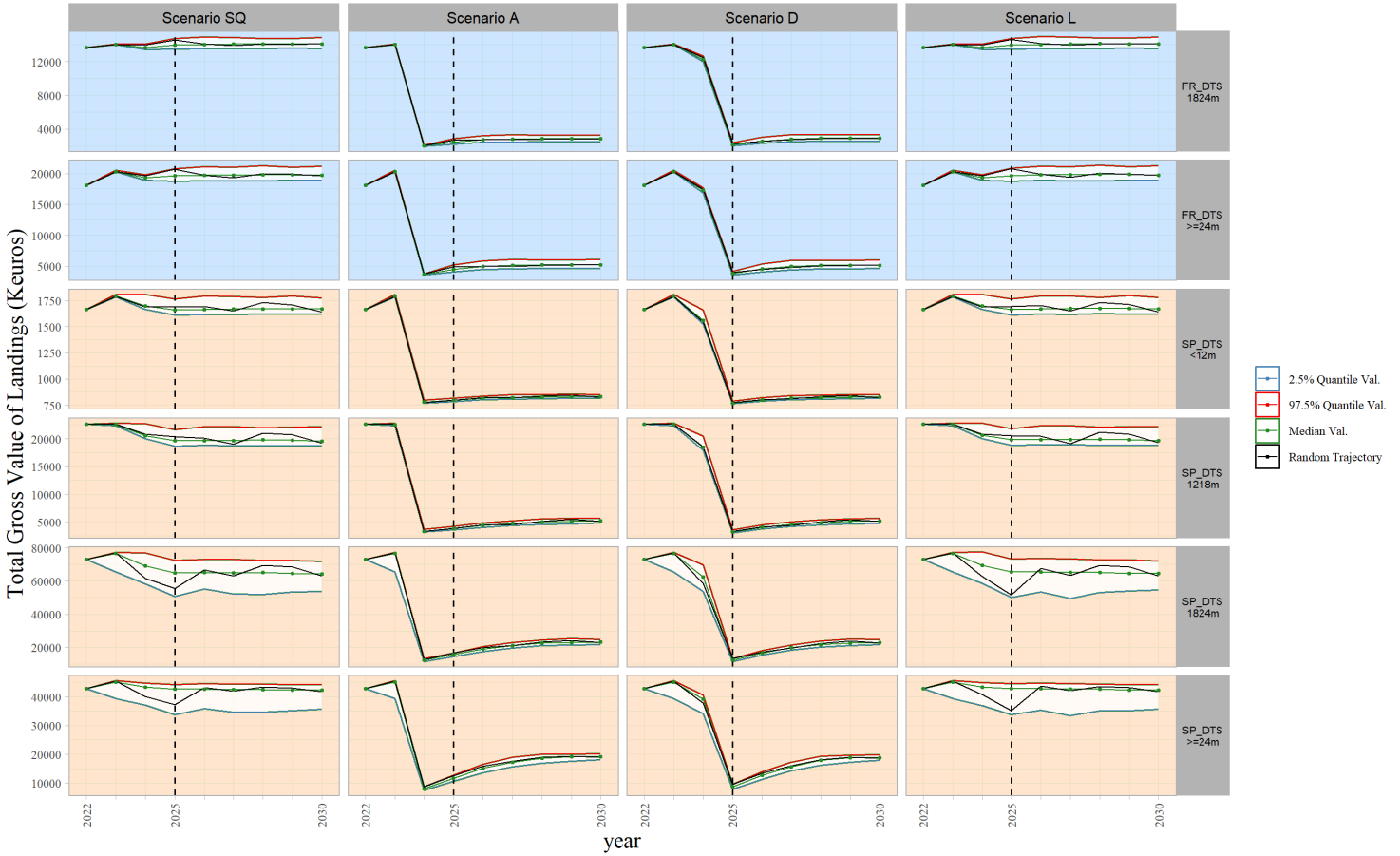


Figure 6.1.2.6. EMU1 (IAM model). Evolution of the total Gross Value of Landings (GVL, i.e. revenues, in K euros) by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

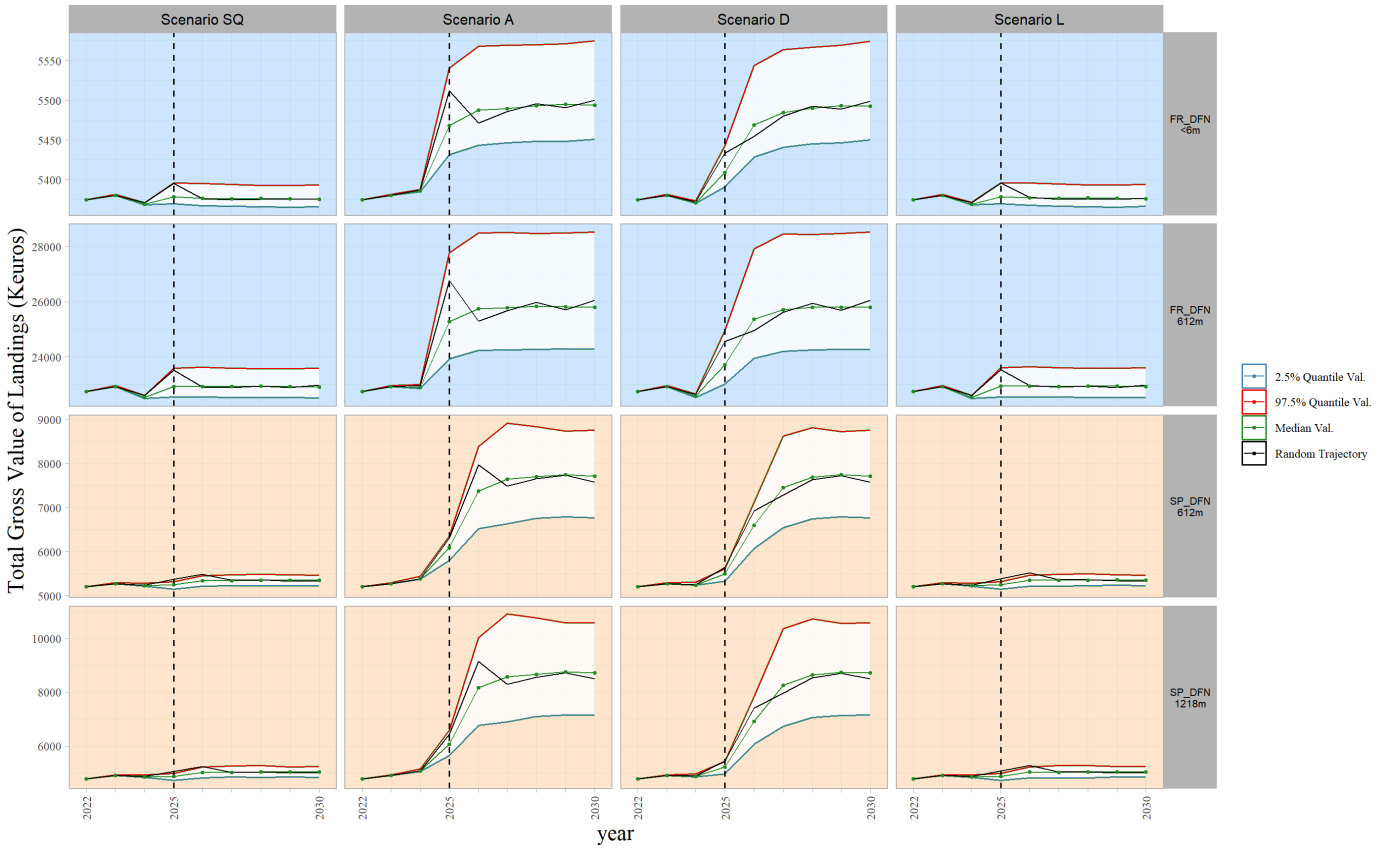


Figure 6.1.2.7. EMU1 (IAM model). Evolution of the total Gross Value of Landings (GVL, i.e. revenues, in K euros) by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

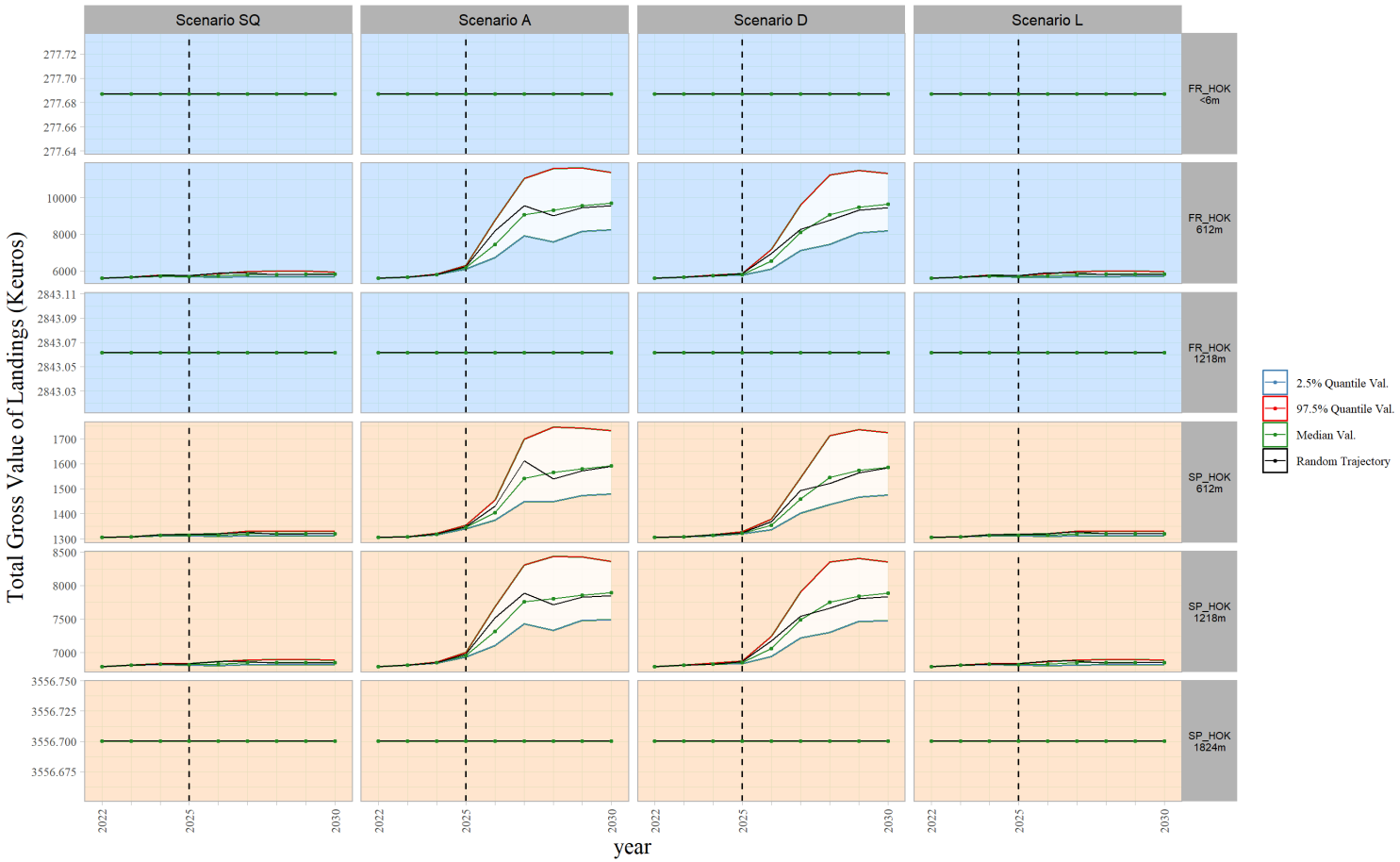


Figure 6.1.2.8. EMU1 (IAM model). Evolution of the total Gross Value of Landings (GVL, i.e. revenues, in K euros) by vessels using hooks fleet segments under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m

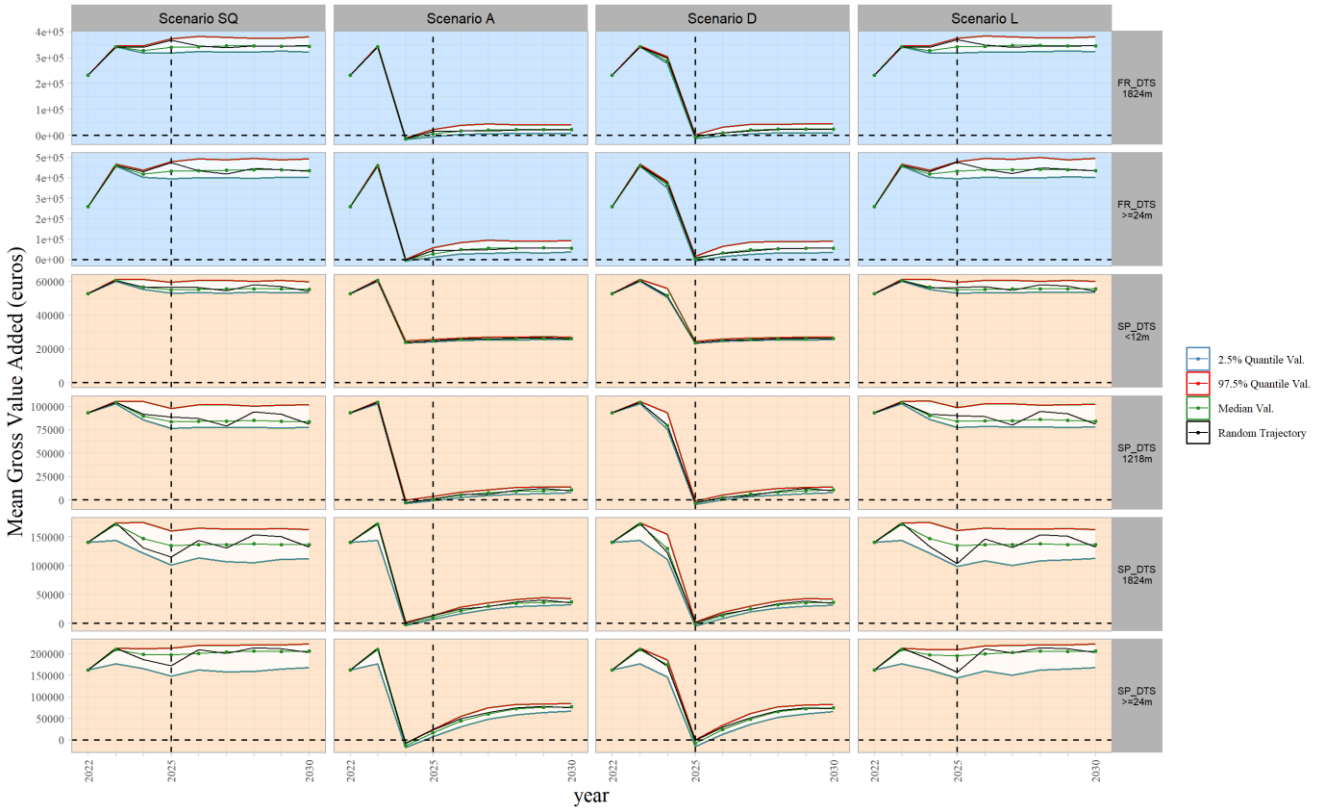


Figure 6.1.2.9. EMU1 (IAM model). Evolution of the average Gross Value Added (GVA, in euros) per vessel by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

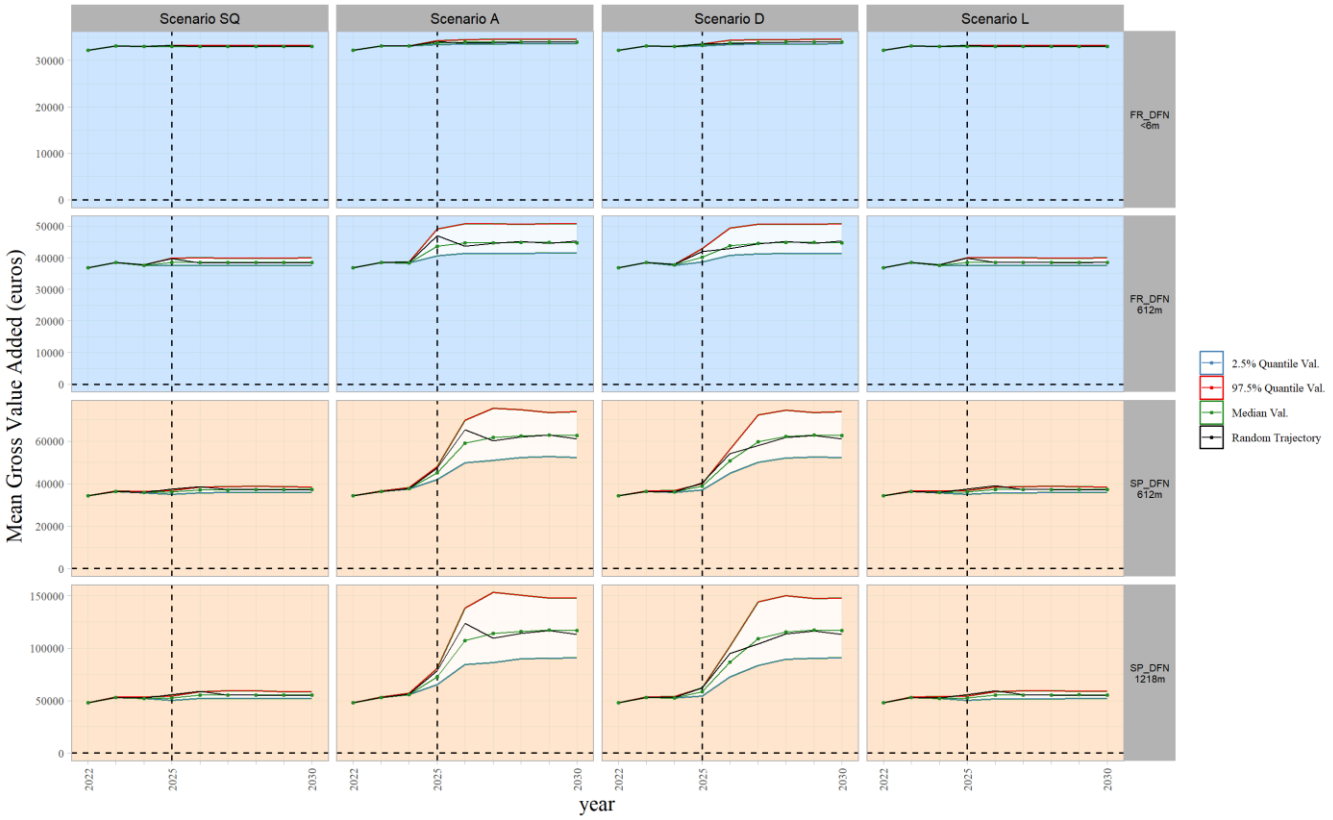


Figure 6.1.2.10. EMU1 (IAM model). Evolution of the average Gross Value Added (GVA, in euros) per vessel by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

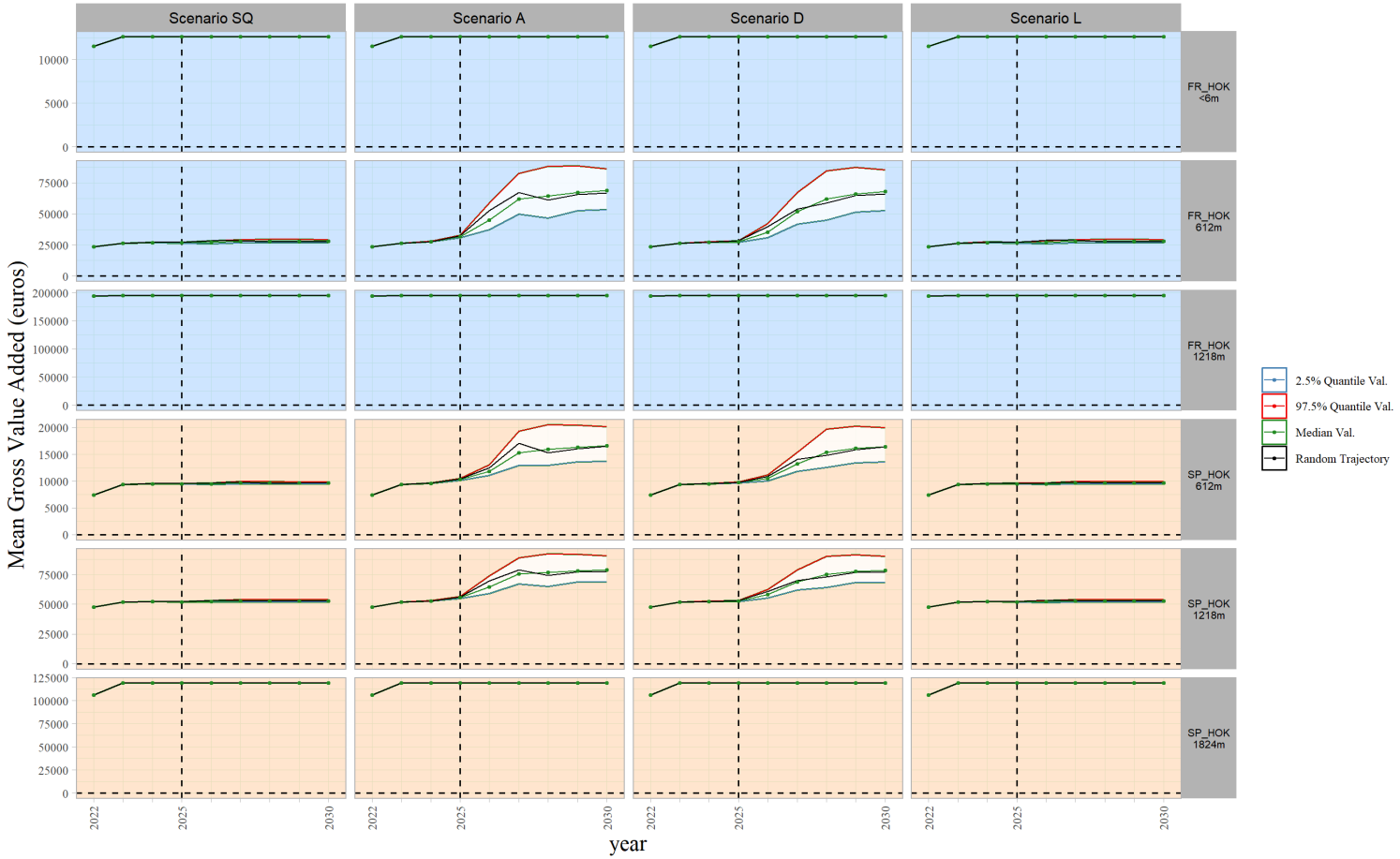


Figure 6.1.2.11. EMU1 (IAM model). Evolution of the average Gross Value Added (GVA, in euros) per vessel by vessels using hooks fleet segments under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m.

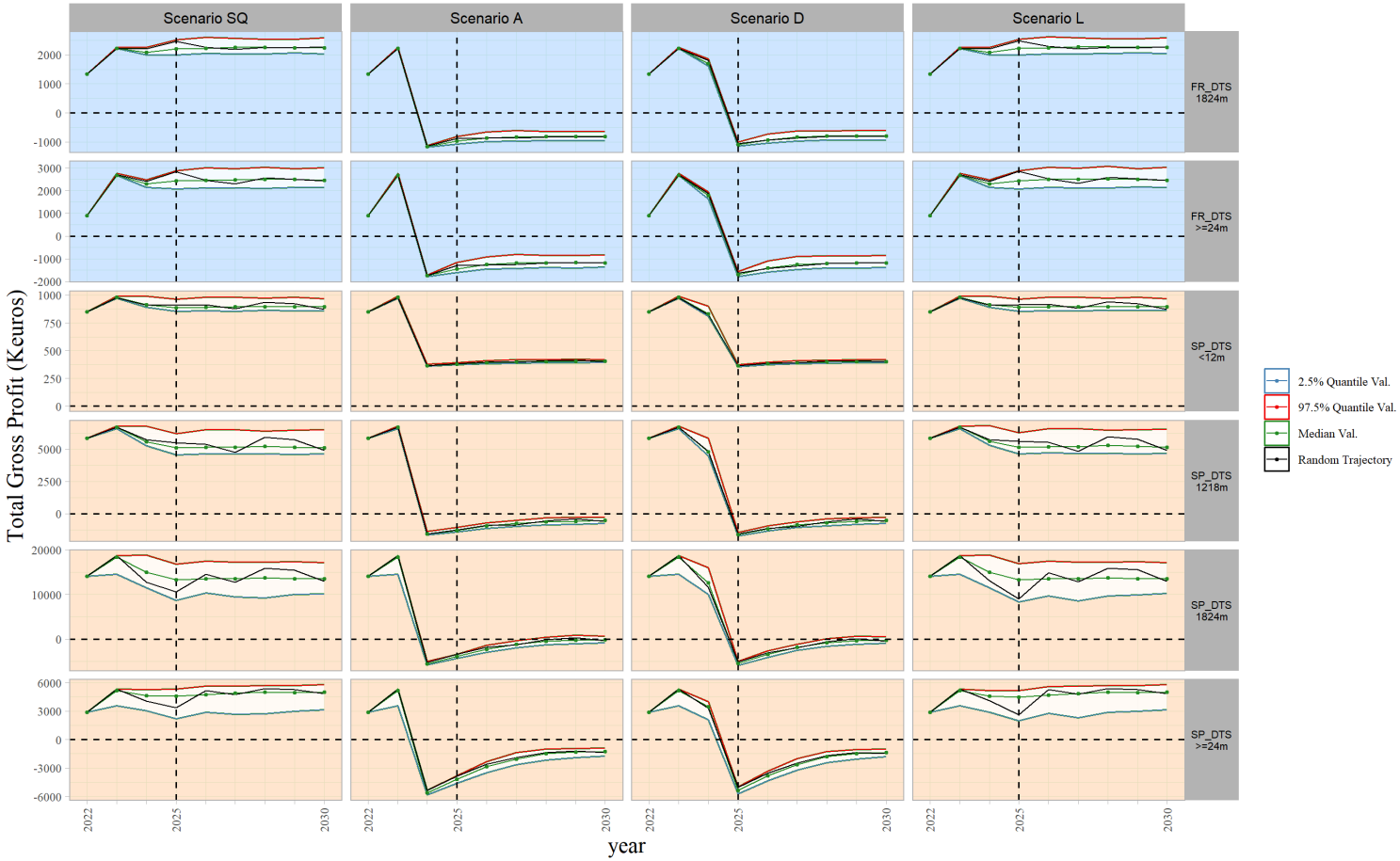


Figure 6.1.2.12. EMU1 (IAM model). Evolution of the Total Gross Profit (GP, in K euros) by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

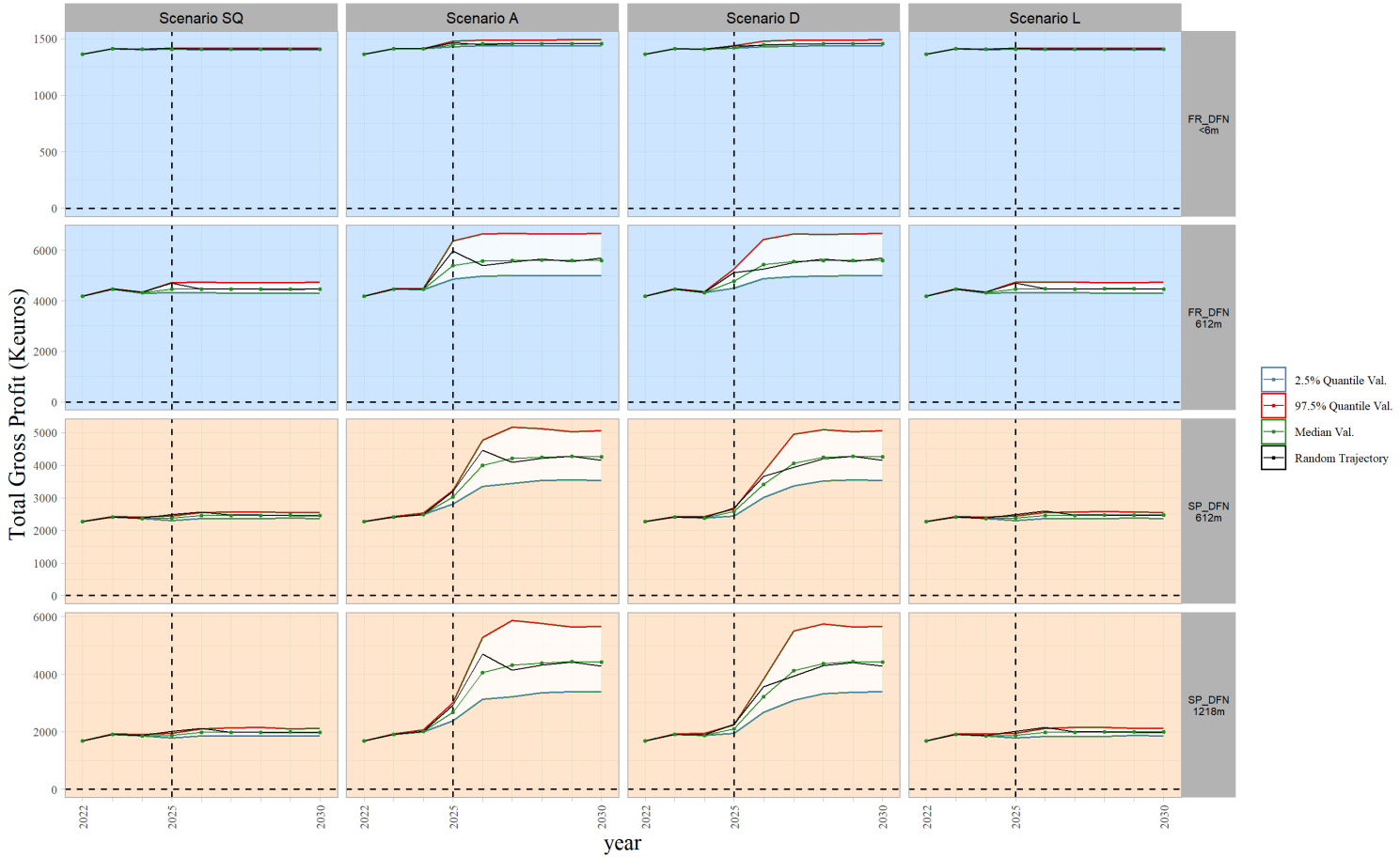


Figure 6.1.2.13. EMU1 (IAM model). Evolution of the Total Gross Profit (GP, in K euros) by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

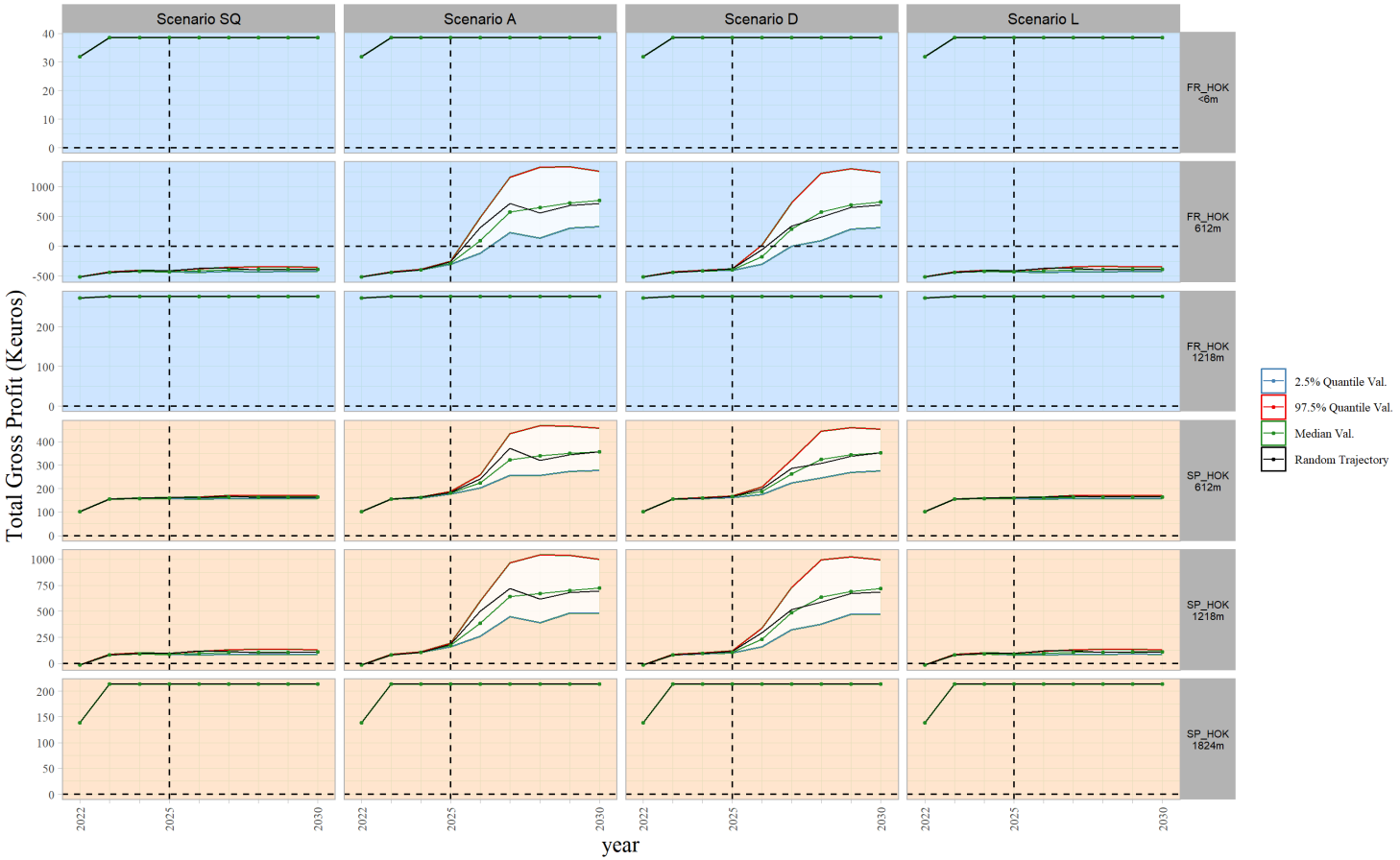


Figure 6.1.2.14. EMU1 (IAM model). Evolution of the Total Gross Profit (GP, in K euros) by HOK (i.e. vessels using hooks) fleet segments under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m.

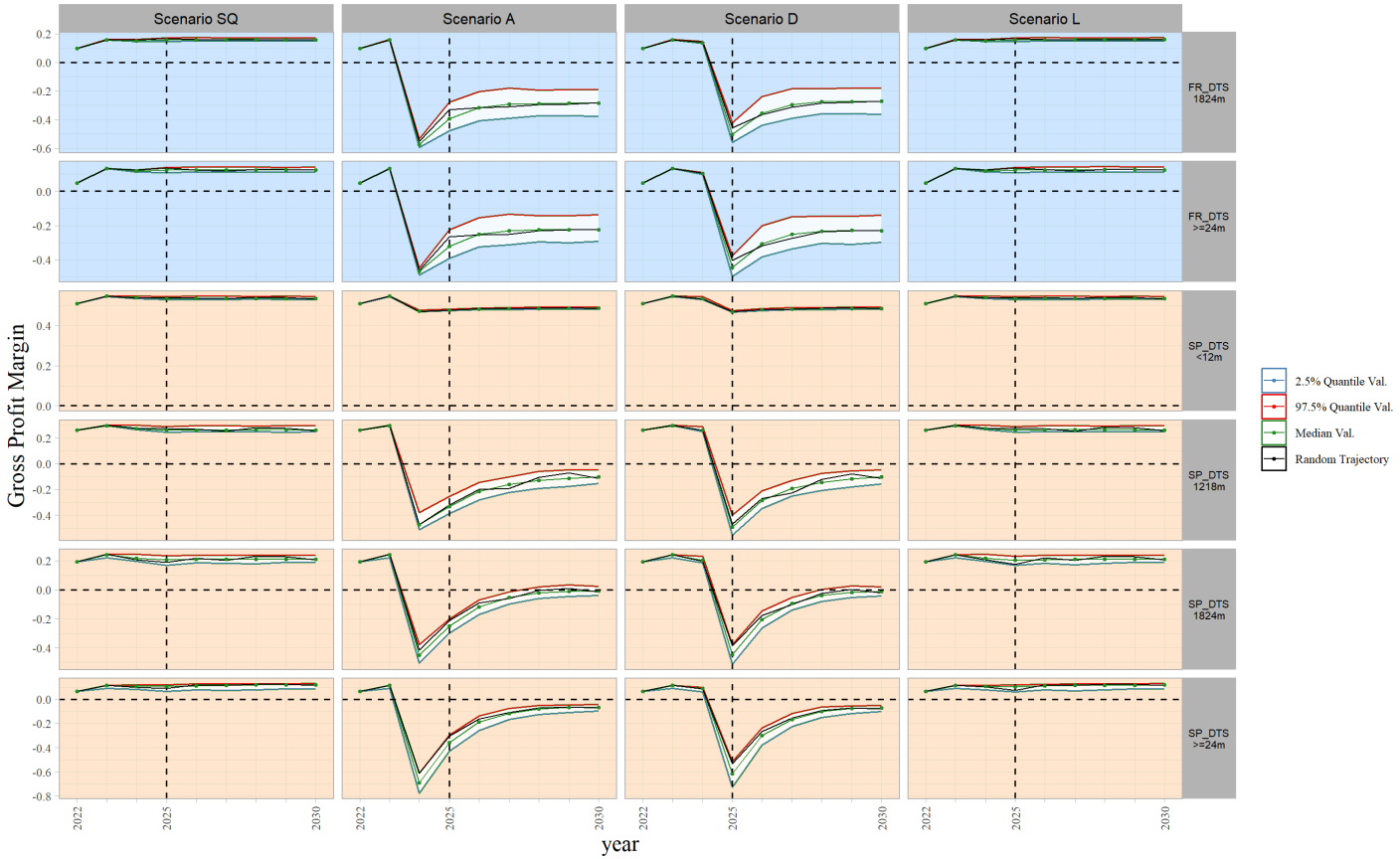


Figure 6.1.2.15. EMU1 (IAM model). Evolution of the Gross Profit Margin by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French demersal trawlers 18-24m, French demersal trawlers >24m, Spanish trawlers < 12m, Spanish trawlers 12-18m, Spanish trawlers 18-24m, and Spanish trawlers >24m.

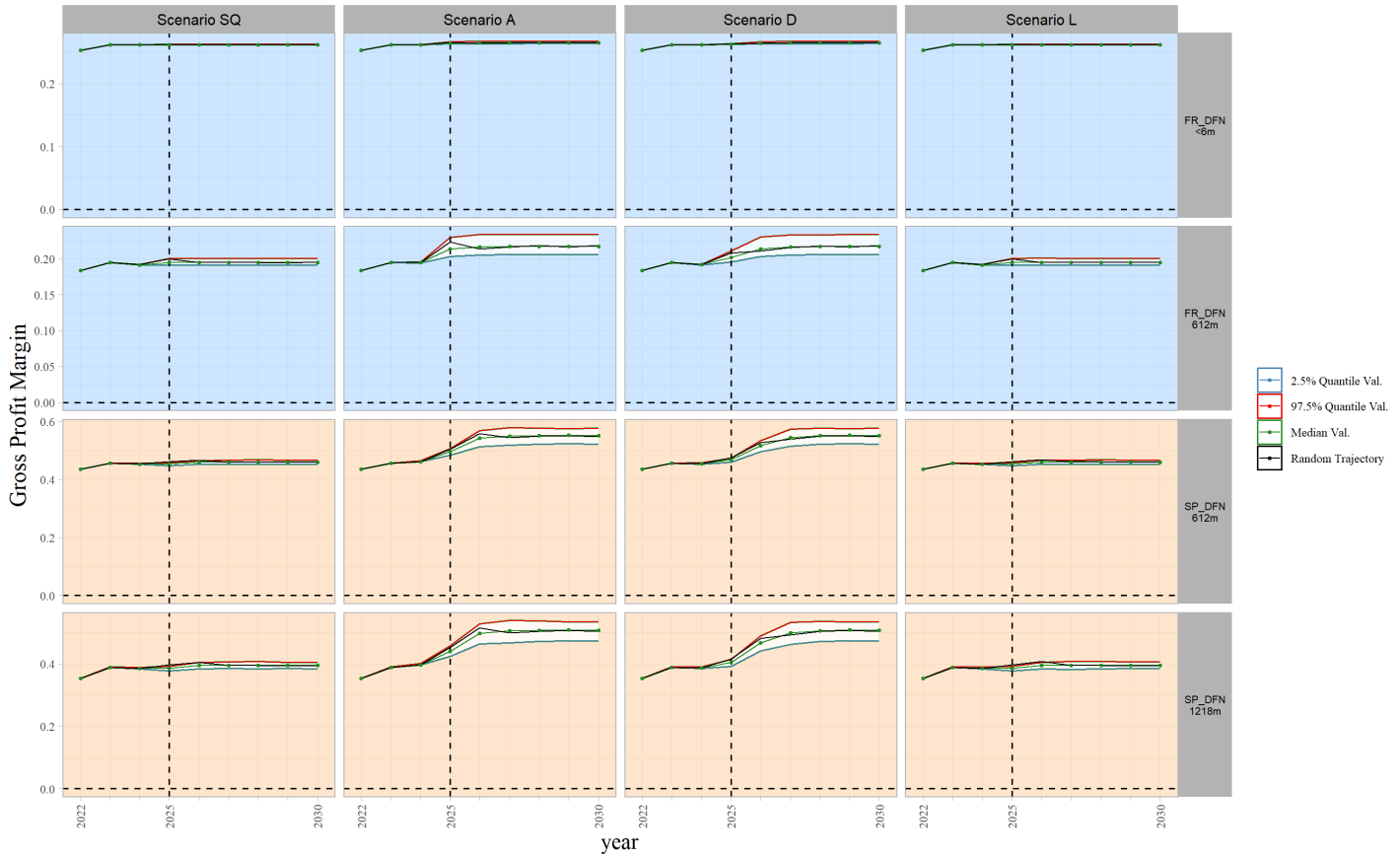


Figure 6.1.2.16. EMU1 (IAM model). Evolution of the Gross Profit Margin by netter fleet segment under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French netters <06m and 06-12m, and Spanish netters 06-12m and 12-18m.

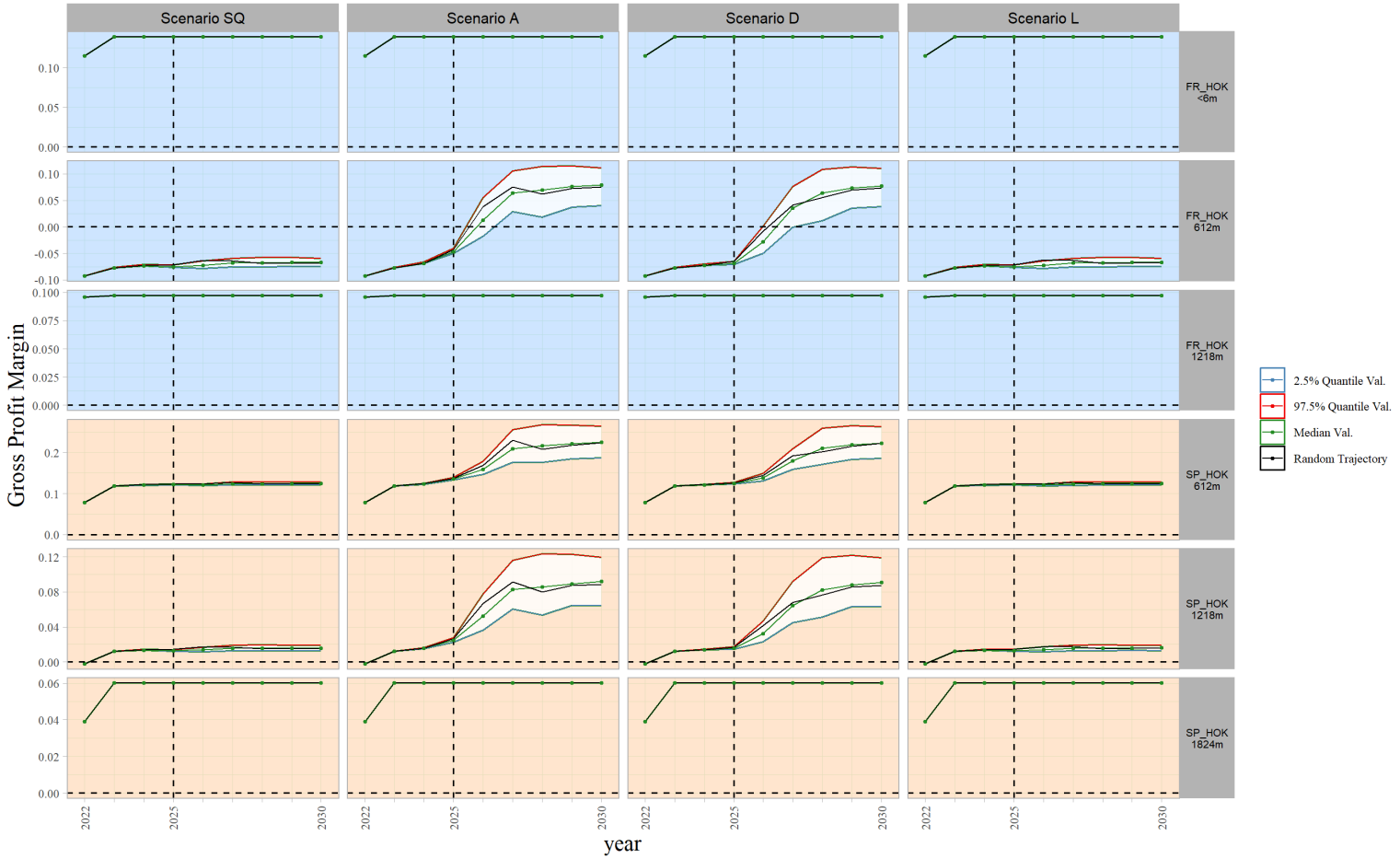


Figure 6.1.2.17. EMU1 (IAM model). Evolution of the Gross Profit Margin by vessels using hooks fleet segments under alternative scenarios from 2022 to 2030. Vertical dotted black lines indicate the year 2025. Scenarios are in column and fleet segment in row. The fleet segments are as follow (from top to bottom): French vessels using hooks 00-06m, 06-12m and 12-18m, Spanish vessels using hooks 06-12m, 12-18m and 18-24m.

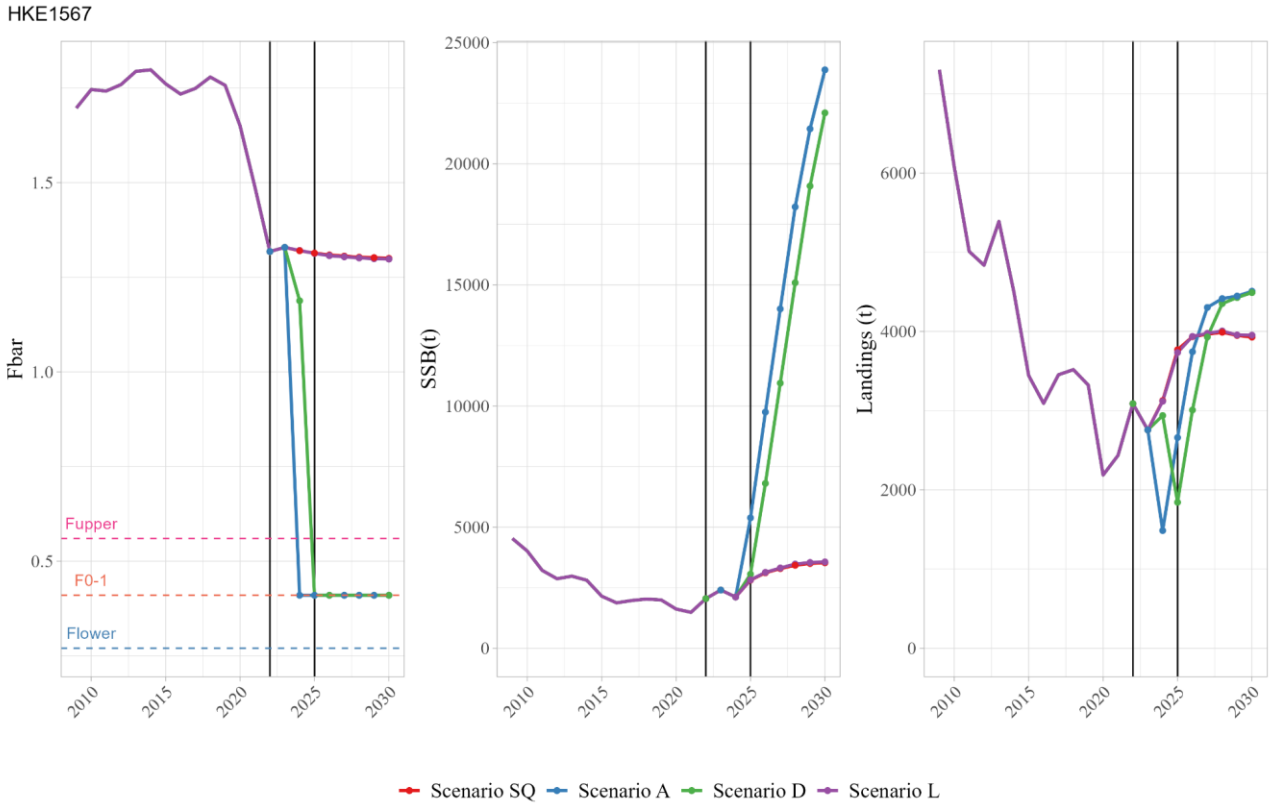


Figure 6.1.2.18. EMU1 (IAM model). Predicted median values for Hake in GSAs 1-5-6-7 (HKE1567) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

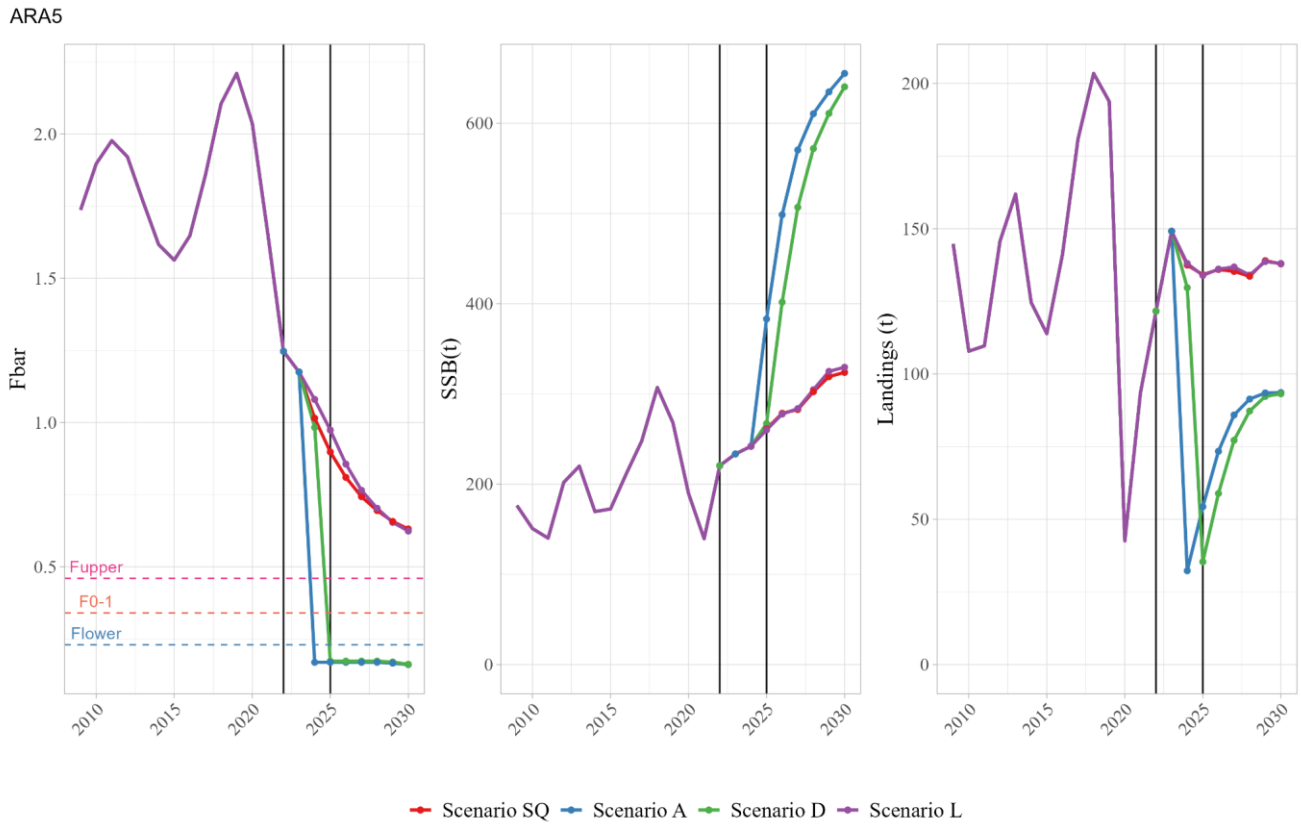


Figure 6.1.2.19. EMU1 (IAM model). Predicted median values for blue and red shrimp GSA5 (ARA5) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

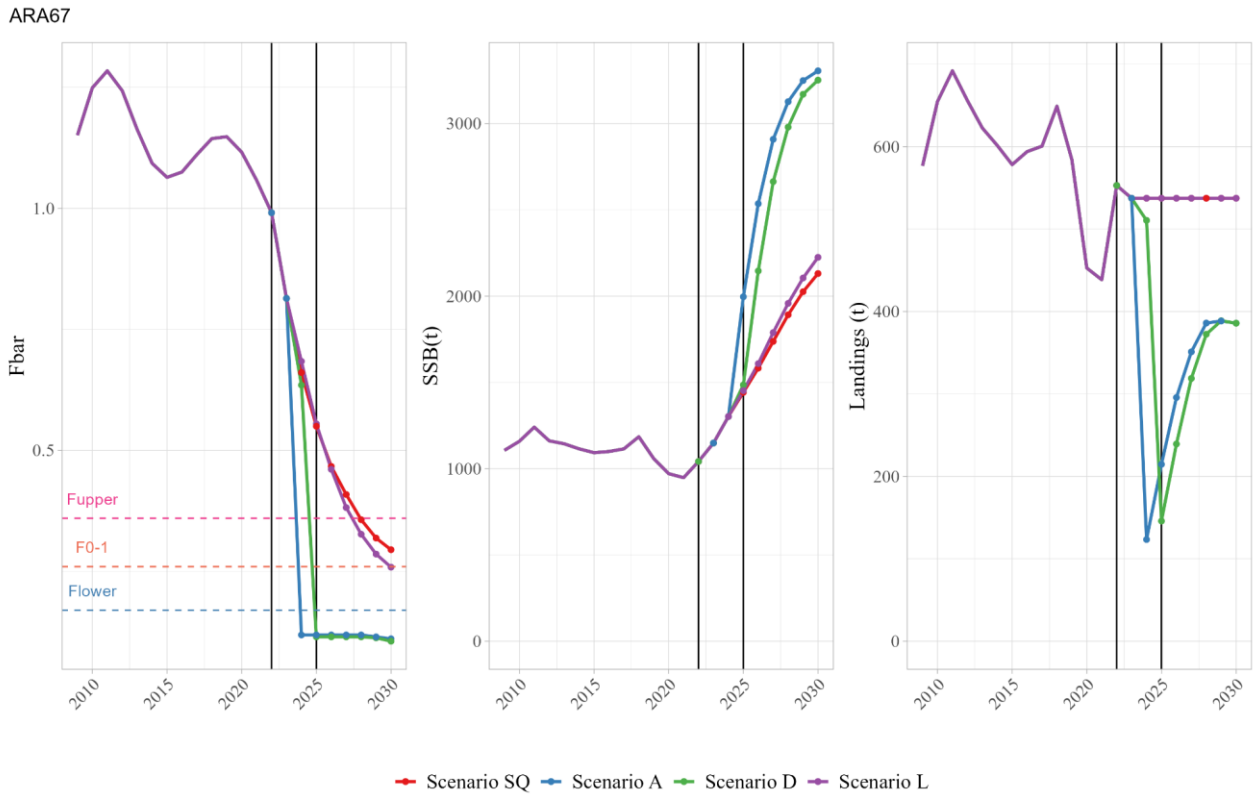


Figure 6.1.2.20. EMU1 (IAM model). Predicted median values for blue and red shrimp GSAs6-7 (ARA67) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

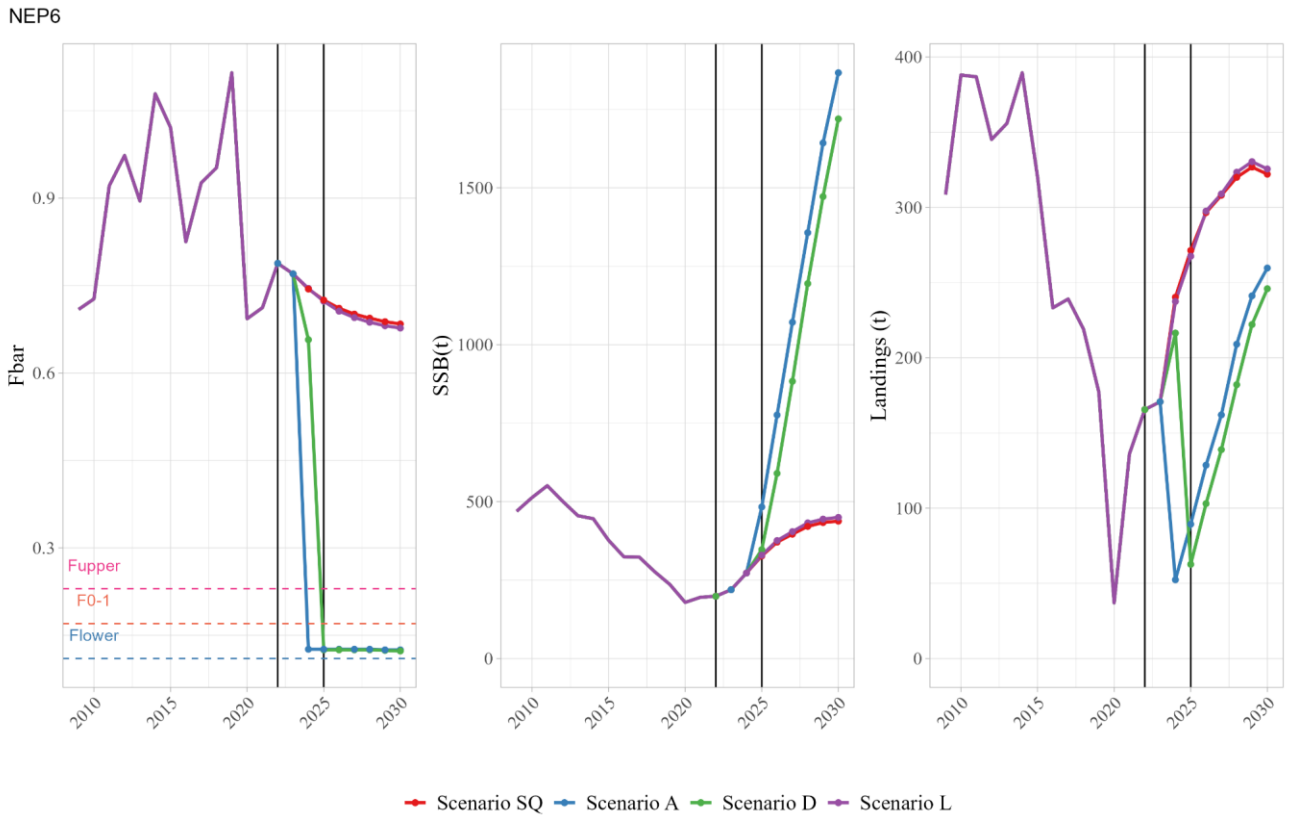


Figure 6.1.2.21. EMU1 (IAM model). Predicted median values for Norway lobster GSA6 (NEP6) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

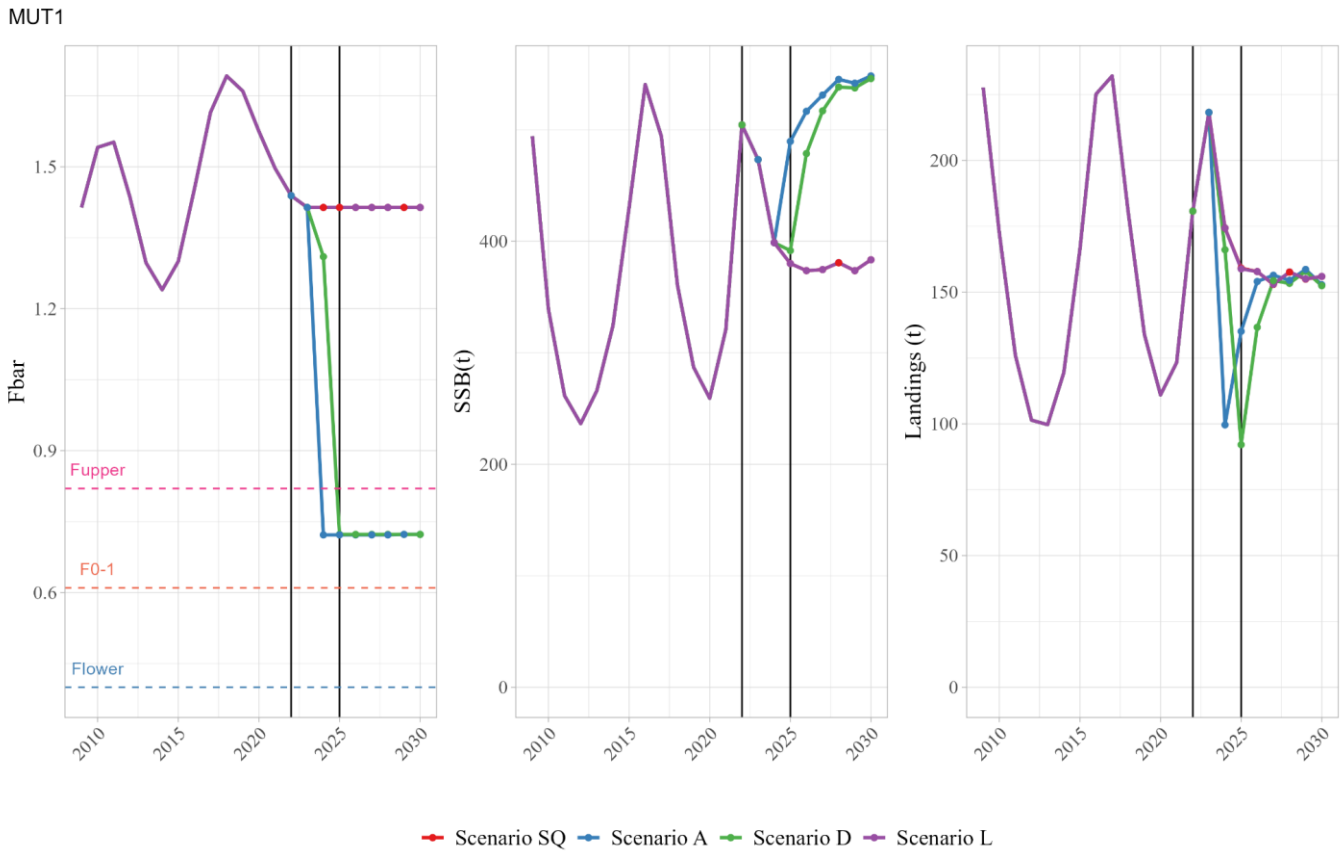


Figure 6.1.2.22. EMU1 (IAM model). Predicted median values for red mullet GSA1 (MUT1) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

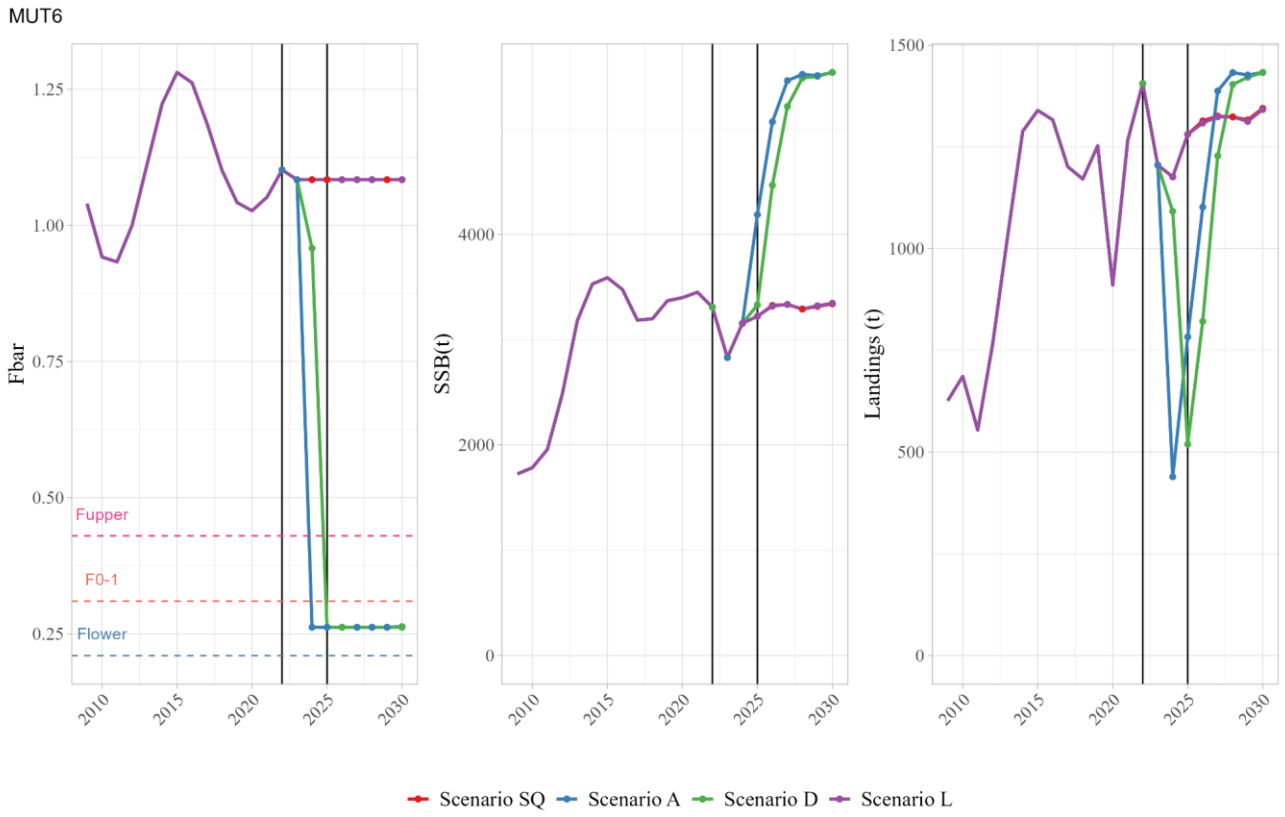


Figure 6.1.2.23. EMU1 (IAM model). Predicted median values for red mullet GSA6 (MUT6) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

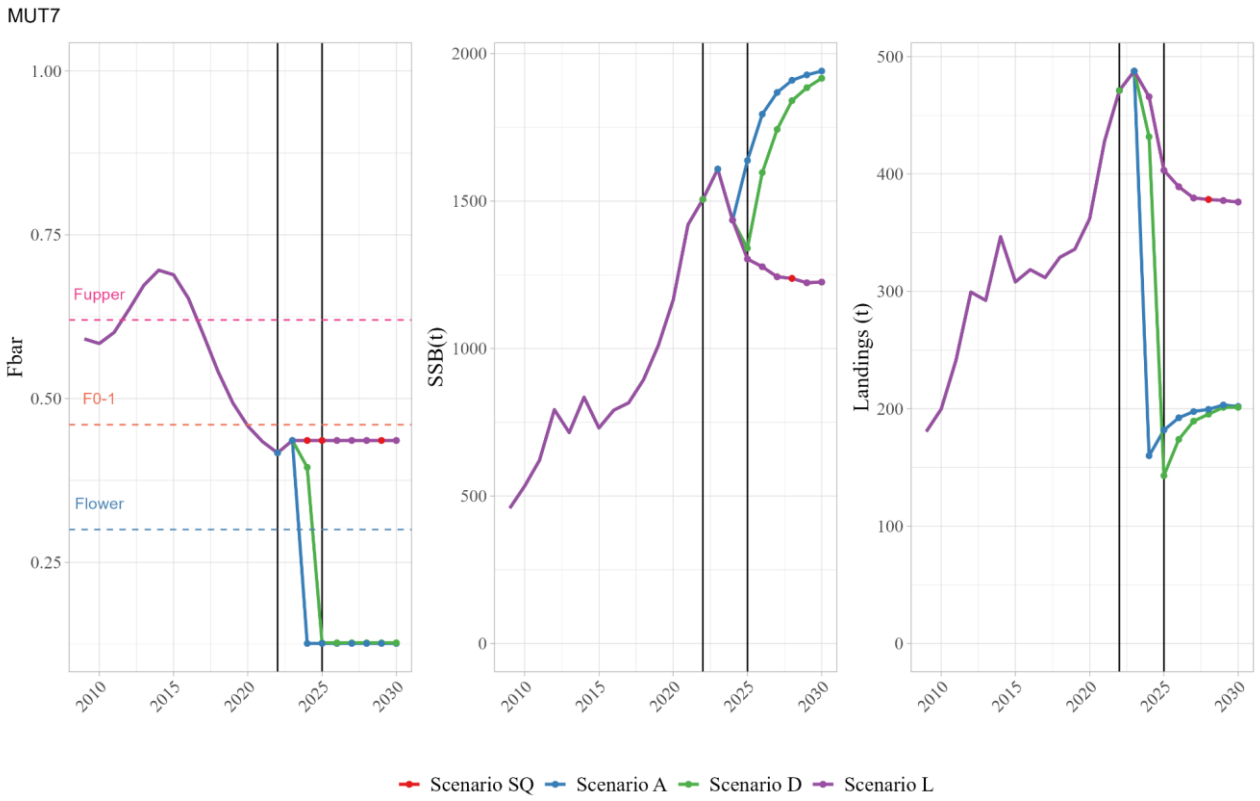


Figure 6.1.2.24. EMU1 (IAM model). Predicted median values for red mullet GSA7 (MUT7) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

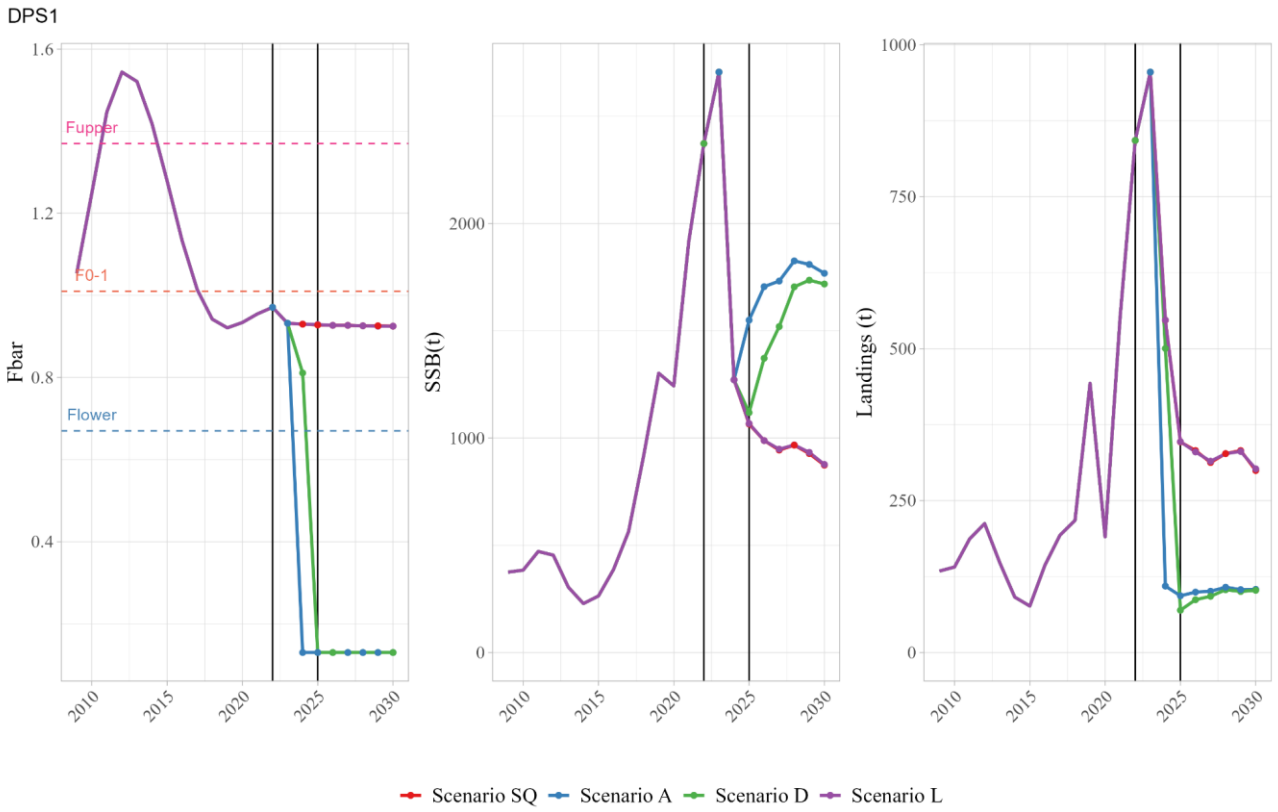


Figure 6.1.2.25. EMU1 (IAM model). Predicted median values for deep-water rose shrimp GSA1 (DPS1) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

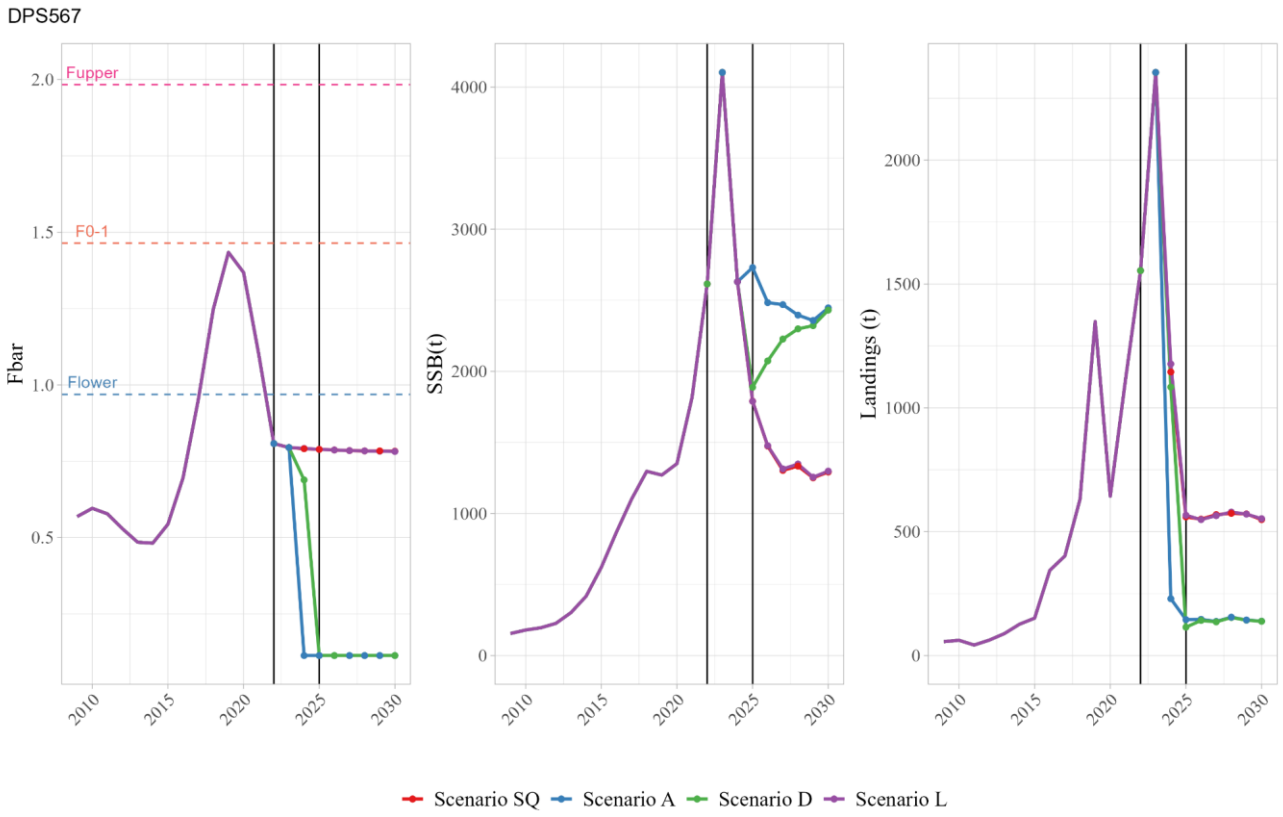


Figure 6.1.2.26. EMU1 (IAM model). Predicted median values for deep-water rose shrimp GSAs5-6-7 (DPS567) fishing mortality (left), SSB (middle) and total landings (right) under the four alternative scenarios (in colors). Historical values are shown on the left of the first vertical black line, which indicates the year 2022, and the simulated values on the right of this first vertical line. The second vertical black line indicates the year 2025.

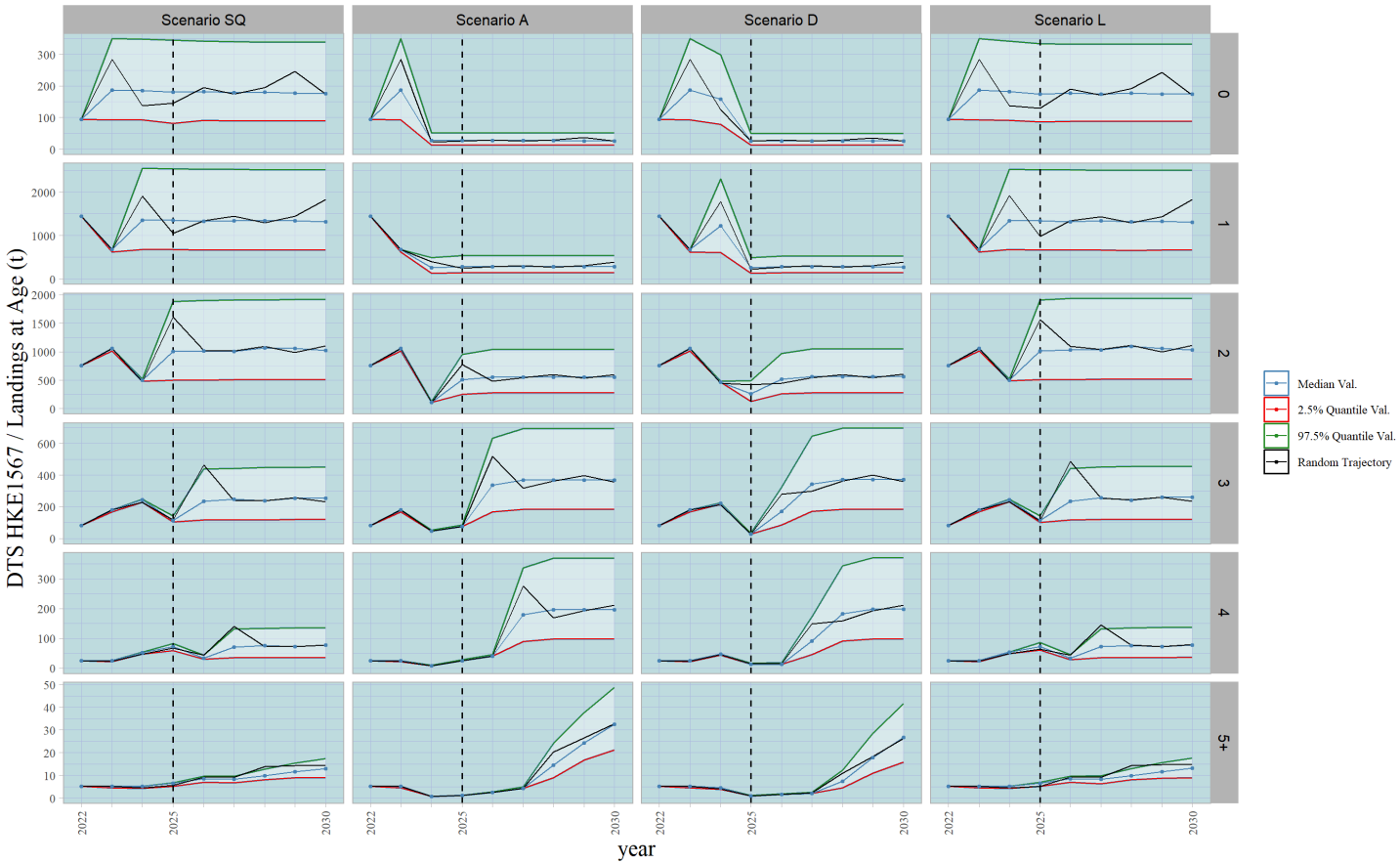


Figure 6.1.2.27. EMU1 (IAM model). Evolution of the total annual landings by age (in tonnes) by French and Spanish trawlers (DTS) of hake GSAs1-5-6-7 (HKE1567) under alternative scenarios from 2022 to 2030. Scenarios are in column and HKE1567 ages in row. Vertical black dotted lines indicate the year 2025. Scenarios are in column and ages in row.

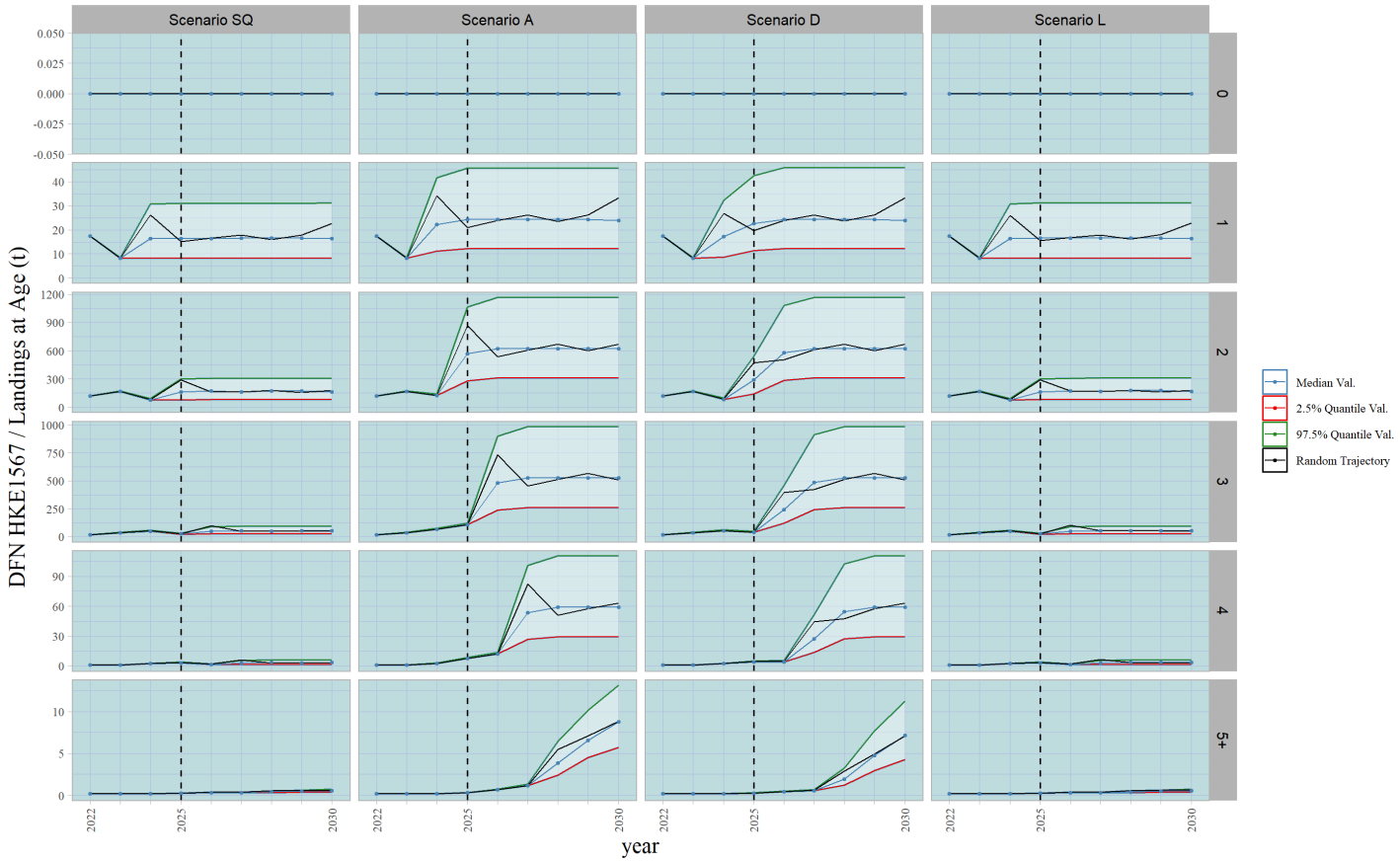


Figure 6.1.2.28. EMU1 (IAM model). Evolution of the total annual landings by age (in tonnes) by French and Spanish netters (DFN) of hake GSAs1-5-6-7 (HKE1567) under alternative scenarios from 2022 to 2030. Scenarios are in column and HKE1567 ages in row. Vertical black dotted lines indicate the year 2025. Scenarios are in column and ages in row.

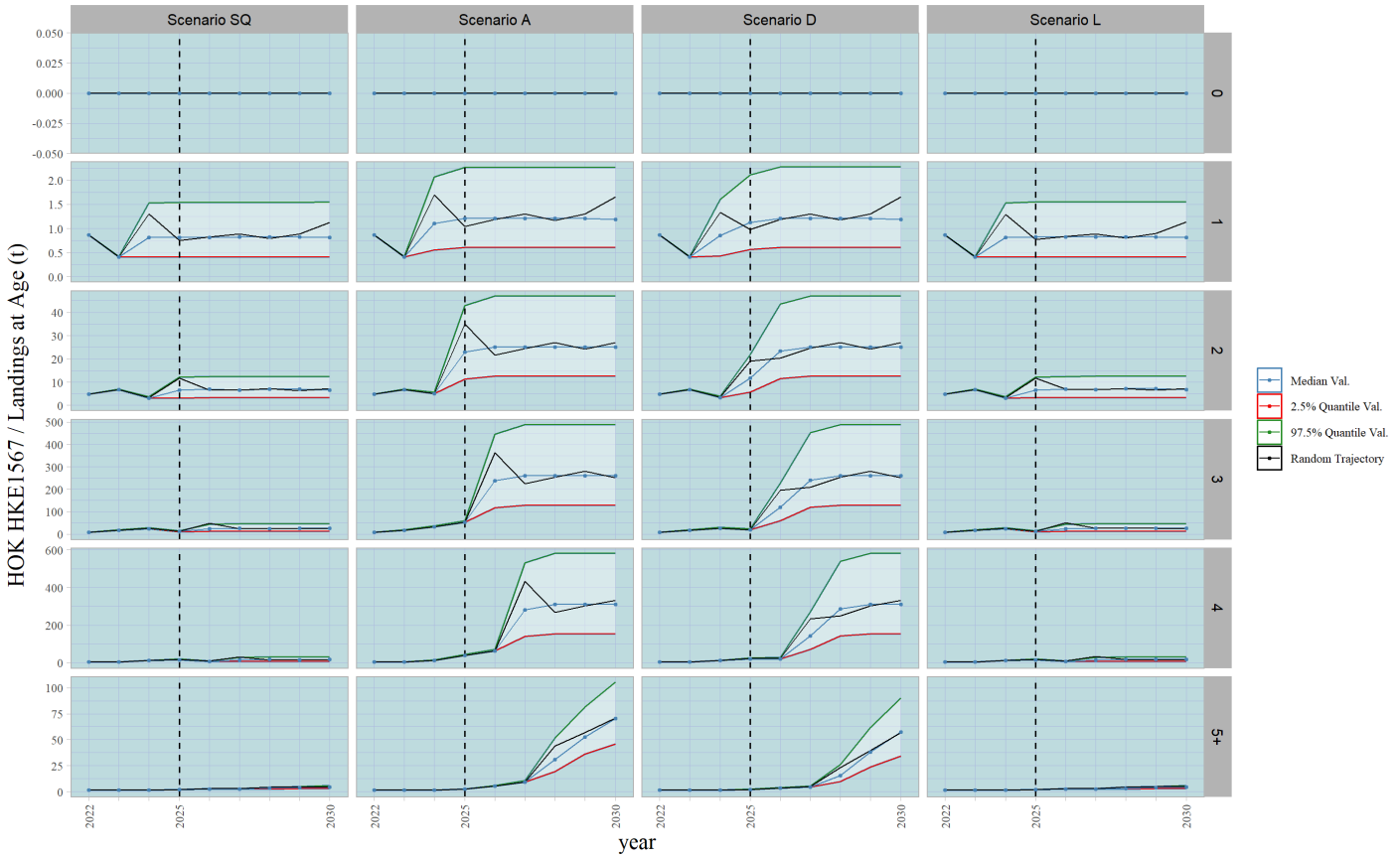


Figure 6.1.2.29. EMU1 (IAM model). Evolution of the total annual landings by age (in tonnes) by French and Spanish vessels using hooks (HOK) of hake GSAs1-5-6-7 (HKE1567) under alternative scenarios from 2022 to 2030. Scenarios are in column and HKE1567 ages in row. Vertical black dotted lines indicate the year 2025. Scenarios are in column and ages in row.

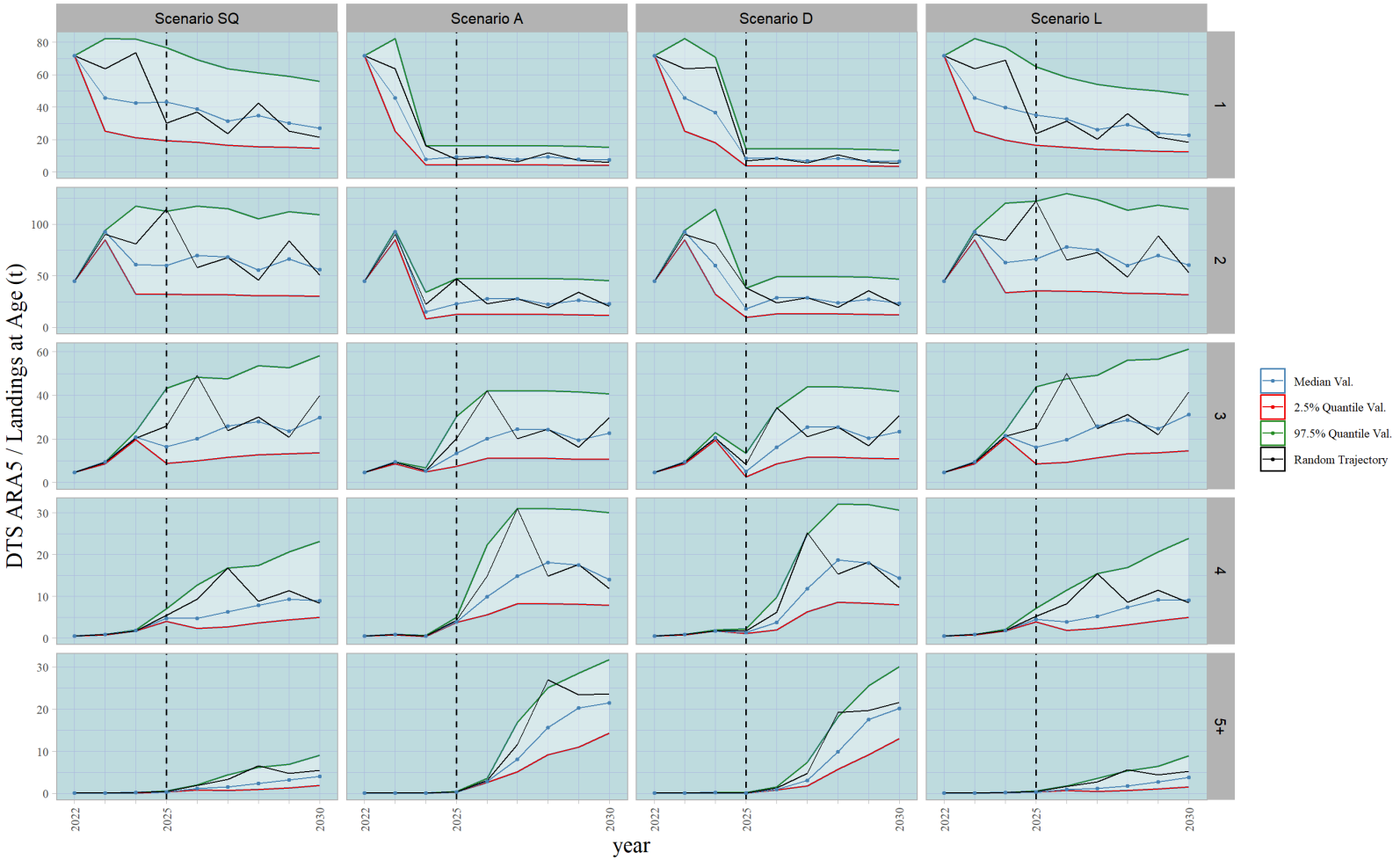


Figure 6.1.2.30. EMU1 (IAM model). Evolution of the total annual landings by age (in tonnes) by French and Spanish trawlers (DTS) of blue and red shrimp GSA5 (ARA5) under alternative scenarios from 2022 to 2030. Scenarios are in column and ARA5 ages in row. Vertical black dotted lines indicate the year 2025. Scenarios are in column and ages in row.

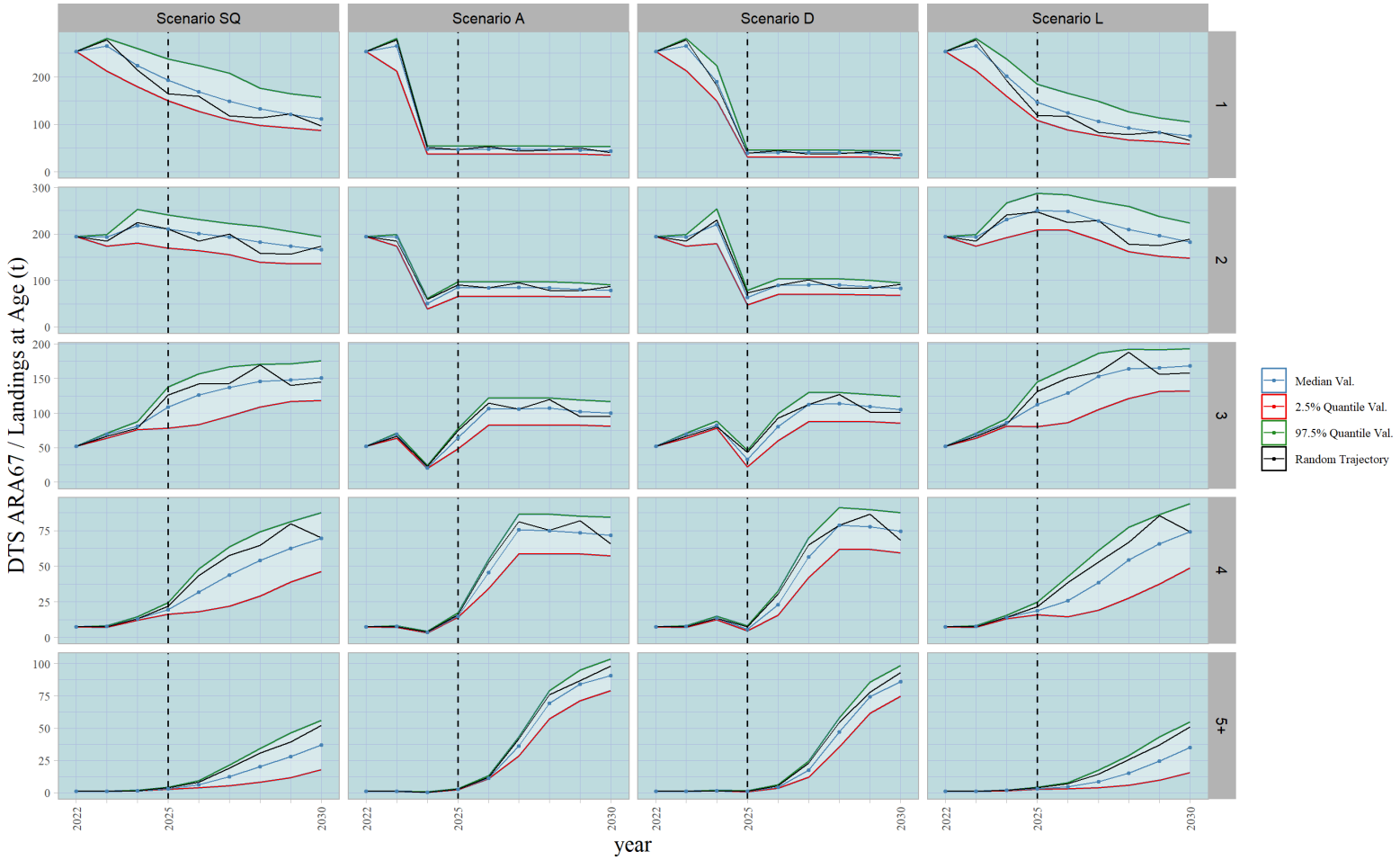


Figure 6.1.2.31. EMU1 (IAM model). Evolution of the total annual landings by age (in tonnes) by French and Spanish trawlers (DTS) of blue and red shrimp GSAs6-7 (ARA67) under alternative scenarios from 2022 to 2030. Scenarios are in column and ARA67 ages in row. Vertical black dotted lines indicate the year 2025. Scenarios are in column and ages in row.

Table 6.1.2.1. EMU1 (IAM model). Estimated total landings in 2024 (in tons) per stock by scenario. The median values are used. Single-stock catch advice for 2024 values are from EWG23-09.

| Stock | Single-stock catch advice for 2024 | Total landings (in tons) per scenario 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| HKE1567 | 350 | 3127.4 | 1486.1 | 2938.2 | 3118.5 |
| ARA5 | 51 | 137.5 | 32.3 | 129.7 | 138.0 |
| ARA67 | 214 | 537.5 | 123.4 | 510.6 | 537.5 |
| NEP6 | 7 | 240.3 | 52.4 | 216.4 | 237.4 |
| MUT1 | 68 | 174.3 | 99.6 | 166.1 | 174.3 |
| MUT6 | 365 | 1176.5 | 439.4 | 1091.8 | 1176.5 |
| MUT7 | 494 | 465.8 | 160.0 | 431.7 | 465.8 |
| DPS1 | 1007 | 546.9 | 109.3 | 500.4 | 547.0 |
| DPS567 | 3092 | 1144.9 | 229.4 | 1083.9 | 1177.3 |

Table 6.1.2.2. EMU1 (IAM model). Estimated Fbar in 2024 per stock by scenario. The median values are used. Single-stock advice F for 2024 values are from EWG23-09.

| Stock | Single-stock advice F for 2024 | Fbar in 2024 per scenario | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| HKE1567 | 0.11 | 1.32 | 0.41 | 1.19 | 1.32 |
| ARA5 | 0.26 | 1.02 | 0.17 | 0.98 | 1.08 |
| ARA67 | 0.24 | 0.66 | 0.12 | 0.63 | 0.68 |
| NEP6 | 0.03 | 0.74 | 0.13 | 0.66 | 0.75 |
| MUT1 | 0.36 | 1.41 | 0.72 | 1.31 | 1.41 |
| MUT6 | 0.25 | 1.08 | 0.26 | 0.96 | 1.08 |
| MUT7 | 0.46 | 0.44 | 0.13 | 0.39 | 0.44 |
| DPS1 | 1.01 | 0.93 | 0.13 | 0.81 | 0.93 |
| DPS567 | 1.45 | 0.79 | 0.11 | 0.69 | 0.79 |

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.1.2.3. EMU1 (IAM model). Estimated Spawning Stock Biomass (SSB) in 2024 (in tons) per stock by scenario. The median values are used. Single-stock advice SSB for 2024 values are from EWG23-09.

| Stock | Single-stock advice SSB for 2024 | Spawning Stock Biomass (SSB) in 2024 per scenario (in tons) | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| HKE1567 | 2074.7 | 2116.24 | 2116.24 | 2116.24 | 2116.24 |
| ARA5 | -** | 241.94 | 241.94 | 241.94 | 241.94 |
| ARA67 | -** | 1302.11 | 1302.11 | 1302.11 | 1302.11 |
| NEP6 | -** | 272.43 | 272.43 | 272.43 | 272.43 |
| MUT1 | -** | 398.76 | 398.76 | 398.76 | 398.76 |
| MUT6 | -** | 3154.21 | 3154.21 | 3154.21 | 3154.21 |
| MUT7 | -** | 1435.12 | 1435.12 | 1435.12 | 1435.12 |
| DPS1* | 1178 | 1271.54 | 1271.54 | 1271.52 | 1271.52 |
| DPS567* | 1385 | 2630.39 | 2630.39 | 2630.40 | 2630.40 |

* to note : no estimations from EWG 23-09 of Bpa and Blim for DPS1 and DPS567.

** values from the short term projections ran in EWG 2309 were not available

Legend:

| | |
|---|---|
| | SSB2024 >Bpa |
| | Blim < SSB2024 < Bpa |
| | SSB2024 < Blim |

Table 6.1.2.4. EMU1 (IAM model). Estimated Fbar in 2025 and in 2030 per stock by scenario. The median values are used.

| Stock | Fbar in 2025 per scenario | | | |
|---|---|---|---|---|
| | SQ | A | D | L |
| HKE1567 | 1.31 | 0.41 | 0.41 | 1.31 |
| ARA5 | 0.90 | 0.17 | 0.17 | 0.97 |
| ARA67 | 0.55 | 0.12 | 0.12 | 0.55 |
| NEP6 | 0.72 | 0.13 | 0.12 | 0.72 |
| MUT1 | 1.41 | 0.72 | 0.72 | 1.41 |
| MUT6 | 1.08 | 0.26 | 0.26 | 1.08 |
| MUT7 | 0.44 | 0.13 | 0.13 | 0.44 |
| DPS1 | 0.93 | 0.13 | 0.13 | 0.93 |
| DPS567 | 0.79 | 0.11 | 0.11 | 0.79 |
| **Stock** | **Fbar in 2030 per scenario** | | | |
| | **SQ** | **A** | **D** | **L** |
| HKE1567 | 1.30 | 0.41 | 0.41 | 1.30 |
| ARA5 | 0.63 | 0.16 | 0.16 | 0.62 |
| ARA65 | 0.30 | 0.11 | 0.11 | 0.26 |
| NEP6 | 0.68 | 0.12 | 0.12 | 0.68 |
| MUT1 | 1.41 | 0.72 | 0.72 | 1.41 |
| MUT6 | 1.08 | 0.26 | 0.26 | 1.08 |
| MUT7 | 0.44 | 0.13 | 0.13 | 0.44 |
| DPS1 | 0.93 | 0.13 | 0.13 | 0.93 |
| DPS567 | 0.78 | 0.11 | 0.11 | 0.78 |

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.1.2.5. EMU1 (IAM model). Percentage of change in total landings per stock and by scenario between 2022 and 2024, between 2022 and 2025, and between 2022 and 2030. The median values are used.

| Stock | % of change in total landings between 2022 and 2024 per scenario (in %) | | | |
|---|---|---|---|---|
| | SQ | A | D | L |
| HKE1567 | 1.26 | -51.88 | -4.87 | 0.97 |
| ARA5 | 13.03 | -73.45 | 6.63 | 13.46 |
| ARA67 | -2.81 | -77.69 | -7.67 | -2.81 |
| NEP6 | 45.14 | -68.35 | 30.72 | 43.42 |
| MUT1 | -3.54 | -44.89 | -8.10 | -3.54 |
| MUT6 | -16.31 | -68.75 | -22.34 | -16.31 |
| MUT7 | -1.14 | -66.05 | -8.37 | -1.14 |
| DPS1 | -35.10 | -87.02 | -40.62 | -35.08 |
| DPS567 | -26.33 | -85.24 | -30.26 | -24.25 |
| **Stock** | **% of change in total landings between 2022 and 2025 per scenario (in %)** | | | |
| | **SQ** | **A** | **D** | **L** |
| HKE1567 | 22.02 | -13.87 | -40.33 | 20.88 |
| ARA5 | 10.30 | -55.33 | -70.91 | 10.10 |
| ARA67 | -2.81 | -61.19 | -73.63 | -2.81 |
| NEP6 | 63.91 | -46.02 | -62.15 | 61.59 |
| MUT1 | -11.96 | -25.24 | -49.05 | -12.11 |
| MUT6 | -8.87 | -44.30 | -63.05 | -8.87 |
| MUT7 | -14.43 | -61.41 | -69.65 | -14.43 |
| DPS1 | -58.88 | -88.92 | -91.74 | -58.82 |
| DPS567 | -63.98 | -90.67 | -92.63 | -63.55 |

| Stock | % of change in total landings between 2022 and 2030 per scenario | | | |
|---|---|---|---|---|
| | SQ | A | D | L |
| HKE1567 | 27.20 | 45.95 | 45.40 | 27.99 |
| ARA5 | 13.36 | -23.06 | -23.39 | 13.47 |
| ARA67 | -2.81 | -30.22 | -30.23 | -2.81 |
| NEP6 | 94.54 | 56.84 | 48.54 | 96.62 |
| MUT1 | -13.71 | -15.45 | -15.65 | -13.71 |
| MUT6 | -4.33 | 1.95 | 1.93 | -4.54 |
| MUT7 | -20.16 | -57.13 | -57.29 | -20.16 |
| DPS1 | -64.45 | -87.66 | -87.85 | -64.13 |
| DPS567 | -64.69 | -91.07 | -91.10 | -64.44 |

Table 6.1.2.6. EMU1 (IAM model). Socio-economic outputs by fleet segments and per scenarios such as : Gross Profit Margin in 2025, and in 2030, percentage of change in Gross Profit Margin between 2022 and 2025, and between 2022 and 2030, Full Time Equivalent (FTE) change between 2022 and 2024, between 2022 and 2025, and between 2022 and 2030 (in numbers of FTE per fleet), and percentage of change of FTE between 2022 and 2025 , and between 2022 and 2030. The median values from simulations are used.

| Scenarios | Fleet segments | (Estimated level of profitability) Gross profit margin in 2025 | (Estimated level of profitability) Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| SQ | FR_DTS 1824m | 0.16 | 0.16 | 62.01% | 63.58% | 0.74 | 0.74 | 0.74 | 1.42% | 1.42% |
| | FR_DTS >=24m | 0.12 | 0.12 | 150.58% | 151.96% | 7.13 | 7.13 | 7.13 | 8.79% | 8.79% |
| | FR_DFN <6m | 0.26 | 0.26 | 3.37% | 3.33% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_DFN 612m | 0.19 | 0.19 | 6.00% | 5.92% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK < 6 m | 0.14 | 0.14 | 20.88% | 20.88% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK 612 m | -0.08 | -0.07 | -18.97% | -27.57% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | FR_HOK 1218 m | 0.10 | 0.10 | 1.61% | 1.61% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DTS < 12m | 0.53 | 0.54 | 4.79% | 4.93% | 0.88 | 0.88 | 0.88 | 4.47% | 4.47% |
| | SP_DTS 1218m | 0.26 | 0.26 | -0.12% | 0.37% | -17.72 | -19.49 | -23.47 | -6.35% | -7.65% |
| | SP_DTS 1824m | 0.20 | 0.21 | 6.04% | 8.89% | -62.50 | -84.23 | -130.65 | -10.62% | -16.48% |
| | SP_DTS >=24m | 0.11 | 0.12 | 59.82% | 75.43% | -46.25 | -70.13 | -121.16 | -15.10% | -26.09% |
| | SP_DFN 612m | 0.45 | 0.46 | 4.38% | 5.75% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DFN 1218m | 0.39 | 0.39 | 9.30% | 11.89% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP_HOK 612 m | 0.12 | 0.12 | 56.84% | 60.25% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1218 m | 0.01 | 0.02 | -728.03% | -863.32% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1824 m | 0.06 | 0.06 | 53.55% | 53.55% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| A | FR_DTS 1824m | -0.40 | -0.29 | -505.74% | -393.16% | -44.92 | -44.92 | -44.89 | -85.87% | -85.82% |
| | FR_DTS >=24m | -0.32 | -0.23 | -750.69% | -558.63% | -66.22 | -66.22 | -66.18 | -81.61% | -81.56% |
| | FR_DFN <6m | 0.26 | 0.27 | 4.38% | 4.66% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_DFN 612m | 0.21 | 0.22 | 16.06% | 18.06% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK < 6 m | 0.14 | 0.14 | 20.88% | 20.88% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | FR_HOK 612 m | -0.05 | 0.08 | -49.83% | -185.23% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK 1218 m | 0.10 | 0.10 | 1.61% | 1.61% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DTS < 12m | 0.48 | 0.49 | -6.52% | -4.71% | -11.61 | -11.61 | -11.60 | -58.70% | -58.67% |
| | SP_DTS 1218m | -0.33 | -0.10 | -227.58% | -139.38% | -266.10 | -266.10 | -266.10 | -86.73% | -86.73% |
| | SP_DTS 1824m | -0.25 | -0.01 | -229.68% | -104.02% | -686.06 | -686.06 | -687.30 | -86.52% | -86.67% |
| | SP_DTS >=24m | -0.36 | -0.07 | -629.33% | -199.20% | -400.47 | -400.47 | -402.00 | -86.24% | -86.57% |
| | SP_DFN 612m | 0.50 | 0.55 | 14.10% | 26.73% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DFN 1218m | 0.44 | 0.51 | 24.73% | 43.79% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 612 m | 0.14 | 0.22 | 74.46% | 189.77% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP_HOK 1218 m | 0.02 | 0.09 | -1288.85% | -4524.87% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1824 m | 0.06 | 0.06 | 53.55% | 53.55% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| D | FR_DTS 1824m | -0.50 | -0.27 | -615.62% | -379.40% | -5.10 | -44.75 | -44.72 | -85.54% | -85.49% |
| | FR_DTS >=24m | -0.45 | -0.23 | -1005.50% | -568.04% | -3.08 | -66.37 | -66.33 | -81.80% | -81.75% |
| | FR_DFN <6m | 0.26 | 0.27 | 3.71% | 4.65% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_DFN 612m | 0.20 | 0.22 | 9.63% | 18.04% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK < 6 m | 0.14 | 0.14 | 20.88% | 20.88% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | FR_HOK 612 m | -0.07 | 0.08 | -25.87% | -183.43% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK 1218 m | 0.10 | 0.10 | 1.61% | 1.61% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DTS < 12m | 0.47 | 0.49 | -7.89% | -4.82% | -1.14 | -11.63 | -11.62 | -58.82% | -58.78% |
| | SP_DTS 1218m | -0.49 | -0.10 | -289.54% | -139.70% | -51.05 | -265.59 | -265.62 | -86.57% | -86.58% |
| | SP_DTS 1824m | -0.45 | -0.01 | -331.02% | -106.17% | -134.97 | -684.75 | -686.37 | -86.35% | -86.55% |
| | SP_DTS >=24m | -0.62 | -0.07 | -1015.49 % | -209.48% | -78.44 | -399.46 | -401.42 | -86.02% | -86.44% |
| | SP_DFN 612m | 0.47 | 0.55 | 7.64% | 26.72% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DFN 1218m | 0.40 | 0.51 | 14.55% | 43.78% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP_HOK 612 m | 0.13 | 0.22 | 61.40% | 187.54% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1218 m | 0.02 | 0.09 | -853.09% | -4484.62 % | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1824 m | 0.06 | 0.06 | 53.55% | 53.55% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| L | FR_DTS 1824m | 0.16 | 0.16 | 62.23% | 63.89% | 0.74 | 0.74 | 0.74 | 1.42% | 1.42% |
| | FR_DTS >=24m | 0.12 | 0.12 | 151.19% | 152.87% | 7.13 | 7.13 | 7.13 | 8.79% | 8.79% |
| | FR_DFN <6m | 0.26 | 0.26 | 3.37% | 3.34% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_DFN 612m | 0.19 | 0.19 | 6.04% | 5.98% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK < 6 m | 0.14 | 0.14 | 20.88% | 20.88% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | FR_HOK 612 m | -0.08 | -0.07 | -18.91% | -27.92% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | FR_HOK 1218 m | 0.10 | 0.10 | 1.61% | 1.61% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DTS < 12m | 0.53 | 0.54 | 4.82% | 4.97% | 0.88 | 0.88 | 0.88 | 4.47% | 4.47% |
| | SP_DTS 1218m | 0.26 | 0.26 | 0.37% | 0.78% | -16.35 | -17.65 | -23.29 | -5.75% | -7.59% |
| | SP_DTS 1824m | 0.20 | 0.21 | 5.12% | 9.07% | -46.68 | -61.14 | -128.61 | -7.71% | -16.22% |
| | SP_DTS >=24m | 0.10 | 0.12 | 54.73% | 75.28% | -27.27 | -44.43 | -118.90 | -9.57% | -25.60% |
| | SP_DFN 612m | 0.45 | 0.46 | 4.39% | 5.80% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_DFN 1218m | 0.39 | 0.39 | 9.33% | 12.00% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 612 m | 0.12 | 0.12 | 56.83% | 60.47% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

| Scenarios | Fleet segments | (Estimated level of profitability)<br>Gross profit margin in 2025 | (Estimated level of profitability)<br>Gross profit margin in 2030 | % Gross profit margin change between 2022 – 2025 | % Gross profit margin change between 2022 - 2030 | FTE evolution between 2022 and 2024 (in number of FTE per fleet) | FTE evolution between 2022 and 2025 (in number of FTE per fleet) | FTE evolution between 2022 and 2030 (in number of FTE per fleet) | % of change of FTE by fleet between 2022-2025 | % of change of FTE by fleet between 2022-2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| | SP_HOK 1218 m | 0.01 | 0.02 | -727.78% | -868.48% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |
| | SP_HOK 1824 m | 0.06 | 0.06 | 53.55% | 53.55% | 0.00 | 0.00 | 0.00 | 0.00% | 0.00% |

Legend:

| | Indicator |
|---|---|
| | **Gross Profit Margin** |
| | >10% - High |
| | 0-10% - Reasonable |
| | <0% - Weak |

| | MS | Estimated Number of fleet segments in red (which do not cover costs and may not be financially viable) in 2025 | Estimated Number of fleet segments in red (which do not cover costs and may not be financially viable) in 2030 |
|---|---|---|---|
| **Scenario SQ** | **France** | 1 (1 HOK) | 1 (1HOK) |
| | **Spain** | 0 | 0 |
| **Scenario A** | **France** | 3 (2 DTS, 1 HOK) | 2 (2 DTS) |
| | **Spain** | 3 (3 DTS) | 3 (3 DTS) |
| **Scenario D** | **France** | 3 (2 DTS, 1 HOK) | 2 (2 DTS) |
| | **Spain** | 3 (3 DTS) | 3 (3 DTS) |
| **Scenario L** | **France** | 1 (1 HOK) | 1 (1HOK) |
| | **Spain** | 0 | 0 |

**Social and economic values by management scenarios for 2024 and 2025**

Table 6.1.2.7. EMU1 (IAM model). Estimated values by fleet segments and per scenarios in 2024 for the following socio-economic indicators: Gross Value Added (GVA), Gross Profit, Gross Profit Margin, Full Time Equivalent (FTE), engaged crew, average salary (i.e. crew cost / FTE), and CR/BER. The median values are used.

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| **Total Gross Value Added (GVA) per fleet in 2024 (in kEuros)** | FR_DTS 1824m | 7515.9 | -333.3 | 6579.8 | 7516.1 |
| | FR_DTS >=24m | 10479.9 | -79.5 | 9123.9 | 10482.5 |
| | FR_DFN <6m | 4357.1 | 4373.7 | 4359.0 | 4357.1 |
| | FR_DFN 612m | 17072.6 | 17427.5 | 17111.0 | 17072.2 |
| | FR_HOK < 6 m | 176.5 | 176.5 | 176.5 | 176.5 |
| | FR_HOK 612 m | 2592.0 | 2666.8 | 2600.5 | 2591.6 |
| | FR_HOK 1218 m | 2340.7 | 2340.7 | 2340.7 | 2340.7 |
| | SP_DTS < 12m | 1359.6 | 574.5 | 1241.7 | 1359.8 |
| | SP_DTS 1218m | 12462.2 | -412.0 | 10997.6 | 12518.9 |
| | SP_DTS 1824m | 41812.9 | -515.6 | 36884.9 | 41759.0 |
| | SP_DTS >=24m | 24693.7 | -1624.3 | 21596.3 | 24536.1 |
| | SP_DFN 612m | 3332.0 | 3496.7 | 3350.5 | 3331.6 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | SP_DFN 1218m | 3135.3 | 3357.6 | 3160.2 | 3134.7 |
| | SP_HOK 612 m | 369.2 | 374.1 | 369.8 | 369.2 |
| | SP_HOK 1218 m | 2085.9 | 2108.1 | 2088.5 | 2085.8 |
| | SP_HOK 1824 m | 1549.2 | 1549.2 | 1549.2 | 1549.2 |
| **Total Gross profit (GP) by fleet in 2024 (in kEuros)** | FR_DTS 1824m | 2081.8 | -1158.2 | 1695.4 | 2081.8 |
| | FR_DTS >=24m | 2303.7 | -1742.0 | 1784.2 | 2304.8 |
| | FR_DFN <6m | 1404.6 | 1411.6 | 1405.4 | 1404.6 |
| | FR_DFN 612m | 4308.9 | 4448.8 | 4324.1 | 4308.8 |
| | FR_HOK < 6 m | 38.5 | 38.5 | 38.5 | 38.5 |
| | FR_HOK 612 m | -419.2 | -397.0 | -416.7 | -419.3 |
| | FR_HOK 1218 m | 276.6 | 276.6 | 276.6 | 276.6 |
| | SP_DTS < 12m | 915.2 | 366.9 | 832.9 | 915.3 |
| | SP_DTS 1218m | 5586.8 | -1582.3 | 4771.2 | 5618.3 |
| | SP_DTS 1824m | 15025.9 | -5526.5 | 12633.1 | 14999.7 |
| | SP_DTS >=24m | 4647.2 | -5606.4 | 3440.4 | 4585.8 |
| | SP_DFN 612m | 2366.8 | 2491.8 | 2380.9 | 2366.5 |
| | SP_DFN 1218m | 1861.0 | 2007.9 | 1877.5 | 1860.6 |
| | SP_HOK 612 m | 158.7 | 162.2 | 159.1 | 158.7 |
| | SP_HOK 1218 m | 92.8 | 106.0 | 94.4 | 92.8 |
| | SP_HOK 1824 m | 213.7 | 213.7 | 213.7 | 213.7 |
| **Gross profit margin in 2024** | FR_DTS 1824m | 0.15 | -0.57 | 0.14 | 0.15 |
| | FR_DTS >=24m | 0.12 | -0.47 | 0.10 | 0.12 |
| | FR_DFN <6m | 0.26 | 0.26 | 0.26 | 0.26 |
| | FR_DFN 612m | 0.19 | 0.19 | 0.19 | 0.19 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | FR_HOK < 6 m | 0.14 | 0.14 | 0.14 | 0.14 |
| | FR_HOK 612 m | -0.07 | -0.07 | -0.07 | -0.07 |
| | FR_HOK 1218 m | 0.10 | 0.10 | 0.10 | 0.10 |
| | SP_DTS < 12m | 0.54 | 0.47 | 0.53 | 0.54 |
| | SP_DTS 1218m | 0.27 | -0.47 | 0.26 | 0.27 |
| | SP_DTS 1824m | 0.22 | -0.45 | 0.20 | 0.22 |
| | SP_DTS >=24m | 0.11 | -0.69 | 0.09 | 0.11 |
| | SP_DFN 612m | 0.45 | 0.46 | 0.45 | 0.45 |
| | SP_DFN 1218m | 0.38 | 0.40 | 0.39 | 0.38 |
| | SP_HOK 612 m | 0.12 | 0.12 | 0.12 | 0.12 |
| | SP_HOK 1218 m | 0.01 | 0.02 | 0.01 | 0.01 |
| | SP_HOK 1824 m | 0.06 | 0.06 | 0.06 | 0.06 |
| Employment: **Total FTE per fleet in 2024** | FR_DTS 1824m | 53.1 | 7.4 | 47.2 | 53.1 |
| | FR_DTS >=24m | 88.3 | 14.9 | 78.1 | 88.3 |
| | FR_DFN <6m | 47.0 | 47.0 | 47.0 | 47.0 |
| | FR_DFN 612m | 206.6 | 206.6 | 206.6 | 206.6 |
| | FR_HOK < 6 m | 5.1 | 5.1 | 5.1 | 5.1 |
| | FR_HOK 612 m | 43.2 | 43.2 | 43.2 | 43.2 |
| | FR_HOK 1218 m | 7.3 | 7.3 | 7.3 | 7.3 |
| | SP_DTS < 12m | 20.7 | 8.2 | 18.6 | 20.7 |
| | SP_DTS 1218m | 289.1 | 40.7 | 255.8 | 290.4 |
| | SP_DTS 1824m | 730.5 | 106.9 | 658.0 | 746.3 |
| | SP_DTS >=24m | 418.1 | 63.9 | 385.9 | 437.1 |
| | SP_DFN 612m | 107.1 | 107.1 | 107.1 | 107.1 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | SP_DFN 1218m | 88.6 | 88.6 | 88.6 | 88.6 |
| | SP_HOK 612 m | 23.9 | 23.9 | 23.9 | 23.9 |
| | SP_HOK 1218 m | 96.9 | 96.9 | 96.9 | 96.9 |
| | SP_HOK 1824 m | 37.4 | 37.4 | 37.4 | 37.4 |
| Employment: **Engaged crew per fleet in 2024** | FR_DTS 1824m | 70 | 70 | 70 | 70 |
| | FR_DTS >=24m | 101 | 101 | 101 | 101 |
| | FR_DFN <6m | 145 | 145 | 145 | 145 |
| | FR_DFN 612m | 549 | 549 | 549 | 549 |
| | FR_HOK < 6 m | 14 | 14 | 14 | 14 |
| | FR_HOK 612 m | 142 | 142 | 142 | 142 |
| | FR_HOK 1218 m | 38 | 38 | 38 | 38 |
| | SP_DTS < 12m | 48 | 48 | 48 | 48 |
| | SP_DTS 1218m | 495 | 495 | 495 | 495 |
| | SP_DTS 1824m | 1187 | 1187 | 1187 | 1187 |
| | SP_DTS >=24m | 699 | 699 | 699 | 699 |
| | SP_DFN 612m | 209 | 209 | 209 | 209 |
| | SP_DFN 1218m | 151 | 151 | 151 | 151 |
| | SP_HOK 612 m | 99 | 99 | 99 | 99 |
| | SP_HOK 1218 m | 238 | 238 | 238 | 238 |
| | SP_HOK 1824 m | 98 | 98 | 98 | 98 |
| Average salary **(Crew cost/FTE) in 2024** | FR_DTS 1824m | 77976 | 11837 | 70088 | 77978 |
| | FR_DTS >=24m | 81354 | 16542 | 73031 | 81371 |
| | FR_DFN <6m | 20334 | 20400 | 20341 | 20334 |
| | FR_DFN 612m | 23234 | 23626 | 23277 | 23234 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | FR_HOK < 6 m | 9760 | 9760 | 9760 | 9760 |
| | FR_HOK 612 m | 21193 | 21564 | 21236 | 21192 |
| | FR_HOK 1218 m | 53921 | 53921 | 53921 | 53921 |
| | SP_DTS < 12m | 9258 | 4326 | 8518 | 9259 |
| | SP_DTS 1218m | 13894 | 2365 | 12583 | 13945 |
| | SP_DTS 1824m | 22565 | 4221 | 20429 | 22541 |
| | SP_DTS >=24m | 28664 | 5694 | 25961 | 28527 |
| | SP_DFN 612m | 4612 | 4803 | 4634 | 4612 |
| | SP_DFN 1218m | 8462 | 8962 | 8518 | 8460 |
| | SP_HOK 612 m | 2117 | 2131 | 2118 | 2117 |
| | SP_HOK 1218 m | 8388 | 8427 | 8393 | 8388 |
| | SP_HOK 1824 m | 13697 | 13697 | 13697 | 13697 |
| **CR/BER in 2024** | FR_DTS 1824m | 1.94 | -0.17 | 1.69 | 1.94 |
| | FR_DTS >=24m | 1.02 | -0.17 | 0.87 | 1.02 |
| | FR_DFN <6m | 2.93 | 2.94 | 2.93 | 2.93 |
| | FR_DFN 612m | 1.67 | 1.70 | 1.68 | 1.67 |
| | FR_HOK < 6 m | 1.42 | 1.42 | 1.42 | 1.42 |
| | FR_HOK 612 m | 0.48 | 0.50 | 0.48 | 0.48 |
| | FR_HOK 1218 m | 1.38 | 1.38 | 1.38 | 1.38 |
| | SP_DTS < 12m | 10.25 | 4.18 | 9.34 | 10.25 |
| | SP_DTS 1218m | 3.24 | -0.18 | 2.85 | 3.26 |
| | SP_DTS 1824m | 2.36 | -0.17 | 2.06 | 2.36 |
| | SP_DTS >=24m | 1.26 | -0.40 | 1.06 | 1.25 |
| | SP_DFN 612m | 6.29 | 6.60 | 6.32 | 6.29 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2024 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | SP_DFN 1218m | 4.70 | 5.04 | 4.74 | 4.70 |
| | SP_HOK 612 m | 1.16 | 1.18 | 1.16 | 1.16 |
| | SP_HOK 1218 m | 0.91 | 0.92 | 0.91 | 0.91 |
| | SP_HOK 1824 m | 1.16 | 1.16 | 1.16 | 1.16 |

Legend:

| | Indicator | | |
|---|---|---|---|
| | **Gross Value Added; Gross profit; FTE; Engaged crew; Average salary** | **Gross Profit Margin** | **Current revenues on break-even revenues (CR/BER)** |
| | Indicator value > Threshold B* | >10% - High | >1 - High |
| | Threshold A* <Indicator value < Threshold B* | 0-10% - Reasonable | 0.9-1 – Intermediate condition |
| | Indicator value < Threshold A* | <0% - Weak | <0.9 - Weak |

*Thresholds: the minimum (A) and the average values (B) of the indicators along the baseline period

Table 6.1.2.8. EMU1 (IAM model). Estimated values by fleet segments and per scenarios in 2025 for the following socio-economic indicators: Gross Value Added (GVA), Gross Profit, Gross Profit Margin, Full Time Equivalent (FTE), engaged crew, average salary (i.e. crew cost / FTE), and CR/BER. The median values are used.

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| **Total Gross Value Added (GVA) per fleet in** | FR_DTS 1824m | 7816.0 | 111.5 | -184.6 | 7827.5 |
| | FR_DTS >=24m | 10791.8 | 705.4 | 29.6 | 10814.5 |
| | FR_DFN <6m | 4366.3 | 4456.5 | 4396.8 | 4366.6 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| 2025 (in kEuros) | FR_DFN 612m | 17461.3 | 19802.1 | 18254.0 | 17469.5 |
| | FR_HOK < 6 m | 176.5 | 176.5 | 176.5 | 176.5 |
| | FR_HOK 612 m | 2562.9 | 3037.2 | 2662.5 | 2562.0 |
| | FR_HOK 1218 m | 2340.7 | 2340.7 | 2340.7 | 2340.7 |
| | SP_DTS < 12m | 1320.9 | 593.5 | 568.7 | 1322.3 |
| | SP_DTS 1218m | 11561.4 | 121.8 | -477.6 | 11681.3 |
| | SP_DTS 1824m | 38363.9 | 2831.1 | -456.1 | 38309.5 |
| | SP_DTS >=24m | 24544.3 | 2014.5 | -1036.2 | 24232.9 |
| | SP_DFN 612m | 3354.2 | 4202.3 | 3611.2 | 3355.0 |
| | SP_DFN 1218m | 3155.9 | 4353.8 | 3506.4 | 3158.2 |
| | SP_HOK 612 m | 370.7 | 401.7 | 378.6 | 370.7 |
| | SP_HOK 1218 m | 2079.2 | 2219.4 | 2110.0 | 2079.1 |
| | SP_HOK 1824 m | 1549.2 | 1549.2 | 1549.2 | 1549.2 |
| Total Gross profit (GP) by fleet in 2025 (in kEuros) | FR_DTS 1824m | 2205.6 | -974.6 | -1096.8 | 2210.4 |
| | FR_DTS >=24m | 2423.3 | -1441.3 | -1700.2 | 2431.9 |
| | FR_DFN <6m | 1408.5 | 1446.2 | 1421.2 | 1408.6 |
| | FR_DFN 612m | 4462.1 | 5384.3 | 4774.4 | 4465.3 |
| | FR_HOK < 6 m | 38.5 | 38.5 | 38.5 | 38.5 |
| | FR_HOK 612 m | -427.8 | -287.0 | -398.3 | -428.1 |
| | FR_HOK 1218 m | 276.6 | 276.6 | 276.6 | 276.6 |
| | SP_DTS < 12m | 888.2 | 380.1 | 362.8 | 889.1 |
| | SP_DTS 1218m | 5085.2 | -1285.0 | -1618.8 | 5151.9 |
| | SP_DTS 1824m | 13351.2 | -3901.5 | -5497.6 | 13324.8 |
| | SP_DTS >=24m | 4589.0 | -4188.7 | -5377.3 | 4467.7 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | SP_DFN 612m | 2383.7 | 3027.1 | 2578.7 | 2384.3 |
| | SP_DFN 1218m | 1874.6 | 2666.0 | 2106.2 | 1876.1 |
| | SP_HOK 612 m | 159.8 | 181.9 | 165.4 | 159.8 |
| | SP_HOK 1218 m | 88.9 | 171.7 | 107.1 | 88.8 |
| | SP_HOK 1824 m | 213.7 | 213.7 | 213.7 | 213.7 |
| **Gross profit margin in 2025** | FR_DTS 1824m | 0.16 | -0.40 | -0.50 | 0.16 |
| | FR_DTS >=24m | 0.12 | -0.32 | -0.45 | 0.12 |
| | FR_DFN <6m | 0.26 | 0.26 | 0.26 | 0.26 |
| | FR_DFN 612m | 0.19 | 0.21 | 0.20 | 0.19 |
| | FR_HOK < 6 m | 0.14 | 0.14 | 0.14 | 0.14 |
| | FR_HOK 612 m | -0.08 | -0.05 | -0.07 | -0.08 |
| | FR_HOK 1218 m | 0.10 | 0.10 | 0.10 | 0.10 |
| | SP_DTS < 12m | 0.53 | 0.48 | 0.47 | 0.53 |
| | SP_DTS 1218m | 0.26 | -0.33 | -0.49 | 0.26 |
| | SP_DTS 1824m | 0.20 | -0.25 | -0.45 | 0.20 |
| | SP_DTS >=24m | 0.11 | -0.36 | -0.62 | 0.10 |
| | SP_DFN 612m | 0.45 | 0.50 | 0.47 | 0.45 |
| | SP_DFN 1218m | 0.39 | 0.44 | 0.40 | 0.39 |
| | SP_HOK 612 m | 0.12 | 0.14 | 0.13 | 0.12 |
| | SP_HOK 1218 m | 0.01 | 0.02 | 0.02 | 0.01 |
| | SP_HOK 1824 m | 0.06 | 0.06 | 0.06 | 0.06 |
| Employment: **Total FTE per fleet in 2025** | FR_DTS 1824m | 53.1 | 7.4 | 7.6 | 53.1 |
| | FR_DTS >=24m | 88.3 | 14.9 | 14.8 | 88.3 |
| | FR_DFN <6m | 47.0 | 47.0 | 47.0 | 47.0 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | FR_DFN 612m | 206.6 | 206.6 | 206.6 | 206.6 |
| | FR_HOK < 6 m | 5.1 | 5.1 | 5.1 | 5.1 |
| | FR_HOK 612 m | 43.2 | 43.2 | 43.2 | 43.2 |
| | FR_HOK 1218 m | 7.3 | 7.3 | 7.3 | 7.3 |
| | SP_DTS < 12m | 20.7 | 8.2 | 8.1 | 20.7 |
| | SP_DTS 1218m | 287.3 | 40.7 | 41.2 | 289.2 |
| | SP_DTS 1824m | 708.8 | 106.9 | 108.2 | 731.9 |
| | SP_DTS >=24m | 394.2 | 63.9 | 64.9 | 419.9 |
| | SP_DFN 612m | 107.1 | 107.1 | 107.1 | 107.1 |
| | SP_DFN 1218m | 88.6 | 88.6 | 88.6 | 88.6 |
| | SP_HOK 612 m | 23.9 | 23.9 | 23.9 | 23.9 |
| | SP_HOK 1218 m | 96.9 | 96.9 | 96.9 | 96.9 |
| | SP_HOK 1824 m | 37.4 | 37.4 | 37.4 | 37.4 |
| Employment: **Engaged crew per fleet in 2025** | FR_DTS 1824m | 70 | 70 | 70 | 70 |
| | FR_DTS >=24m | 101 | 101 | 101 | 101 |
| | FR_DFN <6m | 145 | 145 | 145 | 145 |
| | FR_DFN 612m | 549 | 549 | 549 | 549 |
| | FR_HOK < 6 m | 14 | 14 | 14 | 14 |
| | FR_HOK 612 m | 142 | 142 | 142 | 142 |
| | FR_HOK 1218 m | 38 | 38 | 38 | 38 |
| | SP_DTS < 12m | 48 | 48 | 48 | 48 |
| | SP_DTS 1218m | 495 | 495 | 495 | 495 |
| | SP_DTS 1824m | 1187 | 1187 | 1187 | 1187 |
| | SP_DTS >=24m | 699 | 699 | 699 | 699 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | SP_DFN 612m | 209 | 209 | 209 | 209 |
| | SP_DFN 1218m | 151 | 151 | 151 | 151 |
| | SP_HOK 612 m | 99 | 99 | 99 | 99 |
| | SP_HOK 1218 m | 238 | 238 | 238 | 238 |
| | SP_HOK 1824 m | 98 | 98 | 98 | 98 |
| Average salary **(Crew cost/FTE) in 2025** | FR_DTS 1824m | 80504 | 15585 | 13089 | 80602 |
| | FR_DTS >=24m | 83269 | 21360 | 17212 | 83408 |
| | FR_DFN <6m | 20371 | 20732 | 20493 | 20372 |
| | FR_DFN 612m | 23663 | 26246 | 24538 | 23672 |
| | FR_HOK < 6 m | 9760 | 9760 | 9760 | 9760 |
| | FR_HOK 612 m | 21050 | 23397 | 21542 | 21045 |
| | FR_HOK 1218 m | 53921 | 53921 | 53921 | 53921 |
| | SP_DTS < 12m | 9015 | 4446 | 4289 | 9024 |
| | SP_DTS 1218m | 13088 | 2843 | 2306 | 13195 |
| | SP_DTS 1824m | 21070 | 5671 | 4247 | 21046 |
| | SP_DTS >=24m | 28534 | 8870 | 6207 | 28262 |
| | SP_DFN 612m | 4638 | 5616 | 4935 | 4639 |
| | SP_DFN 1218m | 8508 | 11207 | 9298 | 8513 |
| | SP_HOK 612 m | 2121 | 2210 | 2144 | 2121 |
| | SP_HOK 1218 m | 8377 | 8618 | 8430 | 8377 |
| | SP_HOK 1824 m | 13697 | 13697 | 13697 | 13697 |
| **CR/BER in 2025** | FR_DTS 1824m | 2.02 | -0.06 | -0.13 | 2.03 |
| | FR_DTS >=24m | 1.06 | -0.08 | -0.16 | 1.06 |
| | FR_DFN <6m | 2.94 | 2.99 | 2.95 | 2.94 |

| Indicator | Fleet segment | Economic and social outputs per scenario in 2025 | | | |
|---|---|---|---|---|---|
| | | SQ | A | D | L |
| | FR_DFN 612m | 1.71 | 1.92 | 1.78 | 1.71 |
| | FR_HOK < 6 m | 1.42 | 1.42 | 1.42 | 1.42 |
| | FR_HOK 612 m | 0.47 | 0.57 | 0.49 | 0.47 |
| | FR_HOK 1218 m | 1.38 | 1.38 | 1.38 | 1.38 |
| | SP_DTS < 12m | 9.95 | 4.32 | 4.13 | 9.96 |
| | SP_DTS 1218m | 3.00 | -0.07 | -0.20 | 3.03 |
| | SP_DTS 1824m | 2.14 | 0.05 | -0.17 | 2.14 |
| | SP_DTS >=24m | 1.25 | -0.17 | -0.36 | 1.23 |
| | SP_DFN 612m | 6.33 | 7.93 | 6.82 | 6.33 |
| | SP_DFN 1218m | 4.73 | 6.59 | 5.28 | 4.74 |
| | SP_HOK 612 m | 1.17 | 1.26 | 1.19 | 1.17 |
| | SP_HOK 1218 m | 0.91 | 0.94 | 0.92 | 0.91 |
| | SP_HOK 1824 m | 1.16 | 1.16 | 1.16 | 1.16 |

Legend:

| | Indicator | | |
|---|---|---|---|
| | **Gross Value Added; Gross profit; FTE; Engaged crew; Average salary** | **Gross Profit Margin** | **Current revenues on break-even revenues (CR/BER)** |
| | Indicator value > Threshold B* | >10% - High | >1 - High |
| | Threshold A* <Indicator value < Threshold B* | 0-10% - Reasonable | 0.9-1 – Intermediate condition |
| | Indicator value < Threshold A* | <0% - Weak | <0.9 - Weak |

*Thresholds: the minimum (A) and the average values (B) of the indicators along the baseline period (AER 2015-2017 values)

### 6.1.3 Discussion

The main objective of the management plan is to achieve fishing mortality values in between Fmsy ranges for each of the stocks mentioned in the management plan by 2025. The results of the IAM simulations suggest that among the four simulated scenarios, only scenarios A and D achieved this objective.To note, that reducing effort to reach Fmsy of hake in GSAs 1-5-6-7 (HKE1567) allow in the same time for all the other stocks to be at or below their Fmsy, only the red mullet in GAS 1 (MUT1) is still a little higher than its Fmsy, but below it's the value estimated for Fupper.

With scenarios SQ and L (i.e., when no reduction of effort implemented to reach Fmsy of Hake), HKE1567 is still above Fmsy (and even its Fupper) in 2025 and after. The other stocks that are also above their Fmsy for the period 2025-2030, with those two scenarios are : red mullet in GSA 1 (MUT1), red mullet in GSA 6 (MUT6), and Nephrops in GSA 6 (NEP6). The blue and red shrimps in GSA 5 and GSAs 6 and 7 (ARA5 and ARA67) are not at Fmsy in 2025, however for ARA67 the stock is at Fmsy in 2030, and ARA5 is just above its Fupper. The stocks MUT7, DPS1 and DPS567 were already at (or below) their Fmsy in 2022, and this is still true for the period 2025-2030.

This leads to the conclusion that effort measures must be implemented to achieve the objectives of the management plan.

Furthermore, scenarios A and D foresee important reduction in French and Spanish trawler fishing efforts, and this benefit all exploited stocks, with expected important increase in biomasses. When we compare the catches at age with scenarios A and D with the catches at age with scenarios SQ and L, we can observe that catches of older ages are expected to increase with scenarios A and D (where reduction of efforts is applied). These two scenarios indeed predict increases of catches of older ages in the medium term by trawlers for HKE1567, MUT1, NEP6, ARA5, and ARA67; and increases of catches of older ages by netters (DFN) of HKE1567, MUT1, MUT6, and MUT7; and increase in catches by vessels using hooks (HOK) of older ages of HKE1567.

The impacts of the selectivity measures are difficult to assess with our simulations. Indeed other measures are implemented in the same time, and improvement in selectivity is applied only on the deep water trawling. Therefore, only catchabilities of Spanish trawlers are modified, and only for deep water trawling for chiwh the effort is smaller than the fishing effort of demersal trawling. In addition, catchabilities of most of the exploited stocks are higher with demersal trawling than with deep water trawling (except for ARA), therefore values of landings at age by trawlers do not allow us to see a significant effect from the selectivity measures.

Maximum catch limit (MCL) measures on ARA are implemented in all scenarios simulated with IAM (scenarios SQ, A, D and L), for the entire simulated period for scenarios SQ, A and L, and only from 2023 to to 2024 for scenarios D (as after, the measures is Fmsy ARA). In scenarios SQ and L, where no reduction of effort are implemented to reach Fmsy, we can predict the effect of the MCL on ARA on the ARA stocks. Biomasses of ARA5 and ARA67 are predicted to increase, with a slope of increase higher for ARA67 than for ARA5. In 2030, the fishing mortalities of the ARA stocks are decreasing toward Fupper in 2030 for ARA5, and toward Fmsy for ARA67. To note that the stock of ARA5 is the most binding.

In the simulations, an increase in SSB estimates is observed between 2022 and 2023 for DPS1 and DPS567, while fishing mortality for these stocks is relatively constant. This increase might be explained, like in EWG 22-11, by the fact that in the stock assessment group EWG 23-09 data, recruitments in the past years (2020-2022) are extremely high. Individuals at age 1 of DPS1 are fully mature, and 50% of individuals at age 1 of DPS567 are mature, which means that by 2022 the exceptional recruitments in 2021 are reflected in the SSB estimates in 2022 and same in 2023. For these stocks, it is therefore questionable whether the random draw with replacement approach to simulating recruitment from the available historical period (2009-2022) is relevant. Indeed, the

results of the EWG 23-09 stock assessments show that recent years have seen better recruitment than past years, and this is particularly true for 2021 and 2022. The way of simulating recruitments for DPS in EMU1 should thus be discussed with the stock experts. If good recruitment years are expected in the future, randomly drawing recruitment in the historical period 2009-2022 would mean that the IAM model underestimates the abundances and therefore the catches of DPS1 and DPS567, and consequently the part of the revenues coming from DPS landings.

Scenarios SQ and L are the scenario where the socio-economic indicators (i.e., total GVA per fleet, mean GVA per vessel, total Gross Profit per fleet, mean Gross Profit per vessel, gross profit margin, employment in terms of FTE, and average salaries) perform best for the trawler fleet segments. It is however important to note that under this scenario the fishing mortalities of HKE1567, ARA5, MUT1, MUT6, and NEP6 are higher than their Fupper for the period 2025-2030.

As said in EWG 21-13 (and detailed in section 7.1.1), it is important to note that landings per unit of effort of other species (than the ones that are explicitly modelled) are assumed constant in time. Consequently, potential positive impacts of effort reduction on those other stock biomasses are not simulated and total landings might thus be underestimated. As the proportion of the landings of those other species are very high for most fleet segments, the negative economic impacts of the effort reduction management scenarios displayed might be overestimated in our simulations. This is true especially in the long run, as positive effect of effort reduction in stock biomasses are not instantaneous.

It is also important to note that estimates of crew costs are unsatisfactory, due to lack of data and information, and doubt about the reliability of the AER data used to estimate the values of crew share by fleet segment. By default, crew costs are estimated as a share of ""what remains to be shared" (i.e. GVL less exploitation costs). No information was provided to the working group regarding a minimum wage per country or fleet segment, so by default this minimum was set to zero in the IAM simulations. It was specified in EWG23-01 that this would be the case if no further information was provided. Consequently, crew costs are very likely to be underestimated in situations where the economic performance of a fleet segment is poor. These concerns regarding the estimations of crew costs are important to kept in mind when analysing outcomes such as Gross Profit, Gross Profit margin, average salary and CR/BER

It is therefore difficult to estimate whether IAM simulations underestimate Gross Profits (due to an underestimation of GVL, i.e. revenues) or overestimate them (due to an underestimation of crew costs).

Finally, it is important to note that the increase between 2022 and 2023 in GVA and GP for the netters and vessels using hooks fleet segments is not due to change in fishing effort (as their fishing effort and number of vessels are kept constant for the whole simulation period and all scenarios), but from the reduction in fuel prices between 2022 and 2023, as projected by AER EWG 23-07.

Tables 6.1.2.1 to 6.1.2.8 synthesize IAM outputs across scenarios for all stocks and fleets, through the examination of several statistics. Upon examination of this table, the trade-off between achieving sustainable harvesting by targeting Fmsy, and ensuring the economic viability of all fleet segments becomes evident, as scenarios A and D - the most successful at reaching Fmsy for all stocks, are also the most detrimental for the economic performances of French and Spanish trawler fleet segments, except for Spanish trawlers below 12 meters.The minor economic negative impact on Spanish trawler below 12 meters is partly explained by the fact that this fleet segment is using other gears than trawl. This fleet segment is indeed using beach and boat seines (more than 20% of its fishing effort in 2022), and this gear is not affected by the effort reduction measures in IAM simulations, as effort reduction to reach Fmsy are applied only on trawls.

## 6.2 BEMTOOL in EMU 2

### 6.2.1 Management scenarios considered

No Compensation mechanism was applied by Italy in 2023 as reported in the TORs. The permanent spatial closure of 2020-2021 were applied and maintained in all the simulations.

Five scenarios among the ones listed in the ToRs were implemented:

Scenario Status quo (SQ): The effort of OTB_DWS/MDD metier is driven by the catch limit of ARA and ARS of 2023 (from 2024 to 2030); once that the catch limit for one fleet segment is reached, the remaining effort of OTB_DWS/MDD is re-allocated to OTB_DEF. The global effort by fleet segment is the same of 2023 and onwards. No Compensation mechanism applied.

Scenario A: effort re-allocation as in Scenario SQ; OTB_DEF and other fleets fishing days reduced of 50% from 2024 to allow HKE91011 to reach Fmsy in 2024. No Compensation mechanism applied.

Scenario C: The effort of OTB_DWS/MDD metier is driven by the Fmsy of ARS and ARA through the catch limit (based on short term forecast EWG 23-09), from 2024 onwards; once that the catch limit for one fleet segment is reached, the remaining effort of OTB_DWS/MDD is re-allocated to OTB_DEF; effort of OTB_DEF reduced of 5.5% (instead of 9.5%, compensation mechanism applied due to 4 weeks, in April, of closure applied to OTB_DEF onwards) in 2024 and reduced of 50% from 2025 (to have Fmsy of hake achieved); other fleets effort 2024=2023=2022 and from 2025 reduced of 50% (to have Fmsy hake achieved).

Scenario D: The effort of OTB_DWS/MDD metier is driven the catch limit of ARS and ARA reduced of 5% in 2024; from 2025 onwards it is driven by a combined catch limit defined to reach Fmsy of both stocks (short term forecast EWG 23-09); once that the catch limit for one fleet segment is reached, the remaining effort of OTB_DWS/MDD is re-allocated to OTB_DEF; effort of OTB_DEF reduced of 5.5% (instead of 9.5%, compensation mechanism applied due to selectivity improvement OTB_DEF of one half of the fleet) in 2024 (parameters following EWG 22-11) and reduced of 50% from 2025 (to have Fmsy of hake achieved); other fleets effort 2024=2023=2022 and from 2025 reduced of 50% (to have Fmsy hake achieved).

Scenario L: The effort of OTB_DWS/MDD metier is driven by the catch limit of ARA and ARS (same of 2023 onwards); once that the catch limit for one fleet segment is reached, the remaining effort of OTB_DWS/ MDD is re-allocated to OTB_DEF. OTB_DEF effort increased of 4 % (compensation mechanism applied due to selectivity improvement OTB_DEF of one half of the fleet) in 2024 and set equal to 2023 from 2025 (with selectivity improvement for the whole fleet); Other fleets effort 2024=2023=2022 and onwards.

The catch limits of ARS and ARA have been split among the fleet segments according to their proportion in the landing in the FDI data in the reference period 2015-2017. The catch limits for the stocks by year and scenario are reported in Table 6.2.1.1.

Table 6.2.1.1 Catch limit paths for ARS and ARA for Scenarios A, B and D.

| Year | SQ | | Scenario A | | Scenario C | | Scenario D | | Scenario L | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARA | ARS | ARA | ARS | ARA | ARS | ARA | ARS | ARA | ARS |
| 2023 | 243 | 354 | 243 | 354 | 243 | 354 | 243 | 354 | 243 | 354 |
| 2024 | 243 | 354 | 243 | 354 | 127 | 279 | 231 | 336 | 243 | 354 |
| 2025 & onwards | 243 | 354 | 243 | 354 | 127 | 279 | 127 | 279 | 243 | 354 |

Scenario E was not carried out because the model is not spatially explicit.

First deterministic runs were done to get a first feedback on:

1) the completeness and coherence of inputs and of the BEMTOOL parameterization;
2) the different scenarios settings.

Then, given the computation time, stochastic runs were performed in a second step and are here reported.

For all scenarios the basis was given by the number of fishing days by fleet as the average in the period 2015-2017.

All scenarios A, B and to D were carried out with the hypothesis that the fleet stops fishing in the metier OTB_DWS and OTB_MDD when one of the two catch limits are reached and the remaining effort is re-allocated on the metier OTB_DEF, increasing the pressure on the stocks targeted by this metier. The model works at monthly level, checking every month and for each trawl fleet if the catch limit is reached or not. This is to simulate that, when a catch limit on ARA and/or ARS is reached, the fleet moves on other fishing grounds, inhabited by other stocks.

The effort in the projections is assumed to be distributed among the months as in the last year of simulation; the monthly ratio between each fleet segment catch to the total catch (p coefficient, used to split the total F among the fleet segments in the BEMTOOL F formulation) in the forecast is the same of the last year of simulation.

In scenarios D and L the basis followed during STECF EWG 21-11 for the change in selectivity has been applied. For HKE an SL50 of 22 cm is assumed for this scenario, while for MUT 9 and MUT 10 an SL50% of 17 cm; for DPS 22.62 mm f carapax length is assumed, while for NEP 28 mm of carapax length was assumed.

The scenarios were implemented on the basis of historical information on the stocks status (SSB, F, catch) mimicked in BEMTOOL model that was observed in agreement with the outcomes of the STECF EWG 22-09.

The performance of the scenarios was evaluated on the basis of spawning stock biomass, catch, F, revenues and gross value added.

### 6.2.2 Results

Figure 6.2.2.1 reports the reached F for each scenario and stock.

For ARS, MUT9 and DPS the Fmsy level is reached by 2025 for all the scenarios explored. For DPS an increase in F is expected in 2024 for scenario L, due to the reallocation of the effort induced by the catch limit but in 2025 the value is below Fmsy. For HKE and NEP9 only scenarios A, C and D allow to reach Fmsy in 2025, while SQ and L have F well above the reference point. It should be noticed that the change in selectivity implemented in scenario L show a slight improvement respect to the SQ scenario, but it does not allow to reach Fmsy in 2025. As a general consideration, the scenarios most impacting on the effort highlight the risk of underutilization of the stocks that already currently are close or in line with the reference point. For ARS the catch limits, that were set according to the EWG 23-09, seem to be not appropriate in the medium and long terms, indeed the corresponding F is well below the Fmsy. To maintain the catch limit until the end of the simulation reduce too much the F respect to the reference point. This is probably due to the use of static catch limits paths based on MSY estimated in 2024, with reference year 2022. This does not take into account dynamically the annual improvement of the stock biomass. For ARA all the scenarios reduce importantly the F well below the current level. It is not possible for this stock to evaluate the F respect the reference point. ARS results a choke species for ARA, indeed the total catch of ARS is driven by its catch limit paths, while the total catch of ARA is below the catch limit. This indicates that the fleet stops fishing before reaching the ARA catch limit, because has reached the catch limit for ARS (Figure 6.2.2.3).

It is important to notice that Fmsy value is expected to change in time, due to the application of management measures, but, for simplicity, it was assumed to be fixed along the years.

Using the biomass reference points of EWG 23-09, all the stocks show SSB levels above or very close the Bpa, highlighting the improvement associated to the measures previously implemented by the MAP and all alternative scenarios; in particular, nothing can be said about MUT10 and ARA9-10-11 that have not agreed updated biomass reference points. It should be noticed that no stock-recruitment relationship is assumed, thus, a constant perturbed recruitment enters annually in the population, without any link with SSB. Respect to the model of last year, for all the stocks the constant recruitment was also assumed, except for hake, for which it was used a segmented regression from EWG 22-01. This year, considering that the assessment was updated through the catch (missing MEDITS 2022 data), the constant recruitment used by EWG 23-09 was considered more precautionary for the projections; the value is in any case below (about 300 000 thousands of recruits) the value estimated by the segmented regression (about 400 000 thousands). Thus, the results for hake can be considered more conservative (Figure 6.2.2.2).

For ARS scenarios A, L and SQ scenarios return a catch value quite comparable, while a similar value is observed for C and D scenarios (Figure 6.2.2.3); the three scenarios show in short term a catch in line with the catch limits, while in the medium term a catch slightly higher is shown. This is due to recovery of the stock, allowing to reach a slightly higher catch with a similar effort year by year. For all the stocks a decrease in the catches is observed in the short term, generally followed by an increase in the medium term. For HKE almost all scenarios show an increase of the catch in the short term, due to the re-allocation of the OTB_DWS/MDD effort on OTB_DEF, followed by a decrease implemented according the scenarios settings. Interestingly, scenario L returns in the short term lower catches than SQ, but in the medium terms higher catches.

Concerning GVA (Figure 6.2.2.4), for GSA 9 the SQ is the best performing scenario for bigger DTS (1218, 1824 and 2440), while DTS0612 benefits more from scenario C and D. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target. For GSA 10 the SQ is the best performing scenario for DTS 0612, 1218 and 1824, while DTS2440 benefits more from scenario C and D. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the

increased availability of bigger individuals, representing their target. The worst scenario for PGP is scenario A, severely impacting also on their effort already in 2024 (Figure 6.2.2.5).
For GSA 11 the best performing scenario for DTS 1218, 1824 and 2440 isD, followed by C. PGP fleet segments benefit more from the scenario L, impacting on selectivity of DTS fleet. This is due to increase in catch of PGP derived from the increased availability of bigger individuals, representing their target (Figure 6.2.2.6). A similar trend is shown by Gross Profit (GP, Figures 6.2.2.7, 6.2.2.8 and 6.2.2.9).

In GSA 9 for DTS 0612 the gross profit margin (GPM, Figure 6.2.2.10) was historically quite deteriorated and this is also shown through all scenarios, being scenario D the one allowing to have a higher, although close to 0, level. For DTS 12 and 1824 all scenarios returns a value between 0.3 and 0.4, while for DTS 2440 is around 0.1. PGP0012 shows a decrease in the short term for all scenarios except SQ and L and, only for L a GPM level around 0.1. A level around 0.25 is shown for PGP1218.

In GSA 10 for DTS 0612 the gross profit margin (GPM, Figure 6.2.2.11) is decreasing since 2008; all scenarios show a value below 0.25, with highest value returned by SQ scenario. For DTS 1218, 1824 the highest values of GPM is returned by scenarios C and D. DTS 2440 has a GPM quite deteriorated from 2021; for PGP the scenarios return a negative value. Scenario L returns the highest value.

In GSA 11 for DTS 1218 the highest gross profit margin (GPM, Figure 6.2.2.12) is returned by scenario D. The values for DTS 1824, 2440 and 0612 are negative, highlighting a deterioration of the profitability for these fleets.

Looking at the average salary, for all fleet segments in GSA 9, the scenarios return an average salary higher than the one observed in 2021; specifically, for DTS 0612 SQ scenario is the best performing, while for DTS 1218 and 1824 the C and D are the best performing. For PGP fleet segments, scenarios D return a value similar to SQ (Figure 6.2.2.13).

In GSA 10, for DTS 0612 SQ and D scenarios are the best performing, while for DTS 1218 and 2440 scenario A is the best performing. For DTS 1824 A is the best in short term, but D in medium and long. For PGP fleet segments, scenarios A return the highest average salary (Figure 6.2.2.14).

Also in GSA 11, for all fleet segments, the scenarios return an average salary higher than the one observed in 2021, except for DTS2440; specifically, for DTS 0612 SQ scenario is the best performing together with D, while for DTS 1218 and 1824 scenario D is the best performing, followed by C and SQ. For PGP fleet segments, scenarios D return a value similar to SQ (Figure 6.2.2.15).

Following EWG 19-01 and 19-14, it is important to highlight that the results from EWG 23-11 for all scenarios are based on the assumption that a reduction in F is a direct consequence of an effort reduction. Inclusion of hyperstability in BEMTOOL was explored by EWG 19-01 and EWG 20-13, where the relationship between fishing effort and fishing mortality was assumed non-linear.

It should be also noticed that the GP and the GPM do not take into account possible subsidies received by operators to face the recent fuel costs increase and the decrease in the number of effort quotas, because this information was not available. This may have impacted negatively on the economic indicators, projecting a worse situation respect to the actual one (underestimating the GPM).

Moreover, the lack of MEDITS data for 2022 could have increased the uncertainty of the stock assessment results that feed BEMTOOL model for the biological and pressure component. This issue should be considered as an additional amount of uncertainty on the projections, although limited respect to the process error. Another important aspect is the missing stock assessment for MUT10 and ARA91011. The proxy used in the model for the projections, need to be replaced by quantitative updated stock assessment results in order to provide more accurate results.

Finally, in the model, a linear relationship between FTE and total fishing days has been assumed for simplicity. Nevertheless, this assumption should be verified through a specific analysis on the historical data.

In the next figures, for F, Catch and SSB, the historical part (until 2023) is represented by the stock assessment results replicated by BEMTOOL.

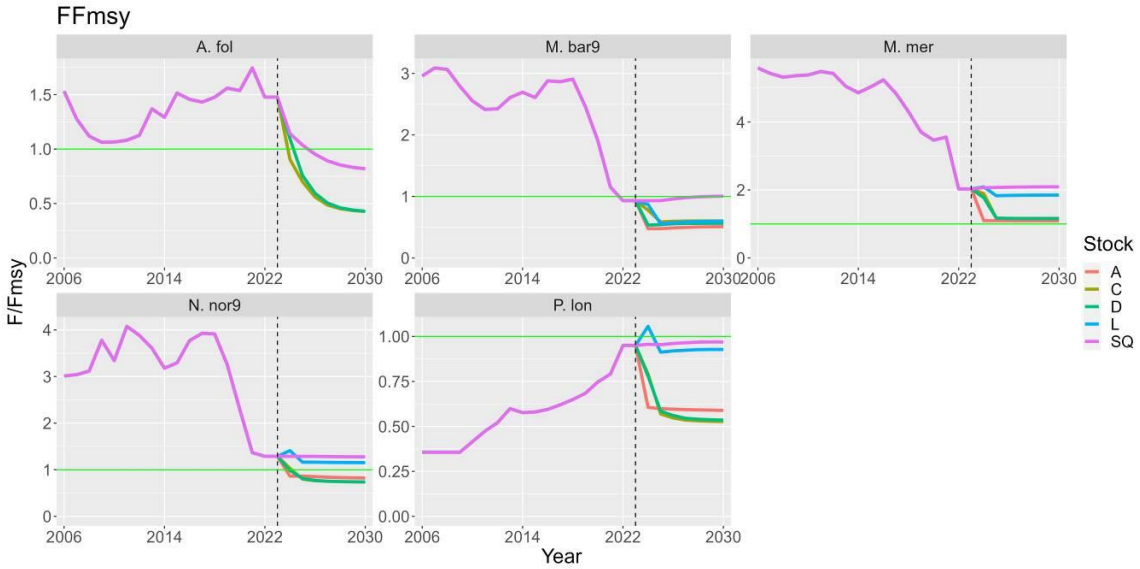


Figure 6.2.2.1– BEMTOOL. Trajectories of the fishing mortality/Fmsy ratio (F current/F0.1) for the five stocks in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. The black vertical dashed lines corresponds to 2023. Green horizontal solid line correspond to 1.

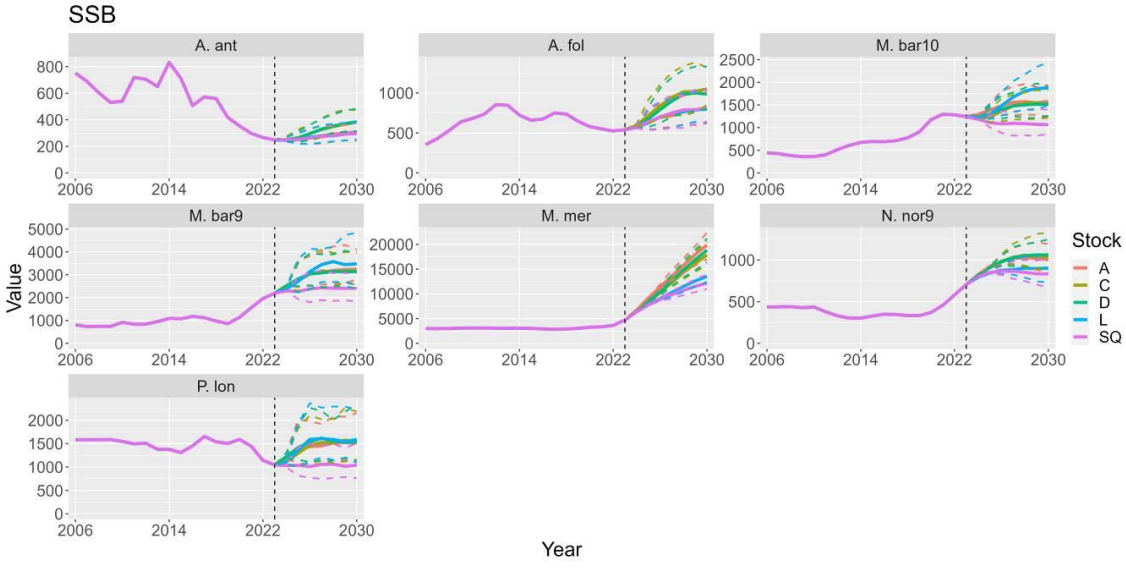


Figure 6.2.2.2– BEMTOOL. Trajectories of the SSB (in tons) for the seven stocks in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

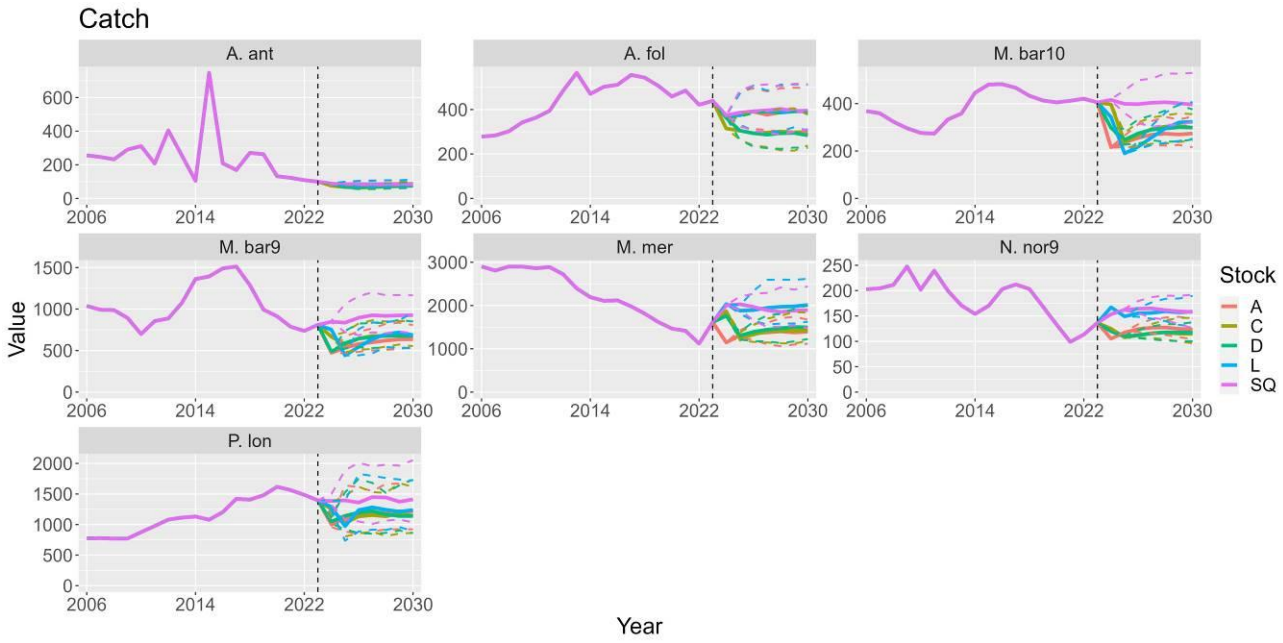


Figure 6.2.2.3– BEMTOOL. Trajectories of catches (tons) for the seven stocks in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

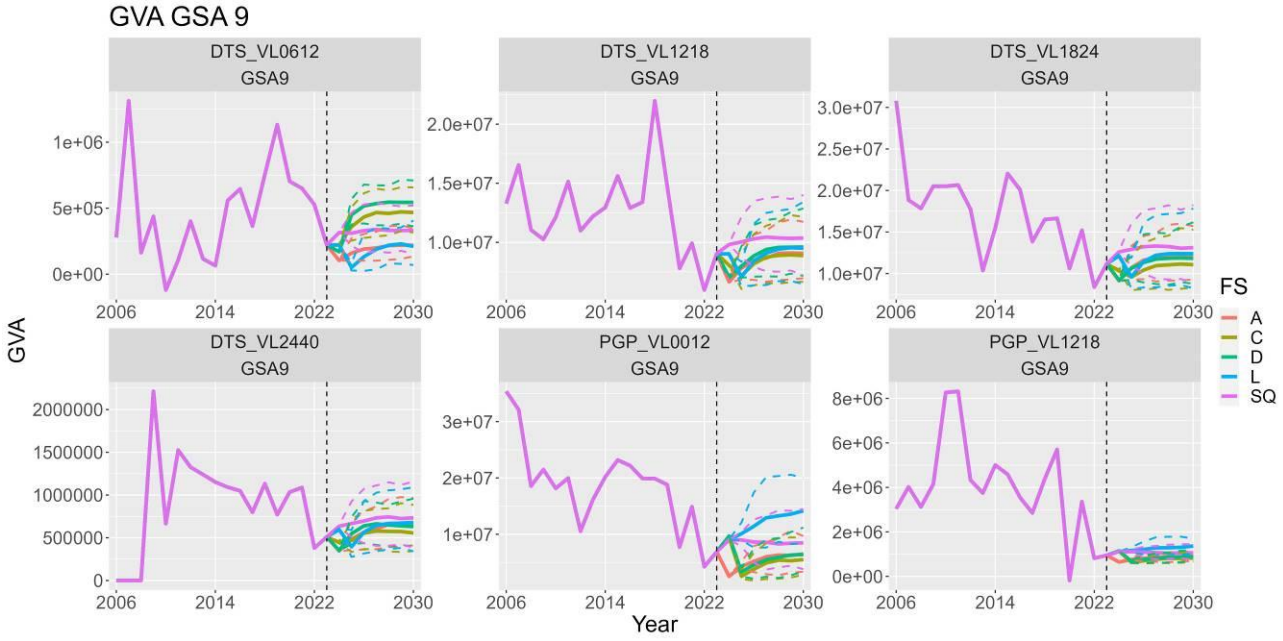


Figure 6.2.2.4– BEMTOOL. Trajectories of gross value added for the fleets operating in GSA 9 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

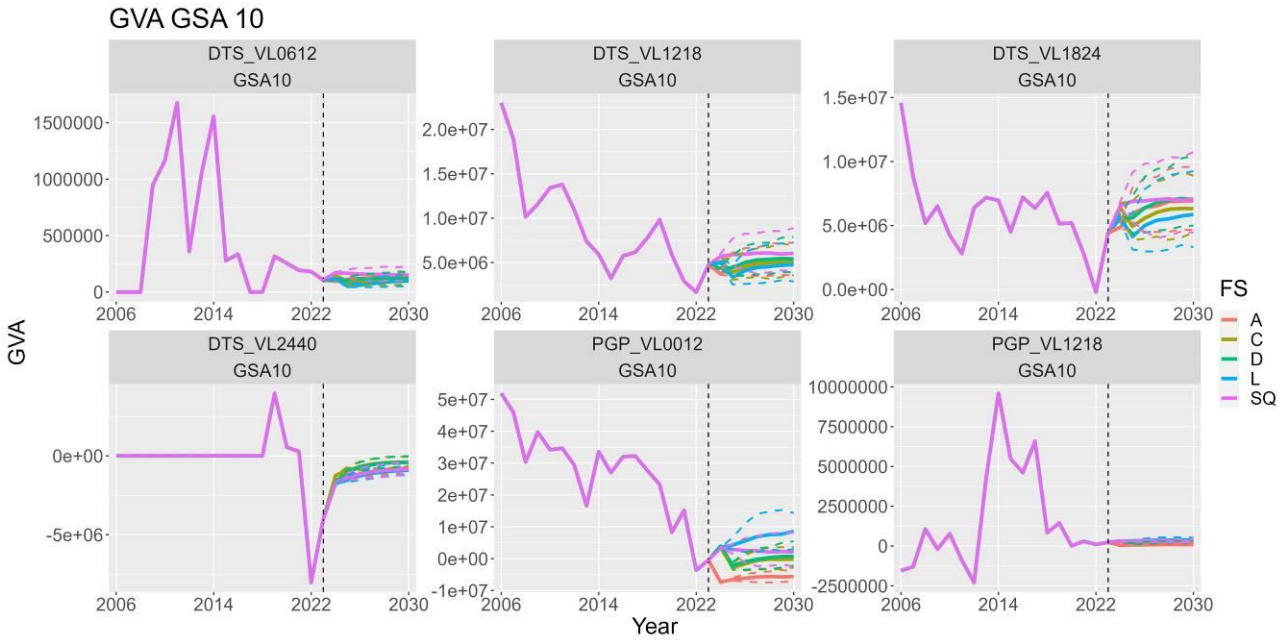


Figure 6.2.2.5– BEMTOOL. Trajectories of gross value added for the fleets operating in GSA 10 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

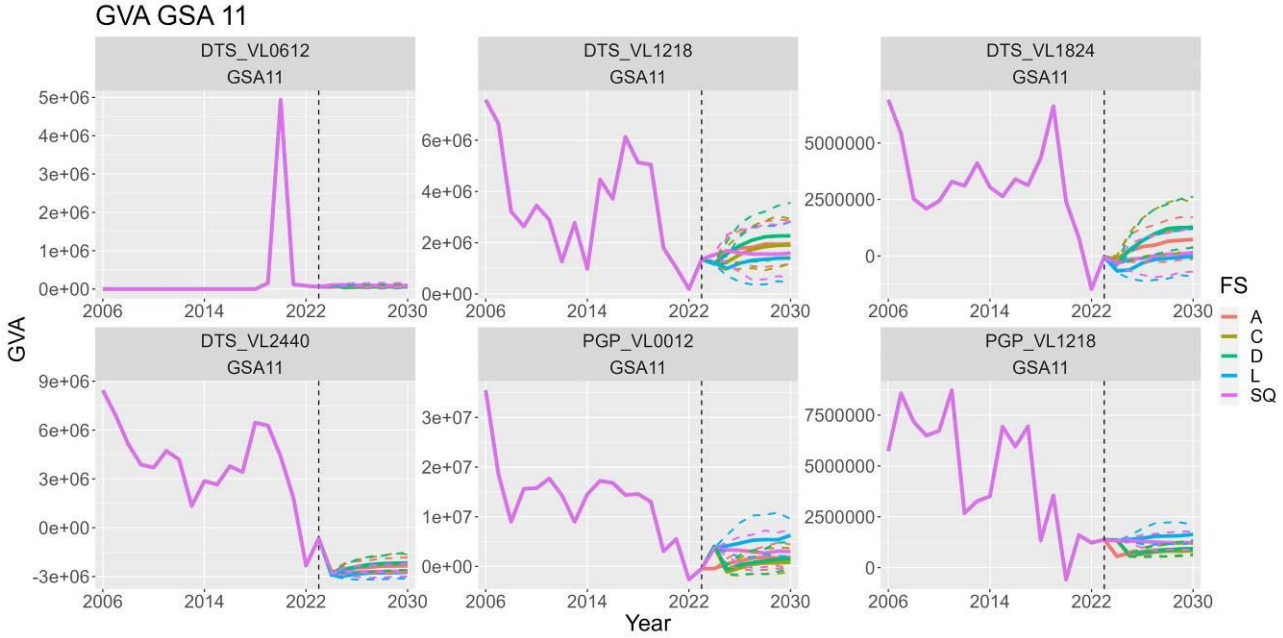


Figure 6.2.2.6– BEMTOOL. Trajectories of gross value added for the fleets operating in GSA 11 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

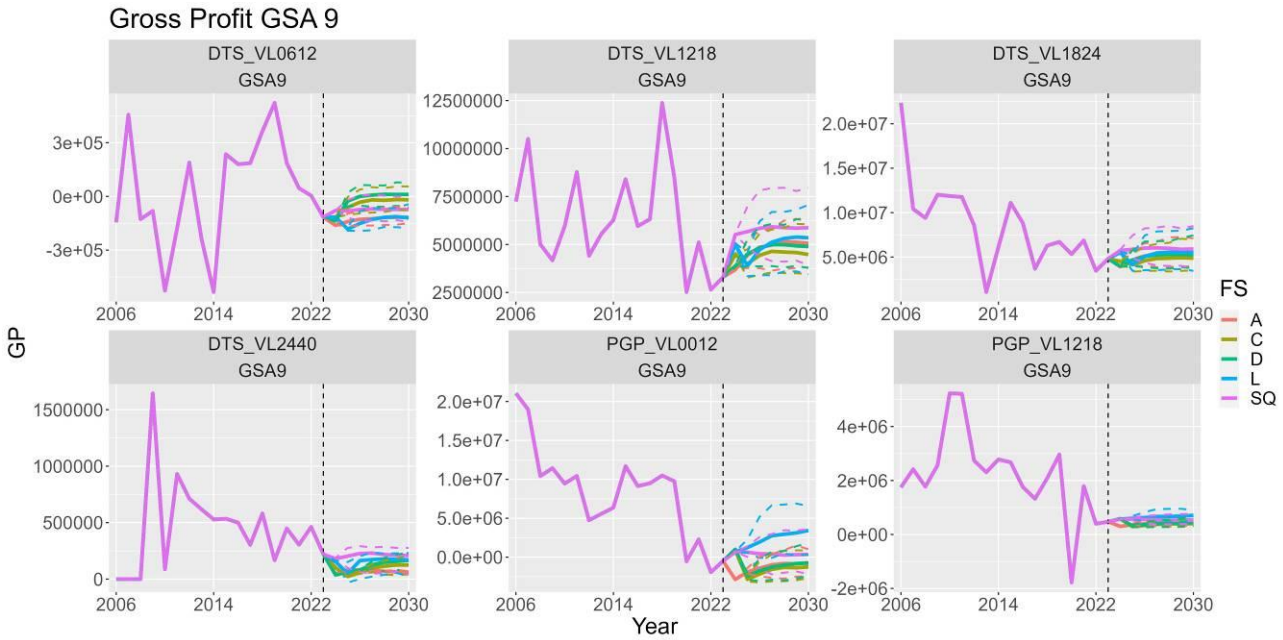


Figure 6.2.2.7– BEMTOOL. Trajectories of gross profit for the fleets operating in GSA 9 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

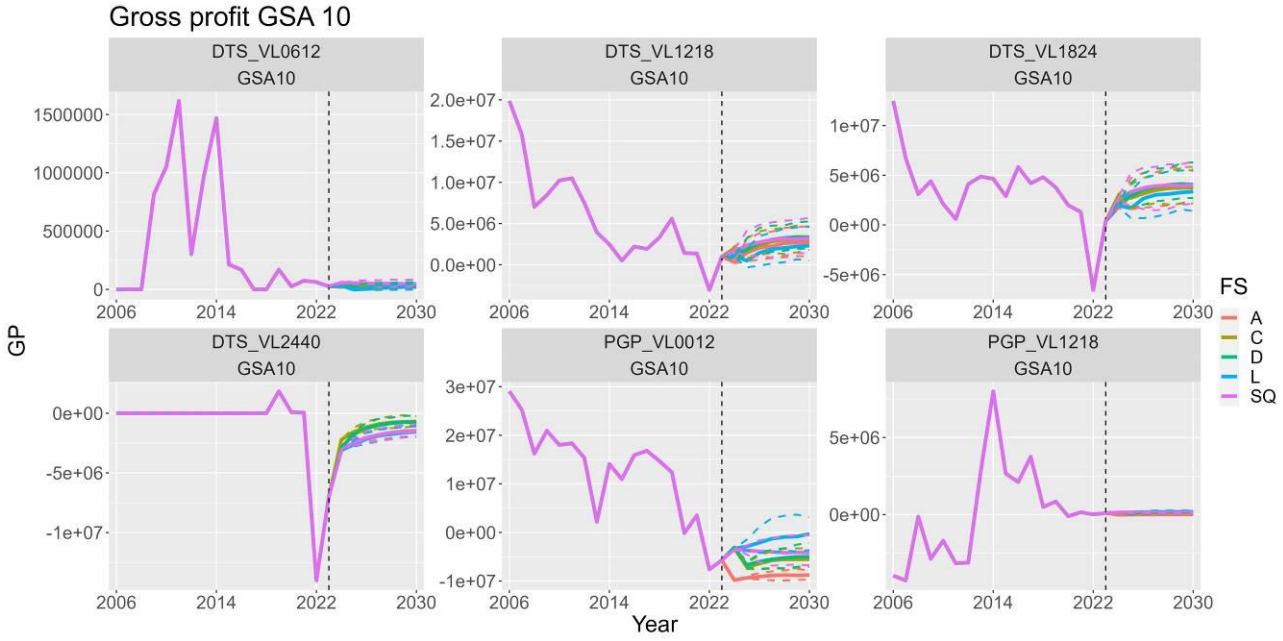


Figure 6.2.2.8– BEMTOOL. Trajectories of gross profit for the fleets operating in GSA 10 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

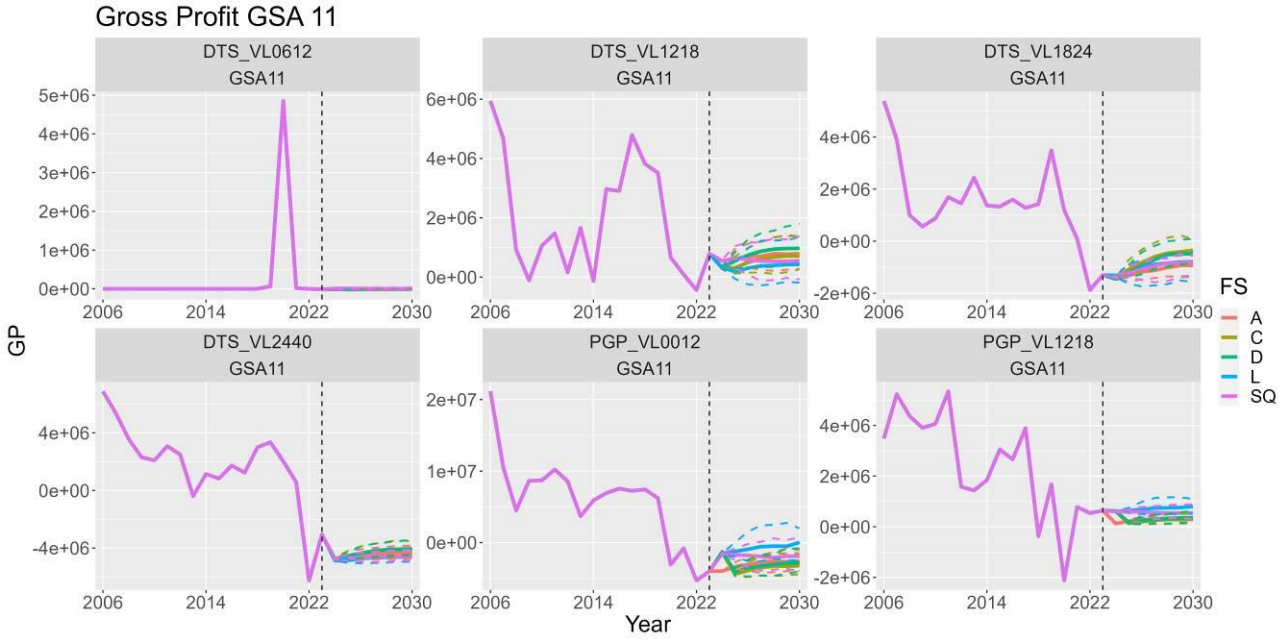


Figure 6.2.2.9– BEMTOOL. Trajectories of gross profit for the fleets operating in GSA 11 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

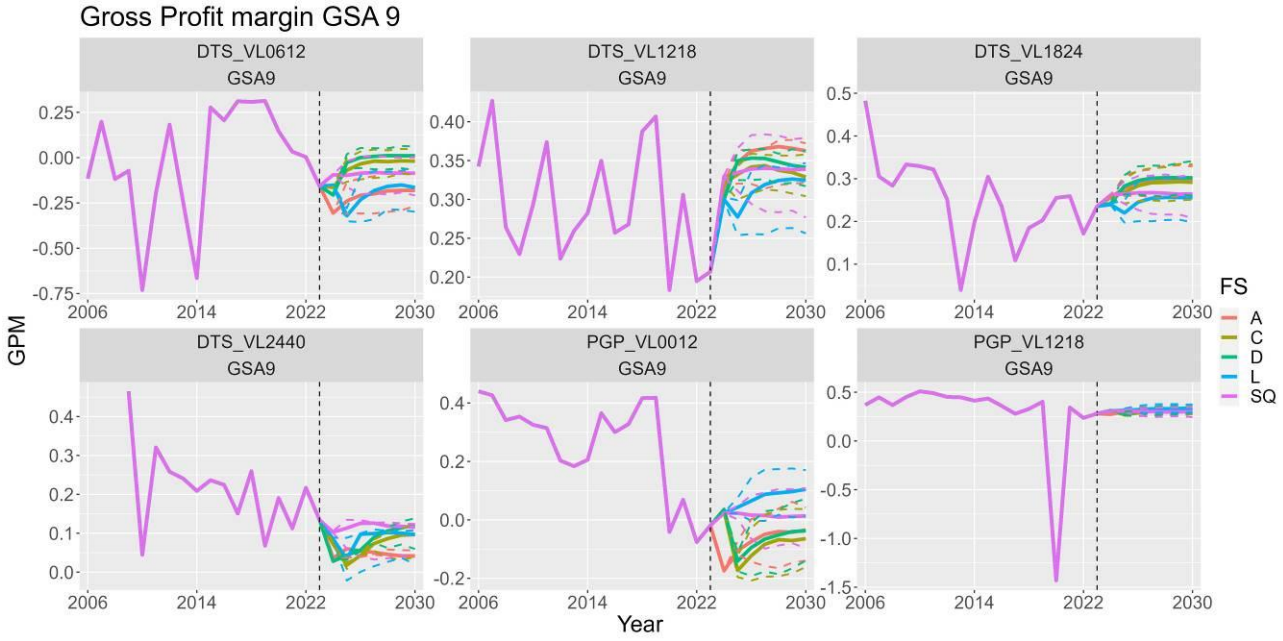


Figure 6.2.2.10– BEMTOOL. Trajectories of gross profit margin for the fleets operating in GSA 9 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

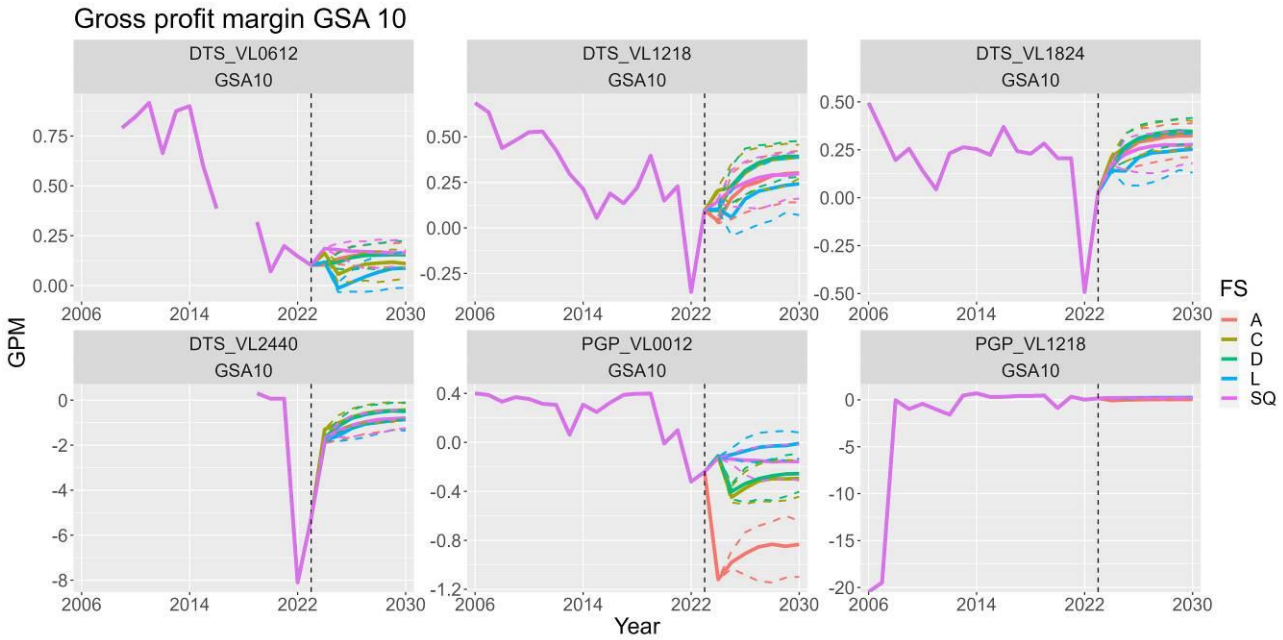


Figure 6.2.2.11– BEMTOOL. Trajectories of gross profit margin for the fleets operating in GSA 10 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

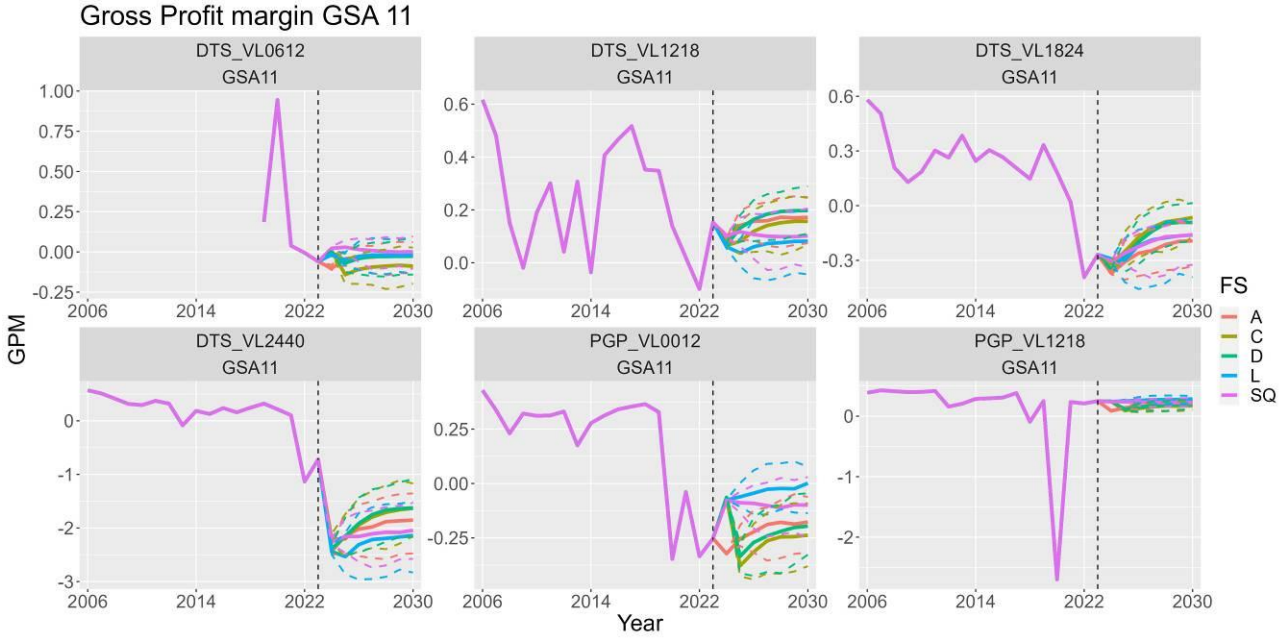


Figure 6.2.2.12– BEMTOOL. Trajectories of gross profit margin for the fleets operating in GSA 11 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

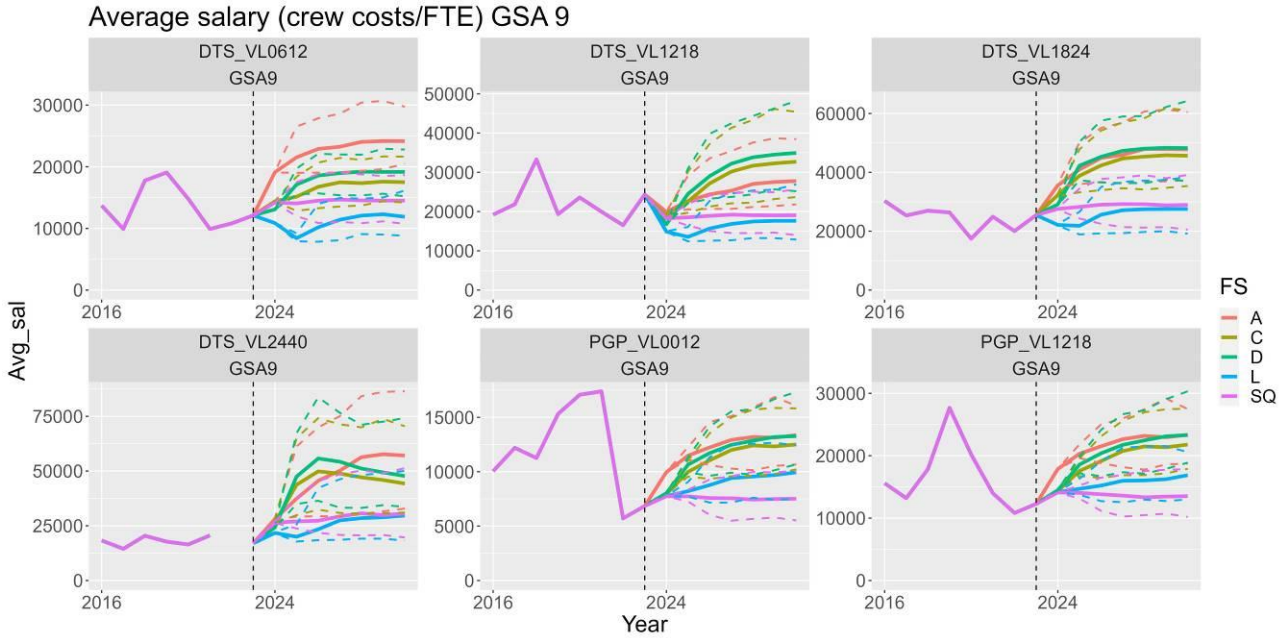


Figure 6.2.2.13– BEMTOOL. Trajectories of the average wage (crew costs/FTE) for the fleets operating in GSA 9 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

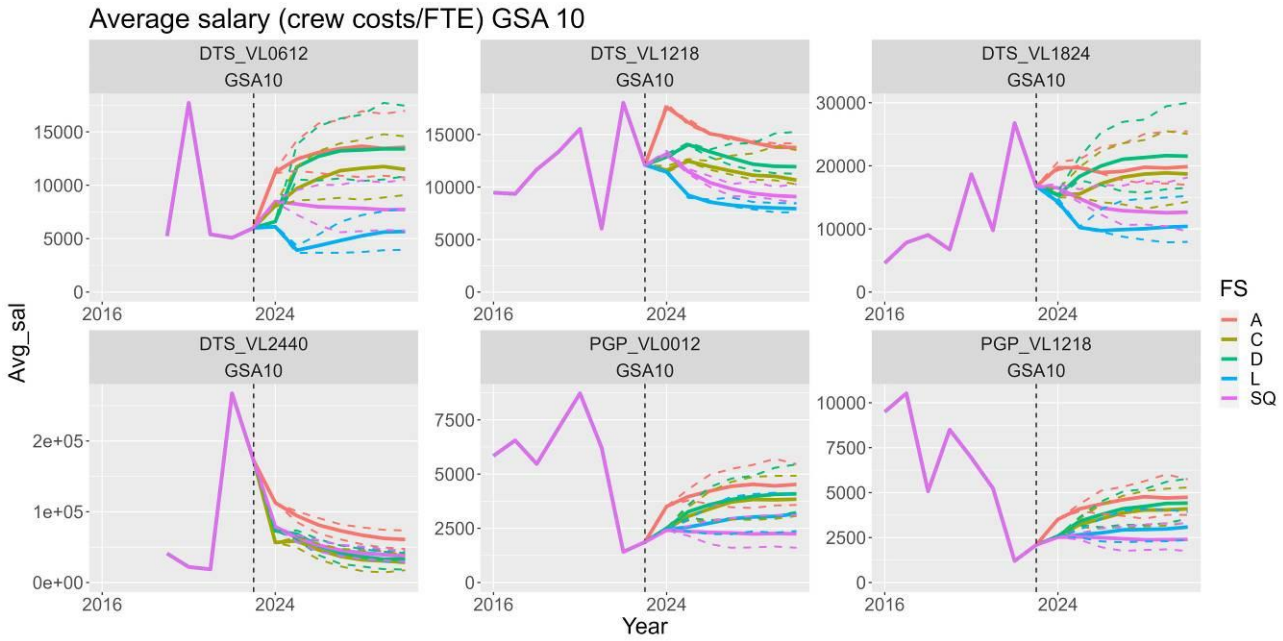


Figure 6.2.2.14– BEMTOOL. Trajectories of the average wage (crew costs/FTE) for the fleets operating in GSA 10 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

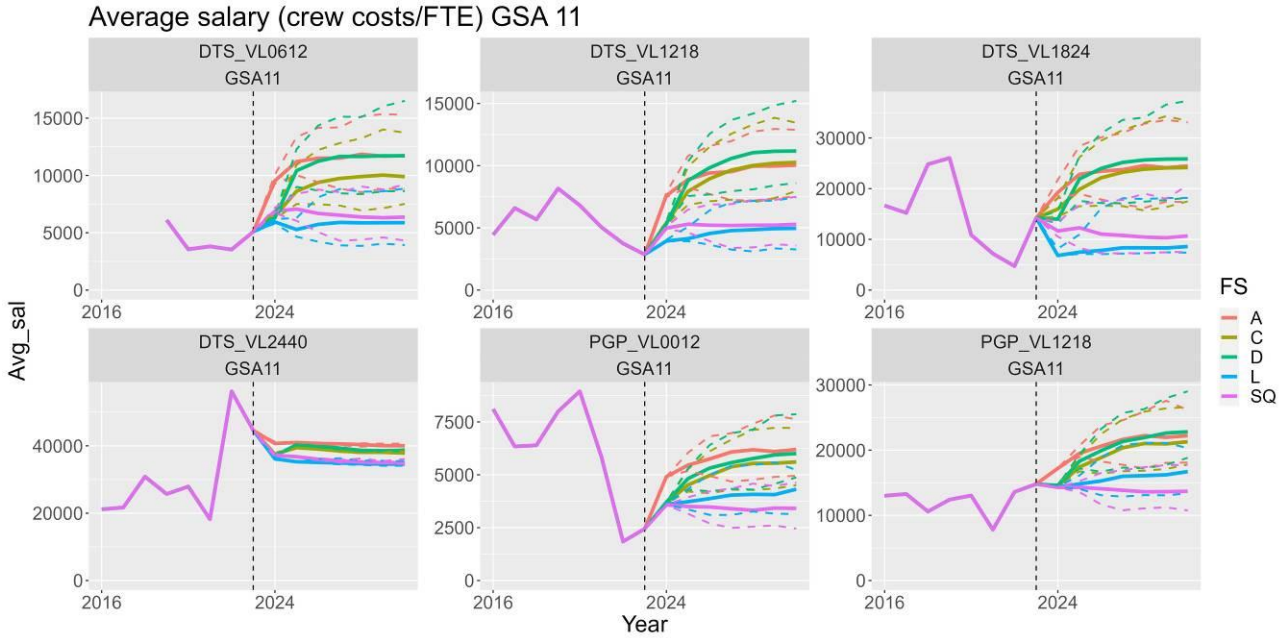


Figure 6.2.2.15– BEMTOOL. Trajectories of the average wage (crew costs/FTE) for the fleets operating in GSA 11 in the hindcasting phase (until 2023) and in the forecast phase (after 2023) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

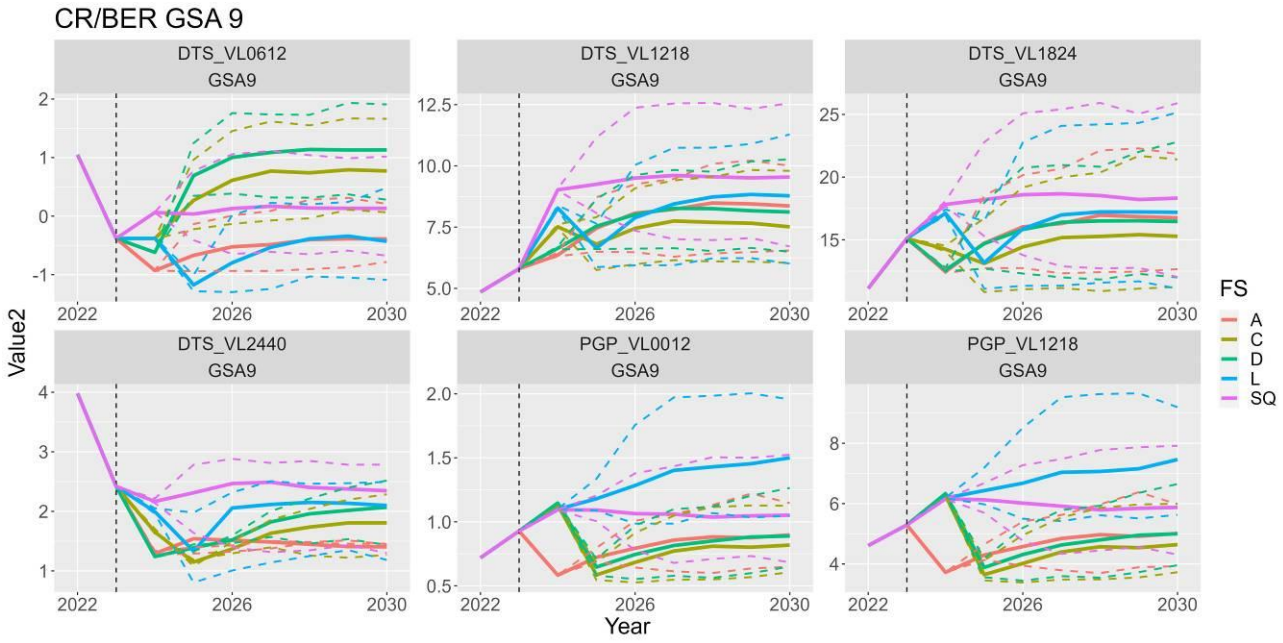


Figure 6.2.2.16– BEMTOOL. Trajectories of the CR/BER for the fleets operating in GSA 9 in the forecast phase (from 2022) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

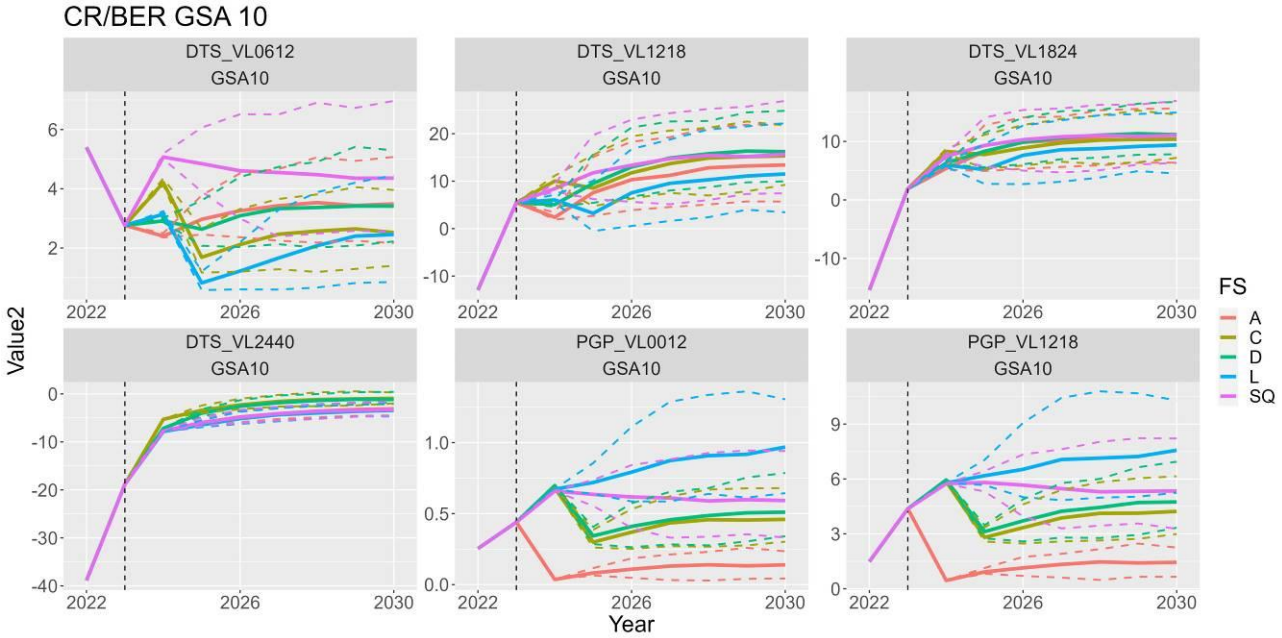


Figure 6.2.2.17– BEMTOOL. Trajectories of the CR/BER for the fleets operating in GSA 10 in the forecast phase (from 2022) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

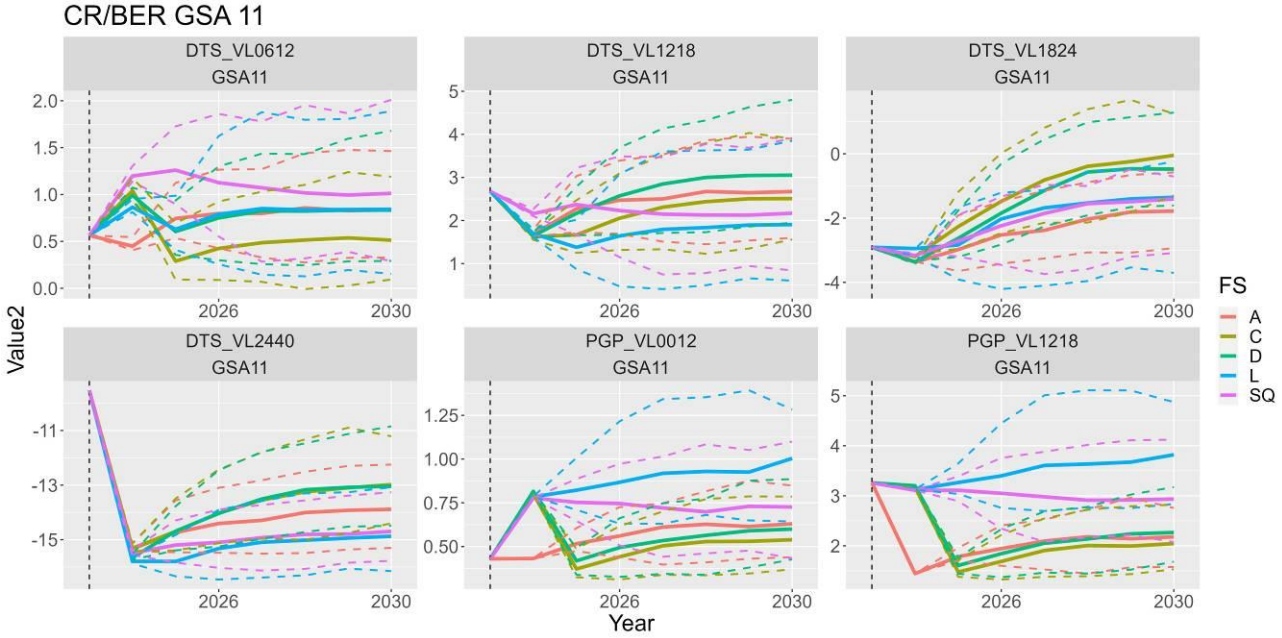


Figure 6.2.2.18– BEMTOOL. Trajectories of the CR/BER for the fleets operating in GSA 11 in the forecast phase (from 2022) under the alternative scenarios. Solid lines correspond to medians, while the dashed lines correspond to 5$^{th}$ and 95$^{th}$ quantiles. The black dashed lines corresponds to 2023.

Main indicators in 2024, 2025 and 2030 and their change (Catches, F, SSB, landings, GPM, FTE loss) by fleet segment, stock and scenarios are reported in the tables from 6.2.2.2.1 to 6.2.2.2.11.

Table 6.2.2.1 - Total catches by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios

| Stock | Single-stock catch advice for 2024 | Catches per scenario 2024 (in tons) | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| ARA91011 | 127 | 88 | 75 | 86 | 88 | 88 |
| ARS91011 | 279 | 354 | 279 | 336 | 354 | 354 |
| MUT10 | 261 | 216 | 397 | 298 | 343 | 416 |
| MUT9 | 976 | 473 | 666 | 484 | 751 | 847 |
| HKE891011 | 1183 | 1144 | 1865 | 1763 | 2034 | 2003 |
| NEP9 | 128 | 105 | 125 | 120 | 167 | 153 |
| DPS91011 | 1586 | 1000 | 1249 | 1049 | 1288 | 1385 |

Table 6.2.2.2: Fishing Mortality (F) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios.

| Stock | Single-stock F advice for 2024 | F(2024) resulting from scenario | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| ARA91011 | NA | 0.36 | 0.30 | 0.35 | 0.36 | 0.36 |
| ARS91011 | 0.43 | 0.49 | 0.39 | 0.47 | 0.49 | 0.49 |
| MUT10 | NA | 0.17 | 0.38 | 0.26 | 0.30 | 0.37 |
| MUT9 | 0.5 | 0.19 | 0.32 | 0.22 | 0.36 | 0.38 |
| HKE891011 | 0.17 | 0.19 | 0.32 | 0.30 | 0.36 | 0.35 |
| NEP9 | 0.13 | 0.11 | 0.13 | 0.12 | 0.18 | 0.16 |
| DPS91011 | 1.26 | 0.76 | 1.00 | 0.98 | 1.33 | 1.20 |

* to note : no estimations from EWG 23-09 of Fmsy for MUT10 and ARA91011.

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.2.2.3: Fishing Mortality (F) by management scenarios for 2025 for single-stock advice (based on STECF 23-09 outputs) and scenarios.

| Stock | F(2025) resulting from scenario | | | | |
|---|---|---|---|---|---|
| | **A** | **C** | **D** | **L** | **SQ** |
| ARA91011 | 0.34 | 0.25 | 0.26 | 0.34 | 0.34 |
| ARS91011 | 0.44 | 0.30 | 0.32 | 0.44 | 0.44 |
| MUT10 | 0.18 | 0.22 | 0.21 | 0.14 | 0.39 |
| MUT9 | 0.20 | 0.24 | 0.22 | 0.23 | 0.38 |
| HKE891011 | 0.19 | 0.19 | 0.19 | 0.31 | 0.35 |
| NEP9 | 0.11 | 0.10 | 0.10 | 0.15 | 0.16 |
| DPS91011 | 0.75 | 0.72 | 0.74 | 1.15 | 1.20 |

* to note : no estimations from EWG 23-09 of Fmsy for MUT10 and ARA91011.

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.2.2.4: Fishing Mortality (F) by management scenarios for 2030 for single-stock advice (based on STECF 23-09 outputs) and scenarios.

| Stock | F(2030) resulting from scenario | | | | |
|---|---|---|---|---|---|
| | **A** | **C** | **D** | **L** | **SQ** |
| ARA91011 | 0.27 | 0.17 | 0.17 | 0.27 | 0.27 |
| ARS91011 | 0.35 | 0.18 | 0.18 | 0.35 | 0.35 |
| MUT10 | 0.19 | 0.23 | 0.21 | 0.14 | 0.41 |
| MUT9 | 0.21 | 0.25 | 0.23 | 0.24 | 0.41 |
| HKE891011 | 0.19 | 0.19 | 0.19 | 0.31 | 0.35 |
| NEP9 | 0.10 | 0.09 | 0.09 | 0.15 | 0.16 |
| DPS91011 | 0.74 | 0.66 | 0.67 | 1.17 | 1.22 |

* to note : no estimations from EWG 23-09 of Fmsy for MUT10 and ARA91011.

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.2.2.2.5: Spawning stock biomass (SSB) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios.

| Stock | Single-stock advice SSB for 2024 | SSB(2024) resulting from scenario | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| ARA91011 | NA* | 248 | 248 | 248 | 248 | 248 |
| ARS91011 | -** | 539 | 539 | 539 | 539 | 539 |
| MUT10 | NA* | 1240 | 1240 | 1240 | 1240 | 1240 |
| MUT9 | 1869 | 2195 | 2195 | 2195 | 2195 | 2195 |
| HKE891011 | 7873 | 4708 | 4708 | 4708 | 4708 | 4708 |
| NEP9 | 751 | 706 | 706 | 706 | 706 | 706 |
| DPS91011 | -** | 1046 | 1046 | 1046 | 1046 | 1046 |

* to note : no estimations from EWG 23-09 of B at F0.1, Blim and Bpa for MUT10 and ARA91011.

** values from the short term projections ran in EWG 2309 were not available

Legend:

| | |
|---|---|
| | SSB2024 >Bpa |
| | Blim < SSB2024 < Bpa |
| | SSB2024 < Blim |

Table 6.2.2.2.5 - Summary of BEMTOOL results in EMU2. Percentage of change in landings of target species per fleet segment and by scenario between 2020 and 2024, between 2020 and 2025, and between 2020 and 2030. The median values are used. The % is calculated as (Landings(2024)-Landings (2020))/ Landings (2020).

| GSA | Fleet segment | Estimated % landings of target species change 2020-2024 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 58% | 152% | 113% | 132% | 192% |
| | DTS_VL1218 | -4% | 15% | 8% | 28% | 38% |
| | DTS_VL1824 | 41% | 84% | 71% | 84% | 100% |
| | DTS_VL2440 | 57% | 68% | 67% | 65% | 77% |
| | PGP_VL0012 | -86% | -46% | -45% | -46% | -47% |
| | PGP_VL1218 | -80% | -23% | -23% | -24% | -24% |
| 11 | DTS_VL0612 | 74% | 199% | 195% | 182% | 216% |
| | DTS_VL1218 | -12% | 2% | -1% | 26% | 27% |
| | DTS_VL1824 | -37% | -28% | -35% | -25% | -21% |
| | DTS_VL2440 | -49% | -43% | -49% | -50% | -44% |
| | PGP_VL0012 | -83% | -68% | -68% | -68% | -69% |
| | PGP_VL1218 | 170% | 416% | 420% | 411% | 409% |
| 9 | DTS_VL0612 | -6% | 37% | 21% | 47% | 72% |
| | DTS_VL1218 | -36% | -22% | -31% | -4% | 0% |
| | DTS_VL1824 | -40% | -31% | -38% | -4% | -8% |
| | DTS_VL2440 | -26% | -20% | -25% | 3% | 2% |
| | PGP_VL0012 | 19% | 126% | 128% | 123% | 122% |
| | PGP_VL1218 | -78% | -57% | -57% | -58% | -58% |

| GSA | Fleet segment | Estimated % landings of target species change 2020-2025 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 75% | 42% | 65% | 65% | 185% |
| | DTS_VL1218 | 3% | -17% | -8% | -5% | 35% |
| | DTS_VL1824 | 50% | 26% | 37% | 47% | 99% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DTS_VL2440 | 64% | 46% | 46% | 51% | 78% |
| | PGP_VL0012 | -84% | -72% | -70% | -44% | -48% |
| | PGP_VL1218 | -77% | -59% | -58% | -21% | -24% |
| 11 | DTS_VL0612 | 101% | 65% | 92% | 160% | 223% |
| | DTS_VL1218 | 2% | -14% | -3% | 7% | 30% |
| | DTS_VL1824 | -28% | -35% | -30% | -36% | -20% |
| | DTS_VL2440 | -41% | -47% | -43% | -54% | -43% |
| | PGP_VL0012 | -81% | -83% | -82% | -68% | -69% |
| | PGP_VL1218 | 207% | 172% | 185% | 428% | 409% |
| 9 | DTS_VL0612 | 6% | 81% | 112% | 1% | 71% |
| | DTS_VL1218 | -28% | -35% | -28% | -26% | 0% |
| | DTS_VL1824 | -32% | -41% | -34% | -27% | -7% |
| | DTS_VL2440 | -16% | -27% | -19% | -18% | 3% |
| | PGP_VL0012 | 35% | 20% | 26% | 131% | 121% |
| | PGP_VL1218 | -75% | -77% | -76% | -56% | -58% |
| **GSA** | **Fleet segment** | **Estimated % landings of target species change 2020-2030** | | | | |
| | | **A** | **C** | **D** | **L** | **SQ** |
| 10 | DTS_VL0612 | 91% | 67% | 89% | 113% | 168% |
| | DTS_VL1218 | 6% | -8% | -2% | 12% | 31% |
| | DTS_VL1824 | 57% | 40% | 49% | 71% | 93% |
| | DTS_VL2440 | 75% | 51% | 47% | 71% | 82% |
| | PGP_VL0012 | -82% | -65% | -64% | -33% | -50% |
| | PGP_VL1218 | -74% | -50% | -47% | -11% | -27% |
| 11 | DTS_VL0612 | 110% | 86% | 113% | 181% | 198% |
| | DTS_VL1218 | 7% | -3% | 9% | 14% | 19% |
| | DTS_VL1824 | -24% | -26% | -23% | -30% | -26% |
| | DTS_VL2440 | -38% | -40% | -37% | -50% | -47% |
| | PGP_VL0012 | -79% | -80% | -78% | -63% | -70% |
| | PGP_VL1218 | 252% | 235% | 258% | 494% | 389% |
| 9 | DTS_VL0612 | 21% | 109% | 138% | 43% | 78% |
| | DTS_VL1218 | -19% | -24% | -18% | -4% | 4% |
| | DTS_VL1824 | -25% | -35% | -30% | -9% | -6% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DTS_VL2440 | -8% | -34% | -29% | 2% | 5% |
| | PGP_VL0012 | 55% | 48% | 56% | 167% | 115% |
| | PGP_VL1218 | -71% | -72% | -71% | -51% | -59% |

Table 6.2.2.2.6 - Summary of BEMTOOL results in EMU2. Percentage of change in landings of target species per stock and by scenario between 2020 and 2024, between 2020 and 2025, and between 2020 and 2030. The median values are used. The % is calculated as (SSB(2024)-SSB(2020))/SSB(2020).

| Stock | Estimated % landings of target species change 2020-2024 | | | | |
|---|---|---|---|---|---|
| | A | C | D | L | SQ |
| ARA91011 | -67% | -72% | -67% | -67% | -67% |
| ARS91011 | 3% | -13% | 0% | 3% | 3% |
| MUT10 | -10% | 56% | 24% | 43% | 73% |
| MUT9 | -19% | 5% | -16% | 30% | 45% |
| HKE891011 | -34% | 6% | 3% | 19% | 17% |
| NEP9 | 20% | 43% | 37% | 91% | 75% |
| DPS91011 | -41% | -30% | -36% | -23% | -19% |

| Stock | Estimated % landings of target species change 2020-2025 | | | | |
|---|---|---|---|---|---|
| | A | C | D | L | SQ |
| ARA91011 | -68% | -75% | -74% | -68% | -68% |
| ARS91011 | 6% | -16% | -16% | 3% | 7% |
| MUT10 | -2% | -7% | 3% | -21% | 66% |
| MUT9 | -8% | -9% | 1% | -21% | 43% |
| HKE891011 | -24% | -29% | -24% | 11% | 18% |
| NEP9 | 34% | 23% | 26% | 71% | 85% |
| DPS91011 | -34% | -43% | -34% | -39% | -20% |

| Stock | Estimated % landings of target species change 2020-2030 | | | | |
|---|---|---|---|---|---|
| | A | C | D | L | SQ |
| ARA91011 | -67% | -72% | -72% | -68% | -68% |
| ARS91011 | 8% | -17% | -22% | 9% | 9% |
| MUT10 | 14% | 15% | 24% | 35% | 65% |

| | | | | | |
|---|---|---|---|---|---|
| MUT9 | 10% | 9% | 17% | 23% | 57% |
| HKE891011 | -19% | -20% | -13% | 19% | 10% |
| NEP9 | 41% | 32% | 34% | 81% | 81% |
| DPS91011 | -30% | -37% | -33% | -23% | -20% |

Table 6.2.2.2.7 - Summary of BEMTOOL results in EMU2. Gross profit margin per fleet segment and by scenario in 2024, in 2025, and 2030. The median values are used. The %of change between 2025 (resp. 2030) and 2020 is calculated as GPM(2025)-GPM(2020) (resp. as GPM(2030)-GPM(2020)).

| GSA | Fleet segment | Estimated level of profitability (gross profit margin) in 2024 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 0.103 | 0.162 | 0.112 | 0.117 | 0.186 |
| | DTS_VL1218 | 0.037 | 0.206 | 0.096 | 0.104 | 0.147 |
| | DTS_VL1824 | 0.155 | 0.213 | 0.160 | 0.142 | 0.176 |
| | DTS_VL2440 | -1.906 | -1.301 | -1.656 | -1.787 | -1.707 |
| | PGP_VL0012 | -1.120 | -0.118 | -0.110 | -0.121 | -0.127 |
| | PGP_VL1218 | -0.076 | 0.206 | 0.208 | 0.204 | 0.203 |
| 11 | DTS_VL0612 | -0.102 | 0.005 | -0.001 | -0.017 | 0.023 |
| | DTS_VL1218 | 0.084 | 0.066 | 0.068 | 0.061 | 0.102 |
| | DTS_VL1824 | -0.371 | -0.319 | -0.348 | -0.292 | -0.305 |
| | DTS_VL2440 | -2.434 | -2.207 | -2.389 | -2.438 | -2.263 |
| | PGP_VL0012 | -0.323 | -0.070 | -0.064 | -0.076 | -0.079 |
| | PGP_VL1218 | 0.088 | 0.243 | 0.246 | 0.241 | 0.240 |
| 9 | DTS_VL0612 | -0.306 | -0.164 | -0.207 | -0.152 | -0.095 |
| | DTS_VL1218 | 0.317 | 0.321 | 0.300 | 0.300 | 0.330 |
| | DTS_VL1824 | 0.256 | 0.259 | 0.242 | 0.239 | 0.262 |
| | DTS_VL2440 | 0.036 | 0.072 | 0.028 | 0.084 | 0.103 |
| | PGP_VL0012 | -0.174 | 0.032 | 0.036 | 0.024 | 0.023 |
| | PGP_VL1218 | 0.273 | 0.310 | 0.312 | 0.308 | 0.307 |

| GSA | Fleet segment | Estimated level of profitability (gross profit margin) in 2025 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 0.134 | 0.057 | 0.117 | -0.013 | 0.179 |
| | DTS_VL1218 | 0.165 | 0.222 | 0.232 | 0.057 | 0.213 |
| | DTS_VL1824 | 0.243 | 0.265 | 0.267 | 0.139 | 0.226 |
| | DTS_VL2440 | -1.441 | -1.018 | -1.161 | -1.588 | -1.342 |
| | PGP_VL0012 | -0.979 | -0.448 | -0.401 | -0.100 | -0.137 |
| | PGP_VL1218 | -0.010 | 0.132 | 0.149 | 0.215 | 0.205 |
| 11 | DTS_VL0612 | -0.042 | -0.141 | -0.069 | -0.050 | 0.029 |
| | DTS_VL1218 | 0.141 | 0.081 | 0.131 | 0.037 | 0.117 |
| | DTS_VL1824 | -0.309 | -0.251 | -0.278 | -0.298 | -0.260 |
| | DTS_VL2440 | -2.141 | -2.201 | -2.154 | -2.533 | -2.157 |
| | PGP_VL0012 | -0.254 | -0.378 | -0.335 | -0.061 | -0.088 |
| | PGP_VL1218 | 0.139 | 0.093 | 0.114 | 0.250 | 0.240 |
| 9 | DTS_VL0612 | -0.240 | -0.070 | -0.027 | -0.321 | -0.098 |
| | DTS_VL1218 | 0.347 | 0.332 | 0.350 | 0.277 | 0.335 |
| | DTS_VL1824 | 0.278 | 0.268 | 0.283 | 0.220 | 0.264 |
| | DTS_VL2440 | 0.060 | 0.018 | 0.044 | 0.034 | 0.113 |
| | PGP_VL0012 | -0.104 | -0.173 | -0.141 | 0.043 | 0.023 |
| | PGP_VL1218 | 0.301 | 0.269 | 0.282 | 0.314 | 0.306 |

| GSA | Fleet segment | Estimated level of profitability (gross profit margin) in 2030 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 0.158 | 0.110 | 0.155 | 0.087 | 0.164 |
| | DTS_VL1218 | 0.302 | 0.389 | 0.393 | 0.242 | 0.298 |
| | DTS_VL1824 | 0.323 | 0.340 | 0.346 | 0.253 | 0.277 |
| | DTS_VL2440 | -0.806 | -0.436 | -0.498 | -0.860 | -0.797 |
| | PGP_VL0012 | -0.833 | -0.295 | -0.255 | -0.010 | -0.158 |
| | PGP_VL1218 | 0.049 | 0.200 | 0.220 | 0.247 | 0.192 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | DTS_VL0612 | -0.026 | -0.088 | -0.027 | -0.020 | 0.002 |
| | DTS_VL1218 | 0.172 | 0.157 | 0.198 | 0.082 | 0.102 |
| | DTS_VL1824 | -0.193 | -0.065 | -0.092 | -0.161 | -0.159 |
| | DTS_VL2440 | -1.853 | -1.632 | -1.624 | -2.138 | -2.042 |
| | PGP_VL0012 | -0.177 | -0.238 | -0.196 | 0.001 | -0.100 |
| | PGP_VL1218 | 0.188 | 0.173 | 0.198 | 0.283 | 0.227 |
| 9 | DTS_VL0612 | -0.181 | -0.019 | 0.010 | -0.165 | -0.086 |
| | DTS_VL1218 | 0.363 | 0.329 | 0.341 | 0.325 | 0.339 |
| | DTS_VL1824 | 0.297 | 0.292 | 0.302 | 0.256 | 0.265 |
| | DTS_VL2440 | 0.042 | 0.096 | 0.121 | 0.097 | 0.115 |
| | PGP_VL0012 | -0.034 | -0.064 | -0.038 | 0.105 | 0.013 |
| | PGP_VL1218 | 0.329 | 0.315 | 0.328 | 0.339 | 0.299 |

Legend:

>10% - High

0-10% - Reasonable

<0% - Weak

Table 6.2.2.2.8 - Summary of BEMTOOL results in EMU2. Change in gross profit margin per fleet segment and by scenario between between 2020 and 2025 and between 2020 and 2030. The median values are used The %of change between 2025 (resp. 2030) and 2020 is calculated as GPM(2025)-GPM(2020) (resp. as GPM(2030)-GPM(2020)).

| GSA | Fleet segment | Estimated % Gross profit margin 2020-2025 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 0.063 | -0.014 | 0.046 | -0.084 | 0.109 |
| | DTS_VL1218 | 0.016 | 0.073 | 0.083 | -0.092 | 0.064 |
| | DTS_VL1824 | 0.037 | 0.059 | 0.061 | -0.067 | 0.020 |
| | DTS_VL2440 | -1.504 | -1.081 | -1.224 | -1.651 | -1.404 |
| | PGP_VL0012 | -0.969 | -0.437 | -0.391 | -0.090 | -0.127 |
| | PGP_VL1218 | 0.863 | 1.006 | 1.023 | 1.088 | 1.078 |
| 11 | DTS_VL0612 | -0.988 | -1.087 | -1.014 | -0.995 | -0.916 |
| | DTS_VL1218 | 0.002 | -0.057 | -0.008 | -0.102 | -0.021 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DTS_VL1824 | -0.491 | -0.433 | -0.460 | -0.480 | -0.442 |
| | DTS_VL2440 | -2.356 | -2.416 | -2.369 | -2.748 | -2.372 |
| | PGP_VL0012 | 0.093 | -0.031 | 0.012 | 0.286 | 0.259 |
| | PGP_VL1218 | 2.840 | 2.794 | 2.814 | 2.951 | 2.941 |
| 9 | DTS_VL0612 | -0.385 | -0.215 | -0.172 | -0.466 | -0.243 |
| | DTS_VL1218 | 0.164 | 0.149 | 0.166 | 0.094 | 0.151 |
| | DTS_VL1824 | 0.023 | 0.013 | 0.028 | -0.035 | 0.009 |
| | DTS_VL2440 | -0.131 | -0.173 | -0.147 | -0.157 | -0.077 |
| | PGP_VL0012 | -0.063 | -0.132 | -0.099 | 0.085 | 0.065 |
| | PGP_VL1218 | 1.732 | 1.701 | 1.713 | 1.746 | 1.738 |

| GSA | Fleet segment | Estimated % Gross profit margin 2020-2030 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | 0.087 | 0.040 | 0.084 | 0.017 | 0.093 |
| | DTS_VL1218 | 0.153 | 0.239 | 0.243 | 0.093 | 0.149 |
| | DTS_VL1824 | 0.117 | 0.134 | 0.140 | 0.047 | 0.071 |
| | DTS_VL2440 | -0.869 | -0.499 | -0.561 | -0.923 | -0.860 |
| | PGP_VL0012 | -0.823 | -0.285 | -0.245 | 0.000 | -0.148 |
| | PGP_VL1218 | 0.923 | 1.073 | 1.093 | 1.121 | 1.065 |
| 11 | DTS_VL0612 | -0.972 | -1.033 | -0.972 | -0.965 | -0.944 |
| | DTS_VL1218 | 0.033 | 0.018 | 0.059 | -0.057 | -0.037 |
| | DTS_VL1824 | -0.375 | -0.247 | -0.274 | -0.343 | -0.341 |
| | DTS_VL2440 | -2.068 | -1.847 | -1.839 | -2.353 | -2.257 |
| | PGP_VL0012 | 0.170 | 0.110 | 0.151 | 0.348 | 0.248 |
| | PGP_VL1218 | 2.889 | 2.873 | 2.899 | 2.984 | 2.928 |
| 9 | DTS_VL0612 | -0.326 | -0.165 | -0.135 | -0.310 | -0.231 |
| | DTS_VL1218 | 0.179 | 0.145 | 0.158 | 0.141 | 0.156 |
| | DTS_VL1824 | 0.042 | 0.037 | 0.047 | 0.001 | 0.010 |
| | DTS_VL2440 | -0.149 | -0.094 | -0.070 | -0.094 | -0.076 |
| | PGP_VL0012 | 0.007 | -0.023 | 0.004 | 0.146 | 0.055 |
| | PGP_VL1218 | 1.760 | 1.747 | 1.760 | 1.770 | 1.730 |

Table 6.2.2.2.9 - Summary of BEMTOOL results in EMU2. Estimated loss of FTE on-board per fleet segment and by scenario between 2020 and 2024, between 2020 and 2025, and between 2020 and 2030. The median values are used. The % is calculated as (FTE(2024)-FTE(2020)).

| GSA | Fleet segment | Estimated loss of FTE on-board 2020-2024 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | -6 | 0 | 0 | 1 | 0 |
| | DTS_VL1218 | -93 | -20 | -20 | 52 | 22 |
| | DTS_VL1824 | -14 | 54 | 54 | 80 | 69 |
| | DTS_VL2440 | -9 | -4 | -4 | -4 | -4 |
| | PGP_VL0012 | -267 | 1834 | 1834 | 1834 | 1834 |
| | PGP_VL1218 | 0 | 51 | 51 | 51 | 51 |
| 11 | DTS_VL0612 | -16 | -9 | -9 | -9 | -9 |
| | DTS_VL1218 | -49 | -3 | -3 | 56 | 31 |
| | DTS_VL1824 | -43 | -32 | -32 | -15 | -22 |
| | DTS_VL2440 | -35 | -31 | -31 | -30 | -31 |
| | PGP_VL0012 | 37 | 760 | 760 | 760 | 760 |
| | PGP_VL1218 | -93 | -68 | -68 | -68 | -68 |
| 9 | DTS_VL0612 | -21 | -12 | -12 | -4 | -7 |
| | DTS_VL1218 | -75 | -34 | -34 | 45 | 12 |
| | DTS_VL1824 | -156 | -123 | -123 | -3 | -54 |
| | DTS_VL2440 | -25 | -23 | -23 | -15 | -18 |
| | PGP_VL0012 | 57 | 597 | 597 | 597 | 597 |
| | PGP_VL1218 | -60 | -40 | -40 | -40 | -40 |

| GSA | Fleet segment | Estimated loss of FTE on-board 2020-2025 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | -6 | -6 | -6 | 0 | 0 |
| | DTS_VL1218 | -97 | -107 | -106 | 22 | 22 |
| | DTS_VL1824 | -18 | -28 | -26 | 69 | 69 |
| | DTS_VL2440 | -9 | -10 | -10 | -4 | -4 |
| | PGP_VL0012 | -267 | 433 | 433 | 1834 | 1834 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | PGP_VL1218 | 0 | 17 | 17 | 51 | 51 |
| 11 | DTS_VL0612 | -16 | -16 | -16 | -9 | -9 |
| | DTS_VL1218 | -49 | -49 | -49 | 31 | 31 |
| | DTS_VL1824 | -43 | -43 | -43 | -22 | -22 |
| | DTS_VL2440 | -35 | -35 | -35 | -31 | -31 |
| | PGP_VL0012 | 37 | 37 | 37 | 760 | 760 |
| | PGP_VL1218 | -93 | -93 | -93 | -68 | -68 |
| 9 | DTS_VL0612 | -21 | -7 | -7 | -7 | -7 |
| | DTS_VL1218 | -75 | -83 | -81 | 12 | 12 |
| | DTS_VL1824 | -156 | -162 | -162 | -54 | -54 |
| | DTS_VL2440 | -25 | -25 | -25 | -18 | -18 |
| | PGP_VL0012 | 57 | 57 | 57 | 597 | 597 |
| | PGP_VL1218 | -60 | -60 | -60 | -40 | -40 |

| GSA | Fleet segment | Estimated loss of FTE on-board 2020-2030 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | -6 | -6 | -6 | 0 | 0 |
| | DTS_VL1218 | -104 | -114 | -114 | 22 | 22 |
| | DTS_VL1824 | -25 | -34 | -34 | 69 | 69 |
| | DTS_VL2440 | -10 | -11 | -11 | -4 | -4 |
| | PGP_VL0012 | -267 | 433 | 433 | 1834 | 1834 |
| | PGP_VL1218 | 0 | 17 | 17 | 51 | 51 |
| 11 | DTS_VL0612 | -16 | -16 | -16 | -9 | -9 |
| | DTS_VL1218 | -49 | -49 | -49 | 31 | 31 |
| | DTS_VL1824 | -43 | -43 | -43 | -22 | -22 |
| | DTS_VL2440 | -35 | -35 | -35 | -31 | -31 |
| | PGP_VL0012 | 37 | 37 | 37 | 760 | 760 |
| | PGP_VL1218 | -93 | -93 | -93 | -68 | -68 |
| 9 | DTS_VL0612 | -21 | -7 | -7 | -7 | -7 |
| | DTS_VL1218 | -80 | -89 | -89 | 12 | 12 |
| | DTS_VL1824 | -161 | -167 | -167 | -54 | -54 |
| | DTS_VL2440 | -25 | -26 | -26 | -18 | -18 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | PGP_VL0012 | 57 | 57 | 57 | 597 | 597 |
| | PGP_VL1218 | -60 | -60 | -60 | -40 | -40 |

Table 6.2.2.2.10 - Summary of BEMTOOL results in EMU2. Estimated % of loss of FTE on-board per fleet segment and by scenario between 2020 and 2024, between 2020 and 2025, and between 2020 and 2030. The median values are used. The % is calculated as (FTE(2024)-FTE(2020))/FTE(2020).

| GSA | Fleet segment | Estimated loss of FTE on-board 2020-2024 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | -48% | -3% | -3% | 9% | 4% |
| | DTS_VL1218 | -32% | -7% | -7% | 18% | 8% |
| | DTS_VL1824 | -8% | 31% | 31% | 47% | 40% |
| | DTS_VL2440 | -43% | -18% | -18% | -18% | -18% |
| | PGP_VL0012 | -28% | 190% | 190% | 190% | 190% |
| | PGP_VL1218 | 0% | 300% | 300% | 300% | 300% |
| 11 | DTS_VL0612 | -69% | -38% | -38% | -38% | -38% |
| | DTS_VL1218 | -30% | -2% | -2% | 34% | 19% |
| | DTS_VL1824 | -39% | -29% | -29% | -13% | -20% |
| | DTS_VL2440 | -42% | -37% | -37% | -36% | -36% |
| | PGP_VL0012 | 5% | 111% | 111% | 111% | 111% |
| | PGP_VL1218 | -79% | -57% | -57% | -57% | -57% |
| 9 | DTS_VL0612 | -60% | -33% | -33% | -11% | -21% |
| | DTS_VL1218 | -33% | -15% | -15% | 20% | 5% |
| | DTS_VL1824 | -52% | -41% | -41% | -1% | -18% |
| | DTS_VL2440 | -70% | -64% | -64% | -43% | -52% |
| | PGP_VL0012 | 12% | 124% | 124% | 124% | 124% |
| | PGP_VL1218 | -76% | -51% | -51% | -51% | -51% |

| GSA | Fleet segment | Estimated loss of FTE on-board 2020-2025 | | | | |
|---|---|---|---|---|---|---|
| | | A | C | D | L | SQ |
| 10 | DTS_VL0612 | -48% | -48% | -48% | 4% | 4% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | DTS_VL1218 | -34% | -37% | -37% | 8% | 8% |
| | DTS_VL1824 | -11% | -16% | -15% | 40% | 40% |
| | DTS_VL2440 | -45% | -49% | -48% | -18% | -18% |
| | PGP_VL0012 | -28% | 45% | 45% | 190% | 190% |
| | PGP_VL1218 | 0% | 100% | 100% | 300% | 300% |
| 11 | DTS_VL0612 | -69% | -69% | -69% | -38% | -38% |
| | DTS_VL1218 | -30% | -30% | -30% | 19% | 19% |
| | DTS_VL1824 | -39% | -39% | -39% | -20% | -20% |
| | DTS_VL2440 | -42% | -42% | -42% | -36% | -36% |
| | PGP_VL0012 | 5% | 5% | 5% | 111% | 111% |
| | PGP_VL1218 | -79% | -79% | -79% | -57% | -57% |
| 9 | DTS_VL0612 | -60% | -21% | -21% | -21% | -21% |
| | DTS_VL1218 | -33% | -37% | -36% | 5% | 5% |
| | DTS_VL1824 | -52% | -54% | -53% | -18% | -18% |
| | DTS_VL2440 | -70% | -71% | -71% | -52% | -52% |
| | PGP_VL0012 | 12% | 12% | 12% | 124% | 124% |
| | PGP_VL1218 | -76% | -76% | -76% | -51% | -51% |

| **GSA** | **Fleet segment** | **Estimated loss of FTE on-board 2020-2030** | | | | |
|---|---|---|---|---|---|---|
| | | **A** | **C** | **D** | **L** | **SQ** |
| 10 | DTS_VL0612 | -48% | -48% | -48% | 4% | 4% |
| | DTS_VL1218 | -36% | -40% | -40% | 8% | 8% |
| | DTS_VL1824 | -14% | -20% | -20% | 40% | 40% |
| | DTS_VL2440 | -48% | -52% | -52% | -18% | -18% |
| | PGP_VL0012 | -28% | 45% | 45% | 190% | 190% |
| | PGP_VL1218 | 0% | 100% | 100% | 300% | 300% |
| 11 | DTS_VL0612 | -69% | -69% | -69% | -38% | -38% |
| | DTS_VL1218 | -30% | -30% | -30% | 19% | 19% |
| | DTS_VL1824 | -39% | -39% | -39% | -20% | -20% |
| | DTS_VL2440 | -42% | -42% | -42% | -36% | -36% |
| | PGP_VL0012 | 5% | 5% | 5% | 111% | 111% |
| | PGP_VL1218 | -79% | -79% | -79% | -57% | -57% |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | DTS_VL0612 | -60% | -21% | -21% | -21% | -21% |
| | DTS_VL1218 | -36% | -40% | -40% | 5% | 5% |
| | DTS_VL1824 | -53% | -55% | -55% | -18% | -18% |
| | DTS_VL2440 | -71% | -73% | -73% | -52% | -52% |
| | PGP_VL0012 | 12% | 12% | 12% | 124% | 124% |
| | PGP_VL1218 | -76% | -76% | -76% | -51% | -51% |

Table 6.2.2.2.11 - Summary of BEMTOOL results in EMU2. Estimated number of fleet segments in red (with CR/BER <1) in 2025 and 2030. The median CR/BER values are used.

| Scenario | MS | Estimated Number of fleet segments in red (which do not cover costs and may not be financially viable) in 2025 | Estimated Number of fleet segments in red (which do not cover costs and may not be financially viable) in 2030 |
|---|---|---|---|
| **A** | **Italy** | 8 | 8 |
| **C** | **Italy** | 8 | 8 |
| **D** | **Italy** | 8 | 7 |
| **L** | **Italy** | 8 | 5 |
| **SQ** | **Italy** | 6 | 6 |

Table 6.2.2.2.12 – Summary of total fishing days by fleet segment and scenario.

| GSA | FS | Scenario | 2023 | 2024 | 2025 | 2030 |
|---|---|---|---|---|---|---|
| **GSA10** | **DTS_VL0612** | A | 754 | 377 | 377 | 377 |
| **GSA10** | **DTS_VL1218** | A | 15141 | 9536 | 9312 | 8976 |
| **GSA10** | **DTS_VL1824** | A | 10097 | 6621 | 6433 | 6158 |
| **GSA10** | **DTS_VL2440** | A | 706 | 490 | 473 | 449 |
| **GSA10** | **PGP_VL0012** | A | 286217 | 71554 | 71554 | 71554 |
| **GSA10** | **PGP_VL1218** | A | 969 | 242 | 242 | 242 |
| **GSA11** | **DTS_VL0612** | A | 519 | 260 | 260 | 260 |
| **GSA11** | **DTS_VL1218** | A | 6930 | 4102 | 4102 | 4102 |
| **GSA11** | **DTS_VL1824** | A | 3416 | 2602 | 2602 | 2602 |
| **GSA11** | **DTS_VL2440** | A | 2038 | 1867 | 1867 | 1867 |
| **GSA11** | **PGP_VL0012** | A | 107776 | 53888 | 53888 | 53888 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **GSA11** | **PGP_VL1218** | A | 1781 | 891 | 891 | 891 |
| **GSA9** | **DTS_VL0612** | A | 1399 | 700 | 700 | 700 |
| **GSA9** | **DTS_VL1218** | A | 15233 | 9645 | 9645 | 9325 |
| **GSA9** | **DTS_VL1824** | A | 11945 | 7036 | 7032 | 6815 |
| **GSA9** | **DTS_VL2440** | A | 656 | 409 | 409 | 396 |
| **GSA9** | **PGP_VL0012** | A | 121468 | 60734 | 60734 | 60734 |
| **GSA9** | **PGP_VL1218** | A | 1607 | 803 | 803 | 803 |
| **GSA10** | **DTS_VL0612** | C | 754 | 705 | 377 | 377 |
| **GSA10** | **DTS_VL1218** | C | 15141 | 13087 | 8811 | 8477 |
| **GSA10** | **DTS_VL1824** | C | 10097 | 9457 | 6041 | 5771 |
| **GSA10** | **DTS_VL2440** | C | 706 | 706 | 440 | 416 |
| **GSA10** | **PGP_VL0012** | C | 286217 | 286217 | 143108 | 143108 |
| **GSA10** | **PGP_VL1218** | C | 969 | 969 | 484 | 484 |
| **GSA11** | **DTS_VL0612** | C | 519 | 519 | 260 | 260 |
| **GSA11** | **DTS_VL1218** | C | 6930 | 5723 | 4102 | 4102 |
| **GSA11** | **DTS_VL1824** | C | 3416 | 3041 | 2602 | 2602 |
| **GSA11** | **DTS_VL2440** | C | 2038 | 2021 | 1867 | 1867 |
| **GSA11** | **PGP_VL0012** | C | 107776 | 107776 | 53888 | 53888 |
| **GSA11** | **PGP_VL1218** | C | 1781 | 1781 | 891 | 891 |
| **GSA9** | **DTS_VL0612** | C | 1399 | 1177 | 1399 | 1399 |
| **GSA9** | **DTS_VL1218** | C | 15233 | 12266 | 9139 | 8708 |
| **GSA9** | **DTS_VL1824** | C | 11945 | 8624 | 6726 | 6511 |
| **GSA9** | **DTS_VL2440** | C | 656 | 493 | 389 | 372 |
| **GSA9** | **PGP_VL0012** | C | 121468 | 121468 | 60734 | 60734 |
| **GSA9** | **PGP_VL1218** | C | 1607 | 1607 | 803 | 803 |
| **GSA10** | **DTS_VL0612** | D | 754 | 705 | 377 | 377 |
| **GSA10** | **DTS_VL1218** | D | 15141 | 13087 | 8881 | 8480 |
| **GSA10** | **DTS_VL1824** | D | 10097 | 9457 | 6098 | 5774 |
| **GSA10** | **DTS_VL2440** | D | 706 | 706 | 445 | 416 |
| **GSA10** | **PGP_VL0012** | D | 286217 | 286217 | 143108 | 143108 |
| **GSA10** | **PGP_VL1218** | D | 969 | 969 | 484 | 484 |
| **GSA11** | **DTS_VL0612** | D | 519 | 519 | 260 | 260 |
| **GSA11** | **DTS_VL1218** | D | 6930 | 5723 | 4102 | 4102 |
| **GSA11** | **DTS_VL1824** | D | 3416 | 3041 | 2602 | 2602 |
| **GSA11** | **DTS_VL2440** | D | 2038 | 2021 | 1867 | 1867 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **GSA11** | **PGP_VL0012** | D | 107776 | 107776 | 53888 | 53888 |
| **GSA11** | **PGP_VL1218** | D | 1781 | 1781 | 891 | 891 |
| **GSA9** | **DTS_VL0612** | D | 1399 | 1177 | 1399 | 1399 |
| **GSA9** | **DTS_VL1218** | D | 15233 | 12266 | 9227 | 8712 |
| **GSA9** | **DTS_VL1824** | D | 11945 | 8624 | 6770 | 6513 |
| **GSA9** | **DTS_VL2440** | D | 656 | 493 | 393 | 372 |
| **GSA9** | **PGP_VL0012** | D | 121468 | 121468 | 60734 | 60734 |
| **GSA9** | **PGP_VL1218** | D | 1607 | 1607 | 803 | 803 |
| **GSA10** | **DTS_VL0612** | L | 754 | 790 | 754 | 754 |
| **GSA10** | **DTS_VL1218** | L | 15141 | 16634 | 15141 | 15141 |
| **GSA10** | **DTS_VL1824** | L | 10097 | 10563 | 10097 | 10097 |
| **GSA10** | **DTS_VL2440** | L | 706 | 706 | 706 | 706 |
| **GSA10** | **PGP_VL0012** | L | 286217 | 286217 | 286217 | 286217 |
| **GSA10** | **PGP_VL1218** | L | 969 | 969 | 969 | 969 |
| **GSA11** | **DTS_VL0612** | L | 519 | 519 | 519 | 519 |
| **GSA11** | **DTS_VL1218** | L | 6930 | 7808 | 6930 | 6930 |
| **GSA11** | **DTS_VL1824** | L | 3416 | 3688 | 3416 | 3416 |
| **GSA11** | **DTS_VL2440** | L | 2038 | 2050 | 2038 | 2038 |
| **GSA11** | **PGP_VL0012** | L | 107776 | 107776 | 107776 | 107776 |
| **GSA11** | **PGP_VL1218** | L | 1781 | 1781 | 1781 | 1781 |
| **GSA9** | **DTS_VL0612** | L | 1399 | 1561 | 1399 | 1399 |
| **GSA9** | **DTS_VL1218** | L | 15233 | 17391 | 15233 | 15233 |
| **GSA9** | **DTS_VL1824** | L | 11945 | 14360 | 11945 | 11945 |
| **GSA9** | **DTS_VL2440** | L | 656 | 774 | 656 | 656 |
| **GSA9** | **PGP_VL0012** | L | 121468 | 121468 | 121468 | 121468 |
| **GSA9** | **PGP_VL1218** | L | 1607 | 1607 | 1607 | 1607 |
| **GSA10** | **DTS_VL0612** | SQ | 754 | 754 | 754 | 754 |
| **GSA10** | **DTS_VL1218** | SQ | 15141 | 15141 | 15141 | 15141 |
| **GSA10** | **DTS_VL1824** | SQ | 10097 | 10097 | 10097 | 10097 |
| **GSA10** | **DTS_VL2440** | SQ | 706 | 706 | 706 | 706 |
| **GSA10** | **PGP_VL0012** | SQ | 286217 | 286217 | 286217 | 286217 |
| **GSA10** | **PGP_VL1218** | SQ | 969 | 969 | 969 | 969 |
| **GSA11** | **DTS_VL0612** | SQ | 519 | 519 | 519 | 519 |
| **GSA11** | **DTS_VL1218** | SQ | 6930 | 6930 | 6930 | 6930 |
| **GSA11** | **DTS_VL1824** | SQ | 3416 | 3416 | 3416 | 3416 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **GSA11** | **DTS_VL2440** | SQ | 2038 | 2038 | 2038 | 2038 |
| **GSA11** | **PGP_VL0012** | SQ | 107776 | 107776 | 107776 | 107776 |
| **GSA11** | **PGP_VL1218** | SQ | 1781 | 1781 | 1781 | 1781 |
| **GSA9** | **DTS_VL0612** | SQ | 1399 | 1399 | 1399 | 1399 |
| **GSA9** | **DTS_VL1218** | SQ | 15233 | 15233 | 15233 | 15233 |
| **GSA9** | **DTS_VL1824** | SQ | 11945 | 11945 | 11945 | 11945 |
| **GSA9** | **DTS_VL2440** | SQ | 656 | 656 | 656 | 656 |
| **GSA9** | **PGP_VL0012** | SQ | 121468 | 121468 | 121468 | 121468 |
| **GSA9** | **PGP_VL1218** | SQ | 1607 | 1607 | 1607 | 1607 |

### 6.2.1 Additional social and economic values by management scenarios for 2024 and 2025

Table 6.2.3.1 Additional socio-economic indicators by fleet segment and scenario for 2024.

| Indicator | GSA | Fleet segment | Economic and social outputs per scenario in 2024 | | | | | avg 2015-2017 | min 2015-2017 |
|---|---|---|---|---|---|---|---|---|---|
| | | | A | C | D | L | SQ | | |
| GVA | 10 | DTS_VL0612 | 95 611 | 147 364 | 110 402 | 116 787 | 172 100 | 204 475 | 0 |
| | | DTS_VL1218 | 3 730 641 | 5 083 076 | 4 328 494 | 4 987 837 | 5 693 859 | 5 044 593 | 3 227 925 |
| | | DTS_VL1824 | 4 867 377 | 6 405 563 | 5 587 355 | 5 587 085 | 6 556 900 | 6 024 891 | 4 513 136 |
| | | DTS_VL2440 | -1 755 597 | -1 243 375 | -1 624 023 | -1 755 733 | -1 702 874 | 1 598 765 | 277330.54 |
| | | PGP_VL0012 | -7 370 664 | 3 613 429 | 3 932 242 | 3 500 135 | 3 274 983 | 30 418 926 | 27 033 311 |
| | | PGP_VL1218 | 44 203 | 310 403 | 315 270 | 307 191 | 305 244 | 5 563 693 | 4 615 342 |
| | 11 | DTS_VL0612 | 49 629 | 93 311 | 89 582 | 80 254 | 104 823 | 1 738 826 | 127 228 |
| | | DTS_VL1218 | 1 205 661 | 1 170 410 | 1 167 990 | 1 201 201 | 1 526 710 | 4 770 175 | 3 716 350 |
| | | DTS_VL1824 | -152 563 | -135 384 | -348 298 | -662 112 | -351 865 | 3 055 170 | 2 635 993 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | DTS_VL2440 | -2 727 394 | -2 728 586 | -2 850 907 | -2 913 066 | -2 781 264 | 3 283 794 | 2 647 641 |
| | | PGP_VL0012 | -435 987 | 3 872 252 | 4 064 400 | 3 699 520 | 3 611 251 | 16 145 210 | 14 384 957 |
| | | PGP_VL1218 | 557 909 | 1 339 791 | 1 356 085 | 1 321 381 | 1 314 562 | 6 607 090 | 5 951 898 |
| | 9 | DTS_VL0612 | 103 567 | 220 296 | 169 854 | 221 013 | 315 496 | 522 715 | 364 073 |
| | | DTS_VL1218 | 6 655 845 | 8 058 236 | 7 051 916 | 9 008 346 | 9 821 808 | 13 973 022 | 12 907 990 |
| | | DTS_VL1824 | 9 128 907 | 10 324 129 | 9 190 036 | 12 129 006 | 12 610 181 | 18 661 897 | 13 845 573 |
| | | DTS_VL2440 | 346 086 | 444 477 | 350 233 | 594 695 | 635 024 | 979 867 | 798 359 |
| | | PGP_VL0012 | 2 515 570 | 9 463 629 | 9 680 167 | 9 062 624 | 9 004 743 | 21 759 724 | 19 909 919 |
| | | PGP_VL1218 | 645 171 | 1 133 439 | 1 147 168 | 1 118 897 | 1 113 200 | 3 664 765 | 2 853 453 |
| GP | 10 | DTS_VL0612 | 19 871 | 45 462 | 27 185 | 30 342 | 57 693 | 127 237 | 0 |
| | | DTS_VL1218 | 306 226 | 1 985 813 | 896 224 | 1 111 380 | 1 632 676 | 1 545 025 | 500 388 |
| | | DTS_VL1824 | 1 749 351 | 2 909 246 | 2 118 348 | 1 979 294 | 2 576 120 | 4 304 123 | 2 898 929 |
| | | DTS_VL2440 | -3 103 042 | -2 216 563 | -2 881 029 | -3 110 202 | -3 061 677 | 659 836 | 52273.947 |
| | | PGP_VL0012 | -9 827 342 | -3 275 707 | -3 085 546 | -3 343 283 | -3 477 579 | 14 561 484 | 10 958 637 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PGP_VL1218 | -15 507 | 137 004 | 139 792 | 135 163 | 134 048 | 2 840 411 | 2 109 109 |
| | 11 | DTS_VL0612 | -18 360 | 1 370 | -315 | -4 528 | 6 570 | 1 644 191 | 16 689 |
| | | DTS_VL1218 | 320 928 | 294 276 | 302 970 | 327 055 | 547 234 | 3 552 903 | 2 903 797 |
| | | DTS_VL1824 | -1 455 691 | -1 397 398 | -1 452 719 | -1 314 780 | -1 386 816 | 1 400 780 | 1 276 980 |
| | | DTS_VL2440 | -4 729 342 | -4 725 183 | -4 824 239 | -4 863 957 | -4 775 649 | 1 261 978 | 824 809 |
| | | PGP_VL0012 | -3 985 336 | -1 408 543 | -1 293 618 | -1 511 855 | -1 564 650 | 7 238 001 | 6 919 248 |
| | | PGP_VL1218 | 125 936 | 612 531 | 622 671 | 601 074 | 596 830 | 3 200 848 | 2 662 312 |
| | 9 | DTS_VL0612 | -162 244 | -116 339 | -136 176 | -116 057 | -78 901 | 200 518 | 180 154 |
| | | DTS_VL1218 | 3 685 476 | 4 480 570 | 3 876 382 | 5 005 580 | 5 518 057 | 6 893 921 | 5 957 788 |
| | | DTS_VL1824 | 3 910 971 | 4 522 056 | 3 956 568 | 5 502 439 | 5 742 130 | 7 875 038 | 3 687 002 |
| | | DTS_VL2440 | 45 225 | 101 419 | 37 258 | 154 205 | 180 815 | 445 887 | 302 909 |
| | | PGP_VL0012 | -2 862 192 | 890 960 | 1 007 928 | 674 348 | 643 082 | 10 106 127 | 9 132 184 |
| | | PGP_VL1218 | 299 311 | 578 815 | 586 674 | 570 491 | 567 229 | 1 919 126 | 1 322 337 |
| | 10 | DTS_VL0612 | 33 | 33 | 33 | 33 | 33 | 13 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Employment: Engaged crew | | DTS_VL1218 | 324 | 324 | 324 | 324 | 324 | 436 | 421 |
| | | DTS_VL1824 | 204 | 204 | 204 | 204 | 204 | 293 | 277 |
| | | DTS_VL2440 | 68 | 68 | 68 | 68 | 68 | 34 | 16 |
| | | PGP_VL0012 | 2 351 | 2 351 | 2 351 | 2 351 | 2 351 | 3 288 | 2 916 |
| | | PGP_VL1218 | 124 | 124 | 124 | 124 | 124 | 305 | 270 |
| | 11 | DTS_VL0612 | 34 | 34 | 34 | 34 | 34 | 36 | 34.081 |
| | | DTS_VL1218 | 197 | 197 | 197 | 197 | 197 | 198 | 183 |
| | | DTS_VL1824 | 95 | 95 | 95 | 95 | 95 | 119 | 108 |
| | | DTS_VL2440 | 75 | 75 | 75 | 75 | 75 | 100 | 97 |
| | | PGP_VL0012 | 323 851 | 323 851 | 323 851 | 323 851 | 323 851 | 1 696 | 1 649 |
| | | PGP_VL1218 | 213 | 213 | 213 | 213 | 213 | 319 | 311 |
| | 9 | DTS_VL0612 | 63 | 63 | 63 | 63 | 63 | 35 | 24 |
| | | DTS_VL1218 | 210 | 210 | 210 | 210 | 210 | 349 | 324 |
| | | DTS_VL1824 | 277 | 277 | 277 | 277 | 277 | 380 | 367 |
| | | DTS_VL2440 | 36 | 36 | 36 | 36 | 36 | 32 | 30 |
| | | PGP_VL0012 | 971 | 971 | 971 | 971 | 971 | 1 581 | 1 535 |
| | | PGP_VL1218 | 91 | 91 | 91 | 91 | 91 | 133 | 127 |
| FTE | 10 | DTS_VL0612 | 7 | 13 | 13 | 14 | 13 | 6 | 0 |
| | | DTS_VL1218 | 194 | 267 | 267 | 339 | 309 | 414 | 372 |
| | | DTS_VL1824 | 158 | 226 | 226 | 252 | 241 | 289 | 277 |
| | | DTS_VL2440 | 12 | 17 | 17 | 17 | 17 | 28 | 12 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PGP_VL0012 | 700 | 2 801 | 2 801 | 2 801 | 2 801 | 2 553 | 2 356 |
| | | PGP_VL1218 | 17 | 68 | 68 | 68 | 68 | 267 | 264 |
| | 11 | DTS_VL0612 | 7 | 14 | 14 | 14 | 14 | 22 | 15 |
| | | DTS_VL1218 | 117 | 163 | 163 | 222 | 197 | 193 | 183 |
| | | DTS_VL1824 | 68 | 79 | 79 | 96 | 89 | 115 | 108 |
| | | DTS_VL2440 | 49 | 53 | 53 | 54 | 54 | 99 | 97 |
| | | PGP_VL0012 | 723 | 1 446 | 1 446 | 1 446 | 1 446 | 1 135 | 1 128 |
| | | PGP_VL1218 | 25 | 50 | 50 | 50 | 50 | 242 | 230 |
| | 9 | DTS_VL0612 | 14 | 23 | 23 | 31 | 28 | 26 | 18 |
| | | DTS_VL1218 | 149 | 190 | 190 | 269 | 236 | 343 | 324 |
| | | DTS_VL1824 | 147 | 180 | 180 | 299 | 249 | 386 | 372 |
| | | DTS_VL2440 | 11 | 13 | 13 | 20 | 17 | 32 | 30 |
| | | PGP_VL0012 | 540 | 1 080 | 1 080 | 1 080 | 1 080 | 1 078 | 854 |
| | | PGP_VL1218 | 19 | 39 | 39 | 39 | 39 | 116 | 115 |
| Average salary (Crew cost/FTE) | 10 | DTS_VL0612 | 75 741 | 101 903 | 83 218 | 86 445 | 114 407 | 83 391 | 0 |
| | | DTS_VL1218 | 3 424 414 | 3 097 264 | 3 432 270 | 3 876 457 | 4 061 184 | 3 885 584 | 3 520 315 |
| | | DTS_VL1824 | 3 118 026 | 3 496 317 | 3 469 007 | 3 607 791 | 3 980 781 | 1 774 049 | 1 379 573 |
| | | DTS_VL2440 | 1 347 445 | 973 188 | 1 257 006 | 1 354 469 | 1 358 803 | 938 929 | 225 057 |
| | | PGP_VL0012 | 2 456 678 | 6 889 136 | 7 017 788 | 6 843 418 | 6 752 561 | 15 748 827 | 15 439 535 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PGP_VL1218 | 59 710 | 173 400 | 175 478 | 172 028 | 171 196 | 2 674 180 | 2 506 232 |
| | 11 | DTS_VL0612 | 67 989 | 91 941 | 89 896 | 84 782 | 98 253 | 94 635 | 81 737 |
| | | DTS_VL1218 | 884 733 | 876 134 | 865 021 | 874 146 | 979 476 | 1 075 960 | 812 553 |
| | | DTS_VL1824 | 1 303 128 | 1 262 014 | 1 104 421 | 652 668 | 1 034 951 | 1 827 772 | 1 800 480 |
| | | DTS_VL2440 | 2 001 948 | 1 996 597 | 1 973 332 | 1 950 892 | 1 994 385 | 2 121 307 | 2 052 084 |
| | | PGP_VL0012 | 3 549 349 | 5 280 795 | 5 358 017 | 5 211 375 | 5 175 901 | 8 203 623 | 7 148 821 |
| | | PGP_VL1218 | 431 974 | 727 260 | 733 414 | 720 308 | 717 732 | 3 170 760 | 3 051 934 |
| | 9 | DTS_VL0612 | 265 810 | 336 635 | 306 030 | 337 070 | 394 396 | 322 053 | 178 373 |
| | | DTS_VL1218 | 2 970 369 | 3 577 666 | 3 175 534 | 4 002 766 | 4 303 752 | 7 013 860 | 6 950 202 |
| | | DTS_VL1824 | 5 217 936 | 5 802 073 | 5 233 468 | 6 626 567 | 6 868 052 | 10 713 498 | 10 158 571 |
| | | DTS_VL2440 | 300 861 | 343 059 | 312 975 | 440 490 | 454 209 | 522 211 | 495 450 |
| | | PGP_VL0012 | 5 377 763 | 8 572 669 | 8 672 239 | 8 388 276 | 8 361 660 | 11 743 051 | 10 416 784 |
| | | PGP_VL1218 | 345 860 | 554 624 | 560 494 | 548 406 | 545 970 | 1 661 697 | 1 531 116 |
| CR/BER | 10 | DTS_VL0612 | 2.40 | 4.21 | 2.92 | 3.14 | 5.07 | | |
| | | DTS_VL1218 | 2.39 | 10.02 | 5.07 | 6.05 | 8.42 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | DTS_VL1824 | 5.38 | 8.28 | 6.30 | 5.95 | 7.45 |
| | | DTS_VL2440 | -7.83 | -5.31 | -7.20 | -7.85 | -7.71 |
| | | PGP_VL0012 | 0.04 | 0.68 | 0.70 | 0.67 | 0.66 |
| | | PGP_VL1218 | 0.45 | 5.85 | 5.95 | 5.78 | 5.74 |
| | 11 | DTS_VL0612 | 0.45 | 1.04 | 0.99 | 0.86 | 1.20 |
| | | DTS_VL1218 | 1.68 | 1.62 | 1.64 | 1.69 | 2.16 |
| | | DTS_VL1824 | -3.37 | -3.20 | -3.36 | -2.95 | -3.16 |
| | | DTS_VL2440 | -15.33 | -15.31 | -15.66 | -15.79 | -15.49 |
| | | PGP_VL0012 | 0.43 | 0.80 | 0.82 | 0.78 | 0.78 |
| | | PGP_VL1218 | 1.45 | 3.17 | 3.20 | 3.12 | 3.11 |
| | 9 | DTS_VL0612 | -0.93 | -0.38 | -0.62 | -0.38 | 0.06 |
| | | DTS_VL1218 | 6.36 | 7.52 | 6.64 | 8.28 | 9.02 |
| | | DTS_VL1824 | 12.46 | 14.25 | 12.59 | 17.12 | 17.82 |
| | | DTS_VL2440 | 1.29 | 1.65 | 1.24 | 2.00 | 2.17 |
| | | PGP_VL0012 | 0.58 | 1.13 | 1.15 | 1.10 | 1.09 |
| | | PGP_VL1218 | 3.72 | 6.26 | 6.33 | 6.19 | 6.16 |

Table 6.2.3.2 Additional socio-economic indicators by fleet segment and scenario for 2025.

| Indicator | GSA | Fleet segment | Economic and social outputs per scenario in 2025 | | | | | avg 2015-2017 | min 2015-2017 |
|---|---|---|---|---|---|---|---|---|---|
| | | | A | C | D | L | SQ | | |
| GVA | 10 | DTS_VL0612 | 111 861 | 75 121 | 102 292 | 50 340 | 165 669 | 204 475 | 0 |
| | | DTS_VL1218 | 4 513 929 | 3 896 643 | 4 416 255 | 3 335 401 | 5 908 658 | 5 044 593 | 3 227 925 |
| | | DTS_VL1824 | 5 930 774 | 4 941 979 | 5 592 240 | 4 135 052 | 6 893 958 | 6 024 891 | 4 513 136 |
| | | DTS_VL2440 | -1 366 179 | -918 578 | -1 021 734 | -1 539 188 | -1 362 791 | 1 598 765 | 277330.54 |
| | | PGP_VL0012 | -6 586 586 | -2 872 957 | -2 127 456 | 4 302 472 | 2 869 884 | 30 418 926 | 27 033 311 |
| | | PGP_VL1218 | 67 296 | 160 360 | 175 900 | 326 739 | 308 357 | 5 563 693 | 4 615 342 |
| | 11 | DTS_VL0612 | 71 430 | 37 841 | 61 154 | 62 949 | 109 427 | 1 738 826 | 127 228 |
| | | DTS_VL1218 | 1 635 713 | 1 237 905 | 1 574 790 | 991 626 | 1 688 110 | 4 770 175 | 3 716 350 |
| | | DTS_VL1824 | 218 005 | 255 393 | 273 649 | -613 751 | -147 025 | 3 055 170 | 2 635 993 |
| | | DTS_VL2440 | -2 541 929 | -2 605 245 | -2 561 061 | -2 971 615 | -2 717 281 | 3 283 794 | 2 647 641 |
| | | PGP_VL0012 | 555 233 | -1 138 275 | -595 995 | 4 140 509 | 3 325 195 | 16 145 210 | 14 384 957 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PGP_VL1218 | 712 057 | 572 195 | 631 502 | 1 385 437 | 1 315 059 | 6 607 090 | 5 951 898 |
| | 9 | DTS_VL0612 | 158 880 | 359 654 | 450 047 | 50 973 | 309 726 | 522 715 | 364 073 |
| | | DTS_VL1218 | 7 825 674 | 7 186 389 | 7 992 540 | 7 069 737 | 10 038 978 | 13 973 022 | 12 907 990 |
| | | DTS_VL1824 | 10 693 787 | 9 578 820 | 10 642 098 | 9 587 660 | 12 912 953 | 18 661 897 | 13 845 573 |
| | | DTS_VL2440 | 484 353 | 468 285 | 547 986 | 394 610 | 666 350 | 979 867 | 798 359 |
| | | PGP_VL0012 | 4 298 214 | 2 543 738 | 3 324 290 | 10 106 157 | 8 986 742 | 21 759 724 | 19 909 919 |
| | | PGP_VL1218 | 755 518 | 630 771 | 676 643 | 1 166 199 | 1 107 645 | 3 664 765 | 2 853 453 |
| GP | 10 | DTS_VL0612 | 27 906 | 9 739 | 23 174 | -2 515 | 54 514 | 127 237 | 0 |
| | | DTS_VL1218 | 1 446 743 | 1 657 662 | 1 875 210 | 489 736 | 2 367 540 | 1 545 025 | 500 388 |
| | | DTS_VL1824 | 2 904 186 | 2 699 759 | 2 923 101 | 1 666 835 | 3 320 253 | 4 304 123 | 2 898 929 |
| | | DTS_VL2440 | -2 455 275 | -1 549 985 | -1 765 204 | -2 622 913 | -2 453 039 | 659 836 | 52273.947 |
| | | PGP_VL0012 | -9 359 666 | -7 144 614 | -6 699 948 | -2 864 716 | -3 719 206 | 14 561 484 | 10 958 637 |
| | | PGP_VL1218 | -2 277 | 51 041 | 59 945 | 146 363 | 135 832 | 2 840 411 | 2 109 109 |
| | 11 | DTS_VL0612 | -8 513 | -23 685 | -13 155 | -12 344 | 8 649 | 1 644 191 | 16 689 |
| | | DTS_VL1218 | 599 798 | 314 148 | 549 574 | 178 330 | 645 652 | 3 552 903 | 2 903 797 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | DTS_VL1824 | -1 325 407 | -1 087 523 | -1 208 364 | -1 277 123 | -1 236 526 | 1 400 780 | 1 276 980 |
| | | DTS_VL2440 | -4 558 539 | -4 546 106 | -4 543 702 | -4 864 832 | -4 691 359 | 1 261 978 | 824 809 |
| | | PGP_VL0012 | -3 392 479 | -4 405 380 | -4 081 038 | -1 248 096 | -1 735 742 | 7 238 001 | 6 919 248 |
| | | PGP_VL1218 | 221 868 | 134 826 | 171 735 | 640 938 | 597 139 | 3 200 848 | 2 662 312 |
| | 9 | DTS_VL0612 | -140 491 | -61 535 | -25 987 | -182 927 | -81 170 | 200 518 | 180 154 |
| | | DTS_VL1218 | 4 439 833 | 3 994 253 | 4 496 011 | 3 878 709 | 5 673 312 | 6 893 921 | 5 957 788 |
| | | DTS_VL1824 | 4 688 273 | 4 134 321 | 4 674 581 | 4 153 018 | 5 872 250 | 7 875 038 | 3 687 002 |
| | | DTS_VL2440 | 83 660 | 22 951 | 60 130 | 51 456 | 203 245 | 445 887 | 302 909 |
| | | PGP_VL0012 | -1 899 257 | -2 846 977 | -2 425 344 | 1 238 036 | 633 359 | 10 106 127 | 9 132 184 |
| | | PGP_VL1218 | 362 478 | 291 068 | 317 327 | 597 568 | 564 050 | 1 919 126 | 1 322 337 |
| Employment: Engaged crew | 10 | DTS_VL0612 | 33 | 33 | 33 | 33 | 33 | 13 | 0 |
| | | DTS_VL1218 | 324 | 324 | 324 | 324 | 324 | 436 | 421 |
| | | DTS_VL1824 | 204 | 204 | 204 | 204 | 204 | 293 | 277 |
| | | DTS_VL2440 | 68 | 68 | 68 | 68 | 68 | 34 | 16 |
| | | PGP_VL0012 | 2 351 | 2 351 | 2 351 | 2 351 | 2 351 | 3 288 | 2 916 |
| | | PGP_VL1218 | 124 | 124 | 124 | 124 | 124 | 305 | 270 |
| | 11 | DTS_VL0612 | 34 | 34 | 34 | 34 | 34 | 36 | 34.081 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | DTS_VL1218 | 197 | 197 | 197 | 197 | 197 | 198 | 183 |
| | | DTS_VL1824 | 95 | 95 | 95 | 95 | 95 | 119 | 108 |
| | | DTS_VL2440 | 75 | 75 | 75 | 75 | 75 | 100 | 97 |
| | | PGP_VL0012 | 323 851 | 323 851 | 323 851 | 323 851 | 323 851 | 1 696 | 1 649 |
| | | PGP_VL1218 | 213 | 213 | 213 | 213 | 213 | 319 | 311 |
| | 9 | DTS_VL0612 | 63 | 63 | 63 | 63 | 63 | 35 | 24 |
| | | DTS_VL1218 | 210 | 210 | 210 | 210 | 210 | 349 | 324 |
| | | DTS_VL1824 | 277 | 277 | 277 | 277 | 277 | 380 | 367 |
| | | DTS_VL2440 | 36 | 36 | 36 | 36 | 36 | 32 | 30 |
| | | PGP_VL0012 | 971 | 971 | 971 | 971 | 971 | 1 581 | 1 535 |
| | | PGP_VL1218 | 91 | 91 | 91 | 91 | 91 | 133 | 127 |
| FTE | 10 | DTS_VL0612 | 7 | 7 | 7 | 13 | 13 | 6 | 0 |
| | | DTS_VL1218 | 190 | 180 | 181 | 309 | 309 | 414 | 372 |
| | | DTS_VL1824 | 154 | 144 | 146 | 241 | 241 | 289 | 277 |
| | | DTS_VL2440 | 12 | 11 | 11 | 17 | 17 | 28 | 12 |
| | | PGP_VL0012 | 700 | 1 400 | 1 400 | 2 801 | 2 801 | 2 553 | 2 356 |
| | | PGP_VL1218 | 17 | 34 | 34 | 68 | 68 | 267 | 264 |
| | 11 | DTS_VL0612 | 7 | 7 | 7 | 14 | 14 | 22 | 15 |
| | | DTS_VL1218 | 117 | 117 | 117 | 197 | 197 | 193 | 183 |
| | | DTS_VL1824 | 68 | 68 | 68 | 89 | 89 | 115 | 108 |
| | | DTS_VL2440 | 49 | 49 | 49 | 54 | 54 | 99 | 97 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | PGP_VL0012 | 723 | 723 | 723 | 1 446 | 1 446 | 1 135 | 1 128 |
| | | PGP_VL1218 | 25 | 25 | 25 | 50 | 50 | 242 | 230 |
| | 9 | DTS_VL0612 | 14 | 28 | 28 | 28 | 28 | 26 | 18 |
| | | DTS_VL1218 | 149 | 141 | 143 | 236 | 236 | 343 | 324 |
| | | DTS_VL1824 | 147 | 140 | 141 | 249 | 249 | 386 | 372 |
| | | DTS_VL2440 | 11 | 10 | 10 | 17 | 17 | 32 | 30 |
| | | PGP_VL0012 | 540 | 540 | 540 | 1 080 | 1 080 | 1 078 | 854 |
| | | PGP_VL1218 | 19 | 19 | 19 | 39 | 39 | 116 | 115 |
| Average salary (Crew cost/FTE) | 10 | DTS_VL0612 | 83 955 | 65 382 | 79 118 | 52 855 | 111 156 | 83 391 | 0 |
| | | DTS_VL1218 | 3 067 186 | 2 238 981 | 2 541 045 | 2 845 665 | 3 541 118 | 3 885 584 | 3 520 315 |
| | | DTS_VL1824 | 3 026 588 | 2 242 220 | 2 669 138 | 2 468 216 | 3 573 705 | 1 774 049 | 1 379 573 |
| | | DTS_VL2440 | 1 089 096 | 631 408 | 743 470 | 1 083 725 | 1 090 248 | 938 929 | 225056.59 |
| | | PGP_VL0012 | 2 773 080 | 4 271 657 | 4 572 492 | 7 167 188 | 6 589 090 | 15 748 827 | 15 439 535 |
| | | PGP_VL1218 | 69 572 | 109 319 | 115 956 | 180 376 | 172 526 | 2 674 180 | 2 506 232 |
| | 11 | DTS_VL0612 | 79 943 | 61 525 | 74 308 | 75 293 | 100 778 | 94 635 | 81737.39 |
| | | DTS_VL1218 | 1 035 915 | 923 757 | 1 025 216 | 813 296 | 1 042 458 | 1 075 960 | 812 553 |
| | | DTS_VL1824 | 1 543 412 | 1 342 917 | 1 482 013 | 663 372 | 1 089 501 | 1 827 772 | 1 800 480 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | DTS_VL2440 | 2 016 610 | 1 940 861 | 1 982 641 | 1 893 218 | 1 974 079 | 2 121 307 | 2 052 084 |
| | | PGP_VL0012 | 3 947 712 | 3 267 105 | 3 485 043 | 5 388 605 | 5 060 937 | 8 203 623 | 7 148 821 |
| | | PGP_VL1218 | 490 190 | 437 369 | 459 767 | 744 499 | 717 920 | 3 170 760 | 3 051 934 |
| | 9 | DTS_VL0612 | 299 371 | 421 189 | 476 035 | 233 900 | 390 896 | 322 053 | 178 373 |
| | | DTS_VL1218 | 3 385 841 | 3 192 136 | 3 496 528 | 3 191 027 | 4 365 666 | 7 013 860 | 6 950 202 |
| | | DTS_VL1824 | 6 005 514 | 5 444 499 | 5 967 517 | 5 434 642 | 7 040 703 | 10 713 498 | 10 158 571 |
| | | DTS_VL2440 | 400 693 | 445 333 | 487 856 | 343 154 | 463 105 | 522 211 | 495 450 |
| | | PGP_VL0012 | 6 197 470 | 5 390 715 | 5 749 634 | 8 868 120 | 8 353 383 | 11 743 051 | 10 416 784 |
| | | PGP_VL1218 | 393 040 | 339 703 | 359 316 | 568 631 | 543 595 | 1 661 697 | 1 531 116 |
| CR/BER | 10 | DTS_VL0612 | 2.97 | 1.69 | 2.64 | 0.82 | 4.85 | | |
| | | DTS_VL1218 | 7.57 | 8.53 | 9.52 | 3.23 | 11.76 | | |
| | | DTS_VL1824 | 8.27 | 7.76 | 8.32 | 5.17 | 9.31 | | |
| | | DTS_VL2440 | -5.99 | -3.41 | -4.02 | -6.46 | -5.98 | | |
| | | PGP_VL0012 | 0.08 | 0.30 | 0.34 | 0.72 | 0.64 | | |
| | | PGP_VL1218 | 0.92 | 2.81 | 3.12 | 6.18 | 5.81 | | |
| | 11 | DTS_VL0612 | 0.74 | 0.29 | 0.61 | 0.63 | 1.26 | | |
| | | DTS_VL1218 | 2.27 | 1.67 | 2.17 | 1.38 | 2.37 | | |
| | | DTS_VL1824 | -2.98 | -2.27 | -2.63 | -2.84 | -2.71 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | DTS_VL2440 | -14.74 | -14.70 | -14.69 | -15.80 | -15.20 |
| | | PGP_VL0012 | 0.52 | 0.37 | 0.42 | 0.82 | 0.75 |
| | | PGP_VL1218 | 1.78 | 1.48 | 1.61 | 3.27 | 3.11 |
| | 9 | DTS_VL0612 | -0.67 | 0.27 | 0.69 | -1.18 | 0.03 |
| | | DTS_VL1218 | 7.46 | 6.81 | 7.54 | 6.64 | 9.25 |
| | | DTS_VL1824 | 14.73 | 13.11 | 14.69 | 13.17 | 18.20 |
| | | DTS_VL2440 | 1.54 | 1.15 | 1.39 | 1.33 | 2.31 |
| | | PGP_VL0012 | 0.72 | 0.59 | 0.65 | 1.18 | 1.09 |
| | | PGP_VL1218 | 4.29 | 3.65 | 3.88 | 6.43 | 6.13 |

Legend:

| | **Indicator** | | |
|---|---|---|---|
| | **Gross Value Added; Gross profit; FTE; Engaged crew; Average salary** | **Gross Profit Margin** | **Current revenues on break-even revenues (CR/BER)** |
| | Indicator value > Threshold B* | >10% - High | >1 - High |
| | Threshold A* <Indicator value < Threshold B* | 0-10% - Reasonable | 0.9-1 – Intermediate condition |
| | Indicator value < Threshold A* | <0% - Weak | <0.9 - Weak |

*Thresholds: the minimum (A) and the average valu values (B) of the indicators along the baseline period (2015-2017)

## 6.3 ISIS-Fish in EMU 1

### 6.3.1 Management scenarios considered

Five scenarios are considered for ISIS-Fish runs: Status-quo, A, B, C and E. Selectivity measures were not simulated because i) the model only describes hake biology and selectivity measures are aimed at deep-water species and ii) it is currently unpractical to model the fact that only part of the fleet implements the measures because it would require to know which sub-segments (strategies, harbour) do and because of technical limitations.

Spatial closures implemented in the Gulf of Lion since 2020 and on the Spanish coast since 2021 were carefully implemented accounting for their seasonal extent. It is worth noting that because ISIS-Fish uses a spatial square grid (resolution 0.05° or 3'), the shape of the closures is a little modified from reality. In addition, some areas smaller than the half of a cell were not modelled. Similarly, ISIS-Fish has a monthly resolution, while some closures apply for only part of a month. To account for temporal closures of more than 15 days, the full month was closed, when less than 15 days were closed the full month was opened to fishing. It is assumed that, if a métier zone overlaps the closed area, the effort is preferentially displaced towards the same métier zone, if it is not fully covered and is lost otherwise.

Four weeks closures implemented in Spain starting in 2023, are also reproduced using the same assumption about effort displacement. As for the implementation in the Gulf of Lion, it is translated into a total ban of trawls for one month during the spawning peak of hake (March).

Effective effort reductions imposed by the regulation are first translated into effort quota in number of fishing days (Table 6.3.3.1). They are then compared to 2022 FDI values and implemented in ISIS-Fish as a reduction or increase in percentage of 2022 values. When effort reductions impact differently OTB DEF and OTB DWS effort, the effort reduction in ISIS-Fish was applied at the métier level. Therefore a boat that both practices OTB DEF and OTB DWS does not suffer the same reduction on both métiers. Otherwise the effort reduction is applied homogeneously on all fleets of the segment.

**Table 6.3.1.1: Effort reduction implemented in ISIS-Fish depending on fleet segment and scenario. The number of days and the proportion of 2022 effort (as reported in FDI data) are indicated.**

| Stock group | Fleet segment | 2023 regulation + 3.5% baseline | | B-2024 Regulation (-9.5) | | C-2024 Regulation (closures -5.5) | | E-2024 Regulation (large6mo -4.5) | |
|---|---|---|---|---|---|---|---|---|---|
| | | nb days | %2022 fdi | nb days | %2022 fdi | nb days | %2022 fdi | nb days | %2022 fdi |
| Red mullet in GSAs 1, 5, 6 and 7; Hake in GSAs 1-5- | ≥ 18 m and < 24 m | 4139.73882 | 1.01536883 | 3684.44774 | 0.90369793 | 3876.14925 | 0.95071725 | 3924.07462 | 0.96247208 |
| | ≥ 24 m | 5047.97723 | 1.04631957 | 4464.46761 | 0.9253726 | 4710.15587 | 0.97629764 | 4771.57793 | 0.9890289 |

| Stock group | Fleet segment | 2023 regulation + 3.5% baseline | | B-2024 Regulation (-9.5) | | C-2024 Regulation (closures -5.5) | | E-2024 Regulation (=B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | nb days | %2022 fdi | nb days | %2022 fdi | nb days | %2022 fdi | nb days | %2022 fdi |
| Red mullet in GSAs 1, 5, 6, 7; Hake in GSAs 1, 5, 6, 7; Deep-water rose shrimp in | < 12 m | 1839.78 | 1.0471144 | 1582.52 | 0.90069437 | 1690.84 | 0.96234491 | 1582.52 | 0.90069437 |
| | ≥ 12 m and < 18 m | 19631.2583 | 0.94532984 | 17244.7 | 0.83040675 | 18249.5667 | 0.87879542 | 17244.7 | 0.83040675 |
| | ≥ 18 m and < 24 m | 36980.935 | 0.95257774 | 32103.54 | 0.82694279 | 34157.18 | 0.87984172 | 32103.54 | 0.82694279 |
| | ≥ 24 m | 13068.445 | 1.07558421 | 11232.38 | 0.92446887 | 12005.46 | 0.98809638 | 11232.38 | 0.92446887 |
| Blue and red shrimps in GSA 1,5,6,7 | < 12 m | | | | | | | | |
| | ≥ 12 m and < 18 m | 879 | 1.14453125 | 804.33 | 1.04730469 | 804.33 | 1.04730469 | 804.33 | 1.04730469 |
| | ≥ 18 m and < 24 m | 8908 | 1.04132206 | 8151.16667 | 0.95285021 | 8151.16667 | 0.95285021 | 8151.16667 | 0.95285021 |
| | ≥ 24 m | 7151 | 0.85542166 | 6493.82167 | 0.77680824 | 6493.82167 | 0.77680824 | 6493.82167 | 0.77680824 |

When scenarios implied to maintain the stock at Fmsy, an effort control rule was designed in order to reduce effort in the coming year according to the value of fishing mortality in the previous year. The effort multiplier only applies on trawlers, homogeneously across fleets and seasons. An assumption of linearity between fishing mortality and effort was necessary, although it is not necessarily verified in ISIS-Fish given the complex spatio-seasonal dynamics. This explains that the fishing mortality actually achieved under this rule might differ slightly from Fmsy. It is worth noting that because of imperfect calibration of the model the catches and the fishing mortality modelled in 2022 do not perfectly match the estimations. Therefore Fmsy value used in ISIS-Fish is scaled to compensate the difference between assessed and modelled F values in 2022, so the effort reduction needed to reach Fmsy is in line with true values.

Simulations start in 2022 and stop in December 2030.

Table 6.3.1.2: Summary of the settings of ISIS-Fish scenarios recalling the main measures of each scenarios per fleet segment: effort (quota, reduction or control rule), closures (the seasonal ones implemented progressively since 2020) and four weeks closures (starting in 2023 in Spain). A "x" indicates that the rule is implemented. Main changes from one scenario to the next are highlighted in red.

| **Scenarios** | | **2023** | **2024** | **2025+** |
|---|---|---|---|---|
| **SQ** | *effort FR* | 2023 quota | 2023 | 2023 |
| | *closures FR* | x | x | x |
| | *4 weeks FR* | | | |
| | *effort ESP DEF* | 2023 quota | 2023 | 2023 |
| | *effort ESP DWS* | 2023 quota | 2023 | 2023 |
| | *closures ESP* | x | x | x |
| | *4 weeks ESP* | x | | |
| **A keep Fmsy** | *effort FR* | 2023 quota | control rule | control rule |
| | *closures FR* | x | x | x |
| | *4 weeks FR* | | | |
| | *effort ESP DEF* | 2023 quota | control rule | control rule |
| | *effort ESP DWS* | 2023 quota | control rule | control rule |
| | *closures ESP* | x | x | x |
| | *4 weeks ESP* | x | | |
| **B 9.5%** | *effort FR* | 2023 quota | -9.5% | control rule |
| | *closures FR* | x | x | x |

| | | | | |
|---|---|---|---|---|
| | *4 weeks FR* | | | |
| | *effort ESP DEF* | 2023 quota | -9.5% | control rule |
| | *effort ESP DWS* | 2023 quota | -9.5% | control rule |
| | *closures ESP* | x | x | x |
| | *4 weeks ESP* | x | | |
| **C**<br>**4 weeks FR**<br>**4 weeks reconducted ESP** | *effort FR* | 2023 quota | -9.5+4% | control rule |
| | *closures FR* | x | x | x |
| | *4 weeks FR (OTB +OTT)* | | x | x |
| | *effort ESP DEF* | 2023 quota | -9.5+4% | control rule |
| | *effort ESP DWS* | 2023 quota | -9.5% | control rule |
| | *closures ESP* | x | x | x |
| | *4 weeks ESP* | x | x | x |
| **E**<br>**large 6mo closures rewarded in 2024** | *effort FR* | 2023 quota | -9.5+5% | control rule |
| | *closures FR* | x | x | x |
| | *4 weeks FR* | | | |
| | *effort ESP DEF* | 2023 quota | -9.5% | control rule |
| | *effort ESP DWS* | 2023 quota | -9.5% | control rule |
| | *closures ESP* | x | x | x |
| | *4 weeks ESP* | x | | |

### 6.3.2 Results

All scenarios but status quo allow a sharp reduction in fishing mortality of hake and Fmsy is reached at the latest in 2028. The scenario status quo, does allow a reduction in F (from 1.2 to 1.1). However it is worth noting that 2023 regulation does not represent a strong constrain on fleet effort compared to 2022 observed effort, it even represents an increase for the French fleets. On the contrary, the effort reduction needed to reach Fmsy in 2024 (scenario A) and 2025 (other scenarios) is very large (from -60% to -67%) (Table 6.3.2.1). The following year effort needed to be reduced again between 6 and 20%, because Fmsy was not reached yet. As explained above, in ISIS-Fish fishing mortality is not constrained, it is an emergent property of the model. F results from the complex spatio-seasonal interactions between effort and stock abundance that imply non-linear relationships between effort and fishing mortality. It is thus expected that the simple computations used to assess effort needed to be at Fmsy be imperfect. The following years, however, the effort change was more limited 1 or 2% depending on the scenario, thanks to the stabilisation of the

model variables. Differences between scenarios B, C and E are small in comparison. Scenario B provides the largest decrease in F in 2024, but shows the highest value of the three intermediate scenarios in 2025. The reverse is observed for scenario C, with a slight decrease in 2024 but the largest in 2025. Scenario E is intermediate. Looking at F at age, the fishing mortality reduction is mainly observed on larger ages because of the increase in their biomass. The recruitment being forced, the effect on age 0 and 1 is lower.

The model predicts a rapid response of the stock to effort reduction. In the status quo scenario however, despite the slight decrease in F, the SSB stabilises at a very low value (lower than 2022). In all the other scenarios, SSB managed to reach Blim either in 2028 (sc. A) or 2029 but stays below Bpa. The rebuilding could be limited due to the constant recruitment, and the results might be more optimistic if a stock recruitment relationship was implemented.

Table 6.3.2.1: Effort reduction (%) applied each year to previous year effort in order to « stay at Fmsy »

| | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** |
|---|---|---|---|---|---|---|---|
| **Scenario A** | -67 | -6 | -1 | -1 | 0 | 0 | 0 |
| **Scenario B** | | -60 | -20 | -3 | -1 | 0 | 0 |
| **Scenario C** | | -63 | -17 | -2 | -1 | 0 | 0 |
| **Scenario E** | | -61 | -18 | -2 | -1 | 0 | 0 |

Catches reflect this fast rebuilding. After a sharp decrease when effort is forced to reach Fmsy (-29%) catches increase to levels far above the status quo (SQ) scenario and 2022 values in all scenarios but SQ. The increase is particularly large for Spanish catches (+33% in 2030 in scenario A compared to scenario SQ) compared to French fleets (+18% in 2030 in scenario A compared to scenario SQ). This is the results of the very large increase in netters and liners catches, which effort is not reduced but who benefit from higher hake biomass. Catches stabilise approximately at the same level in scenarios A, B, C and E in 2030. Among these four scenarios, scenario C provides the highest catch levels in Spain, but the lowest ones in France. A bit higher in ESP, a bit lower in FRA. Interestingly the drop in catches, when effort is decreased to reach Fmsy is larger in 2024 for scenario A (-27% on average), than in 2025 for scenarios B-E (-18% on average).

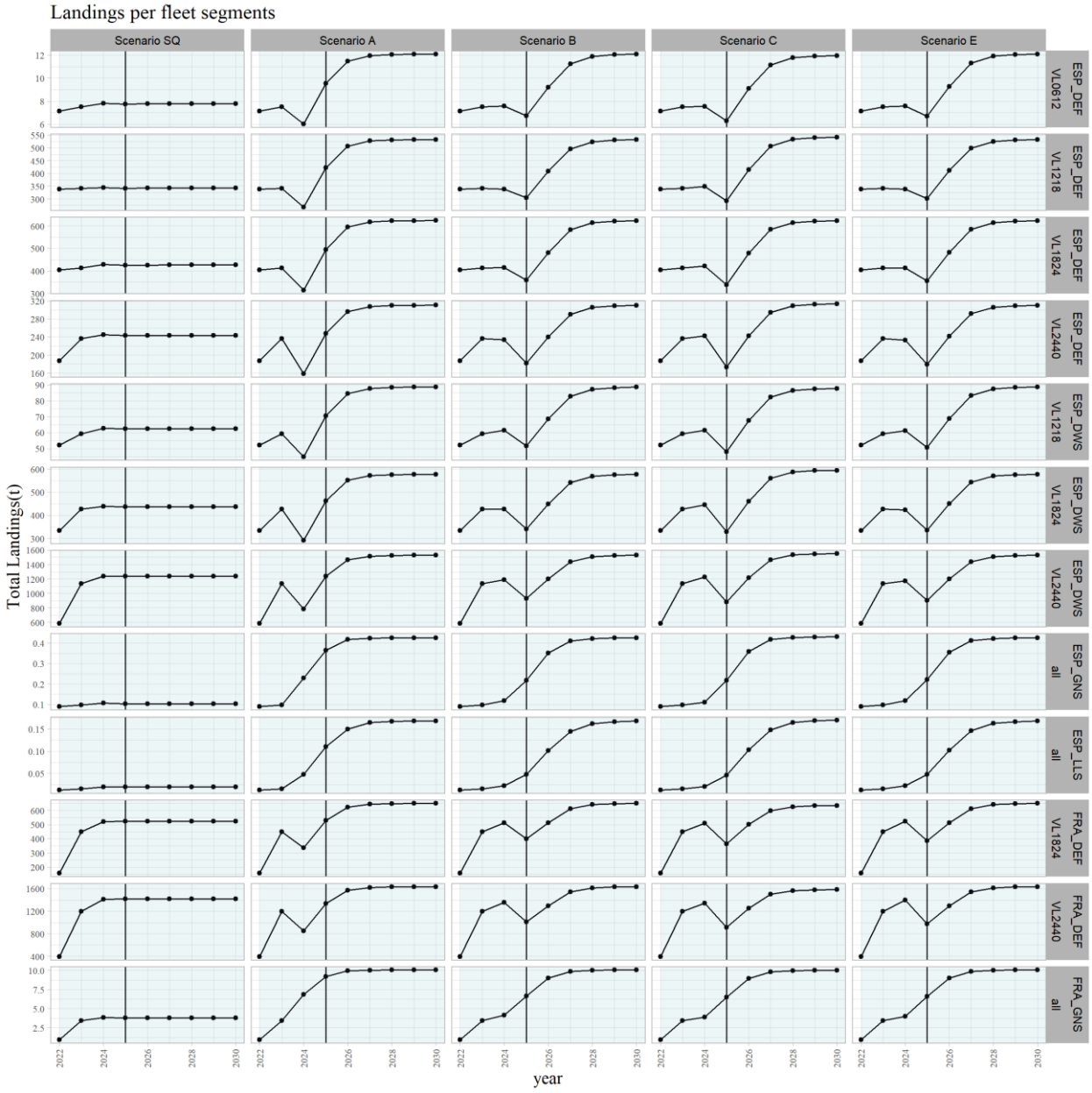


Figure 6.3.2.1: ISIS-Fish EMU1. Landings of Hake1567 by the different fleet segments under alternative management scenarios.

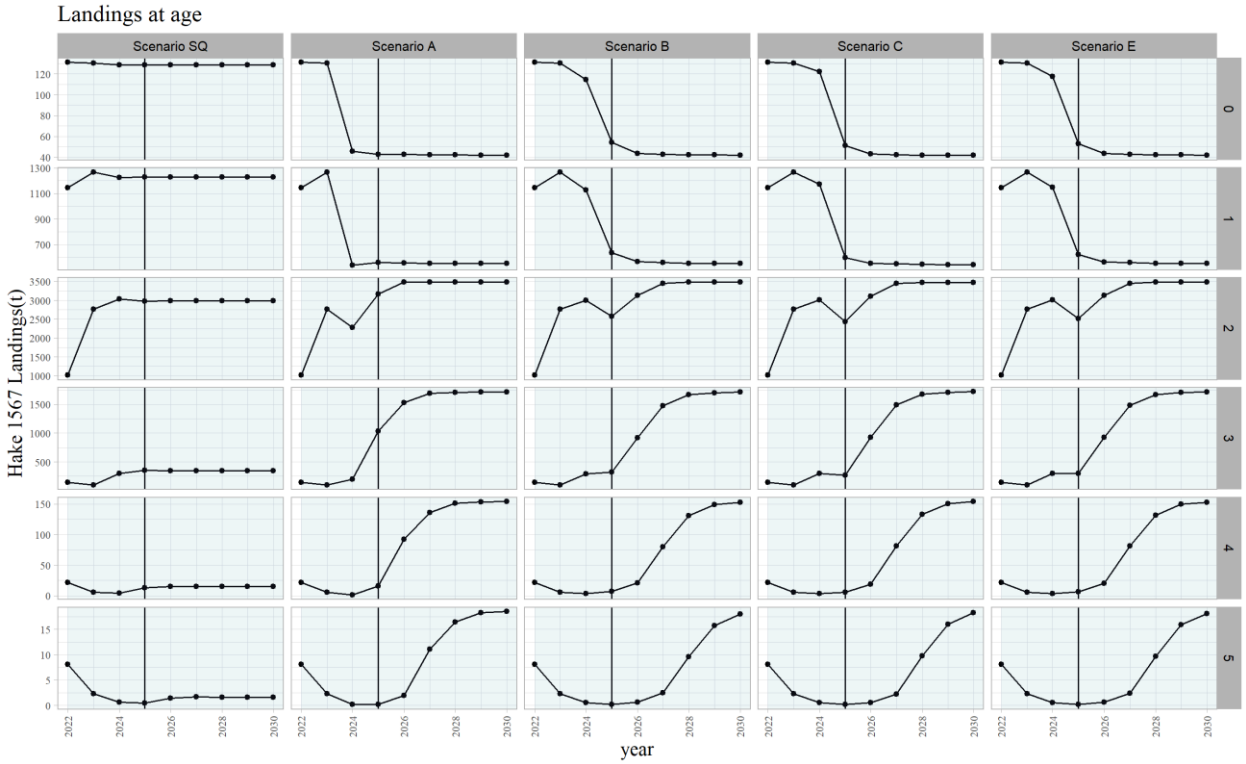


Figure 6.3.2.2: ISIS-Fish EMU1. Landings at age of Hake1567 under alternative management scenarios.

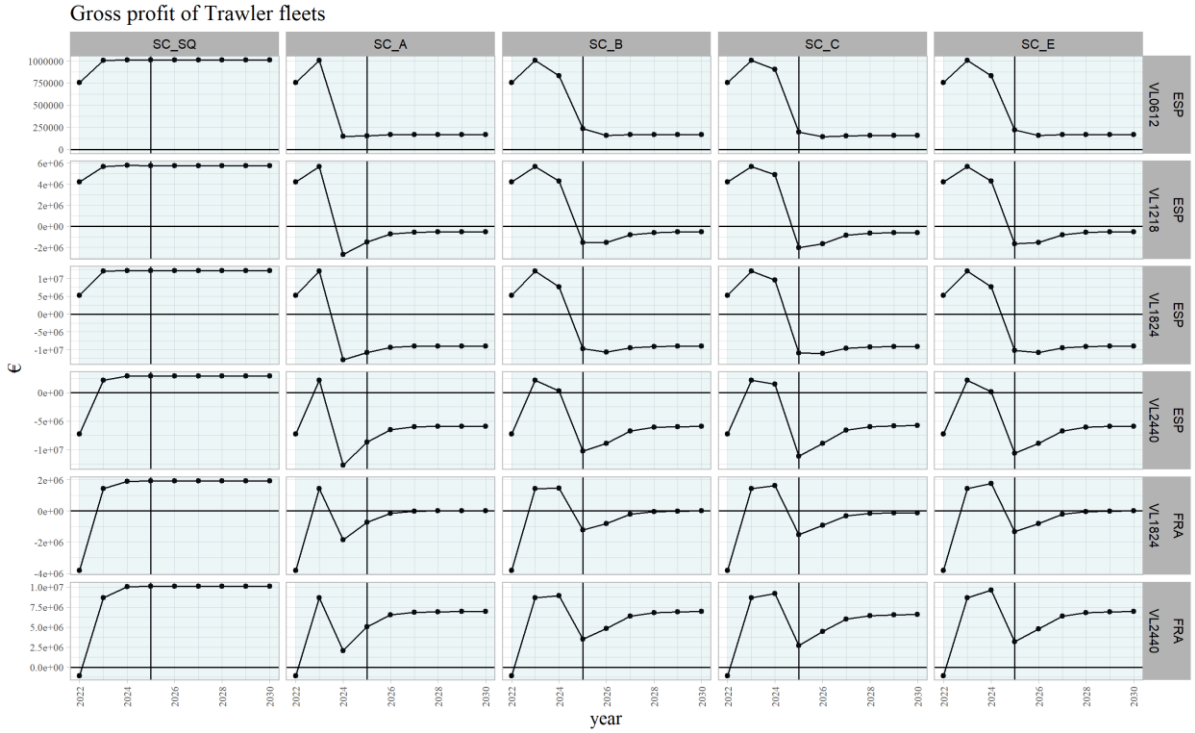


Figure 6.3.2.3: ISIS-Fish EMU1. Gross profit by the different trawler fleet segments under alternative management scenarios.

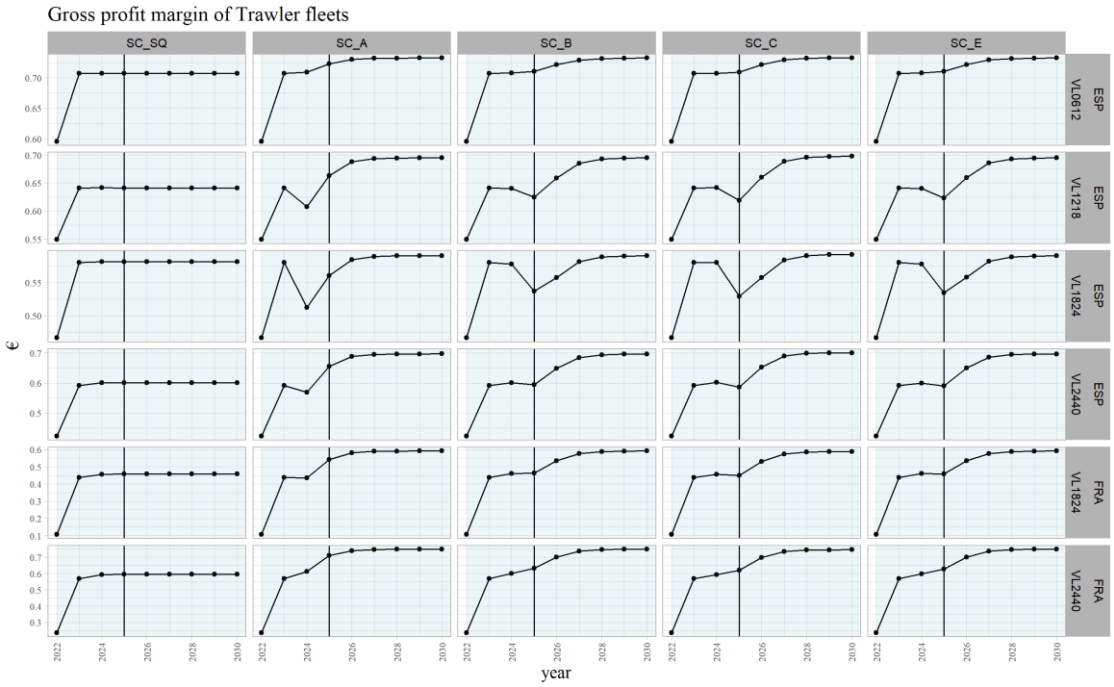


Figure 6.3.2.4: ISIS-Fish EMU1. Gross profit margin of the different trawler fleet segments under alternative management scenarios.

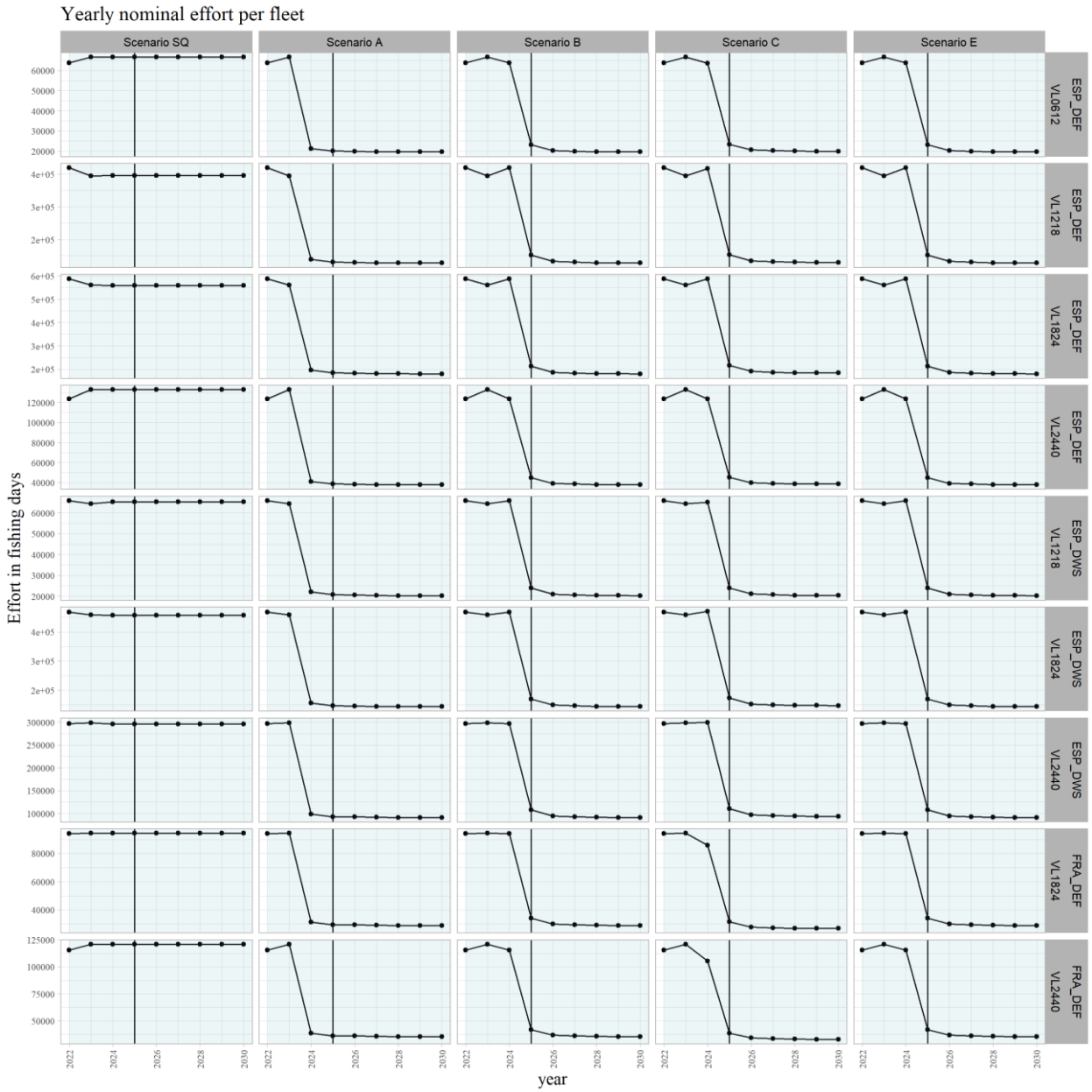


Figure 6.3.2.5 EMU 1 (ISIS-Fish model). Evolution of the effort by trawler fleet segment under alternative scenarios from 2022 to 2030. Vertical black lines indicate the year 2025. Scenarios are in column and fleet segment in row.

Table 6.3.2.1. EMU1 (ISIS-Fish model). Estimated total landings in 2024 (in tons) per stock by scenario.

| Stock | Single-stock catch advice for 2024 | Total landings (in tons) per scenario 2024 | | | | |
|---|---|---|---|---|---|---|
| | | SQ | A | B | C | E |
| HKE1567 | 350 | 4699797 | 3065511 | 4688877 | 4686576 | 4688877 |

Table 6.3.2.2. EMU1 (ISIS-Fish model). Estimated Fbar in 2024 per stock by scenario.

| Stock | Single-stock advice F for 2024 | Fbar in 2024 per scenario | | | | |
|---|---|---|---|---|---|---|
| | | SQ | A | B | C | E |
| HKE1567 | 0.11 | 1.138 | 0.436 | 1.127 | 1.111 | 1.127 |

Table 6.3.2.3. EMU1 (ISIS-Fish model). Estimated SSB in January 2024 per stock by scenario.

| Stock | Single-stock advice SSB for 2024 | Spawning Stock Biomass (SSB) in 2024 per scenario | | | | |
|---|---|---|---|---|---|---|
| | | SQ | A | B | C | E |
| HKE1567 | 2074.5 | 224.1293 | 224.1293 | 224.1293 | 224.1293 | 224.1293 |

Table 6.3.2.4. EMU1 (ISIS-Fish model). Estimated Fbar in 2025 per stock by scenario.

| Stock | Fbar in 2025 per scenario | | | | |
|---|---|---|---|---|---|
| | SQ | A | B | C | E |
| HKE1567 | 1.136 | 0.412 | 0.467 | 0.464 | 0.467 |

Table 6.3.2.5. EMU1 (ISIS-Fish model). Estimated Fbar in 2030 per stock by scenario.

| Stock | Fbar in 2030 per scenario | | | | |
|---|---|---|---|---|---|
| | SQ | A | B | C | E |
| HKE1567 | 1.136 | 0.41 | 0.41 | 0.41 | 0.41 |

Table 6.3.2.6. EMU1 (ISIS-Fish model). Percentage of change in total landings per stock and by scenario between 2022 and 2024, between 2022 and 2025, and between 2022 and 2030. The median values are used.

| Stock | % of change in total landings between 2022 and 2024 per scenario | | | | |
|---|---|---|---|---|---|
| | SQ | A | B | C | E |
| HKE1567 | 90.6 | 24.3 | 90.2 | 90 | 90.2 |
| **Stock** | **% of change in total landings between 2022 and 2025 per scenario** | | | | |
| | **SQ** | **A** | **B** | **C** | **E** |
| HKE1567 | 90.7 | 95.3 | 29.9 | 30.9 | 29.9 |
| **Stock** | **% of change in total landings between 2022 and 2030 per scenario** | | | | |
| | **SQ** | **A** | **B** | **C** | **E** |
| HKE1567 | 90.7 | 142.2 | 142 | 141.9 | 142 |

Economic indicators were computed for the first time based on ISIS-Fish outputs. As a mistake was found in the calculation after the end of the EWG, we will not report the results in tables but just the trends in the graphs, which should anyway be taken with caution.

### 6.3.3 Discussion

#### 6.3.3.1 Remaining issues and future steps

Due to time limitation and incompatible data formats, effort distribution among métiers and zones could not be updated within the week of the group and is therefore based on 2020 data. We hope that the adoption and improvement of the standard data format for VMS and logbook data will help us improve our ability to update effort distribution in a short time. The availability of VMS-logbook data for gear other than trawlers, and of information about a larger set of species would also be useful. For instance, we could improve the way other species revenues are calculated by accounting for their distribution in space.

Calibration was made on 2022 values of catches at age and catches per country. It evidenced that the fit on catches was largely unbalanced between Spanish and French fleets using the initial parameterisation (Spanish catches are too low). The reason might lie in a bad distribution of fish across the region based on model estimate in 2020 ; an inaccurate distribution of fishing effort given that it was parameterised using 2020 data ; a default in the estimation of fleet catchabilities ; or a combination of all this. As a quick fix a correction factor was introduced and calibrated that increases Spanish fleet efficiencies.

Nonetheless calibration is not completely satisfying as Spanish catches are underestimated. Furthermore, simulation revealed that catches of Spanish non-trawler fleets were unrealistically low. Further investigations should explain why and try to correct the issue. A potential reason is the rough description of netters and liners effort distribution due to unavailability of VMS data. This needs to be kept in mind when interpreting Spanish fleet performance.

Following EWG 23-01, economic indicators were implemented in ISIS-Fish. However, lack of time and the remaining uncertainties prevented us from presenting the complete list of economic indicators. This should be shortly resolved.

## 6.4 SMART in EMU 2

### 6.4.1 Management scenarios considered

All the scenarios listed in the TORs were simulated (but see the section 5.4.2 for the caveats). For each scenario, the models are run with the management measures adopted at EU and national level in 2022 (and before), which include both effort and catch management measures; and this is reflected in the 2022 catch and fishing effort used to parameterise the model (FDI and AER). The percentages of trawler effort reduction provided in the scenarios, as in prior EWGs, are computed in relation to the baseline period of 2015–2017 (i.e., the average value of FDI fishing effort by fleet between 2015 and 2017). SMART simulations start in 2022, with the 2022 FDI fishing efforts and number of vessels. Fishing mortalities coming from the non-modelled fleets and gears (i.e. all except the trawl) are estimated constant (and based on 2022 values). However, those non-modelled fleet segments nearly never catch the species of the MAP, therefore they do not have an impact on the species of the plan.

### 6.4.2 Results

The following sections present the main results obtained from the application of SMART in EMU2:

- Effects on the fishing effort pattern (total annual fishing hours per depth stratum)
- Effects on the economic indicators (Total Revenues, Cost and Gross Profit Margin)
- Effects on the stock as F and SSB

### 6.4.2.1 Effects on the fishing effort pattern

Simulation results show that all scenarios could lead to a strong reduction in fishing effort in all bathymetric layers, but mainly in those between 300-500 and between 500-800 (Figure 6.4.2.1.1).

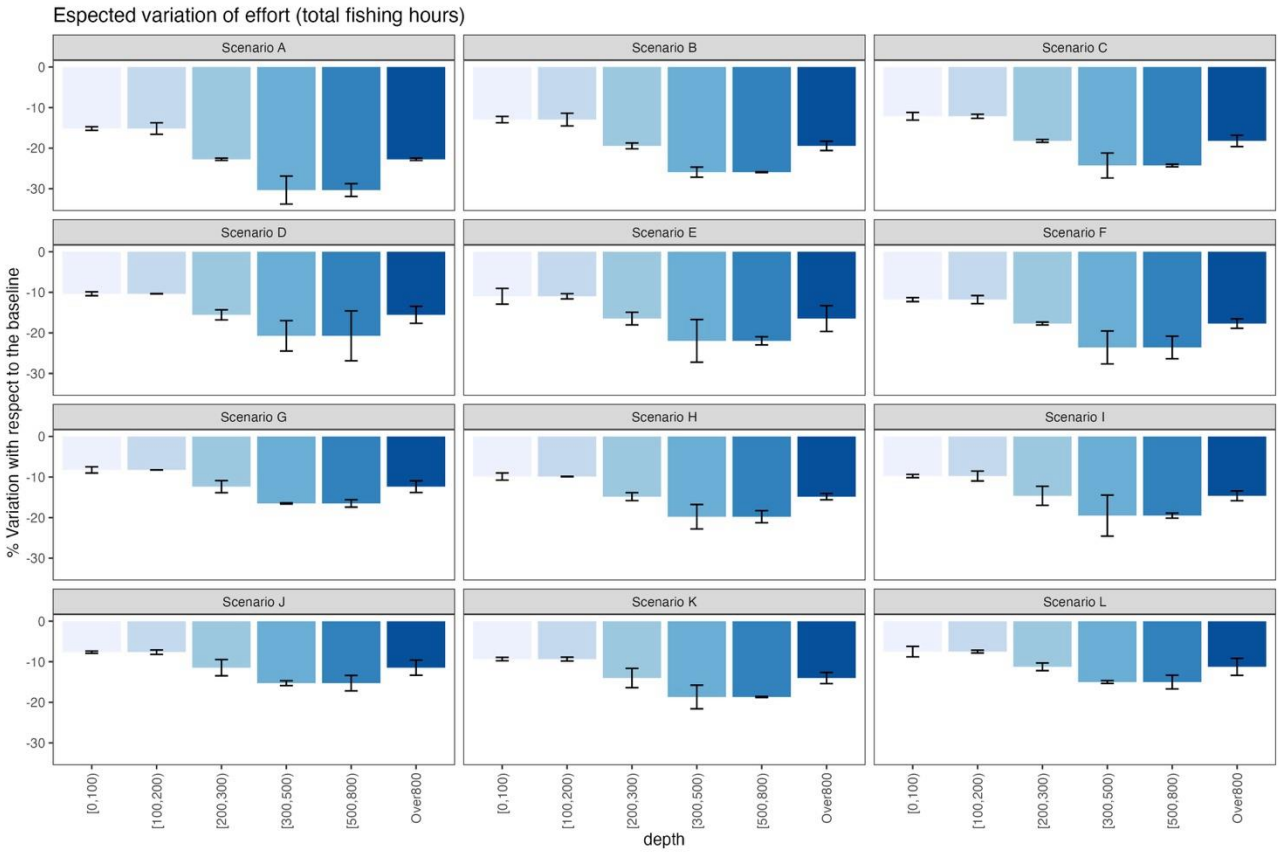


**Figure 6.4.2.1.1 Percentage of variation of effort in total fishing hours per depth strata, for each scenario.**

This result can easily be interpreted in the light of the introduction of catch quotas for shrimp and, at the same time, the constraint determined by the fishing mortality set at $F_{MSY}$ (or a gradual approach to it for stocks such as HKE and NEP). Scenario A is the one that, based on the simulations, could result in the most abrupt and pronounced adaptation of fishing effort to management measures. In contrast, Scenario L is the one associated with less pronounced reductions in the overall pattern.

### 6.4.2.2 Effects on the economic indicators

The predicted patterns of revenues, costs and profits by GSA are represented in Fig. 6.2.2. All simulated scenarios show a substantial reduction in Gross profit margin. These reductions range between 22% (scenario A) and 8% (scenario L). It is interesting to note that this 'net' result is linked to large variations in expected costs and revenues. For example, in scenario A, there is a small reduction in costs (which generally results from the reduction in overall effort but also from the reduction in effort on fishing grounds far from the coast), while the corresponding loss of

revenue is very large. In many other scenarios (e.g. J, K, L), on the contrary, the expected loss of revenue is smaller and sometimes associated with greater cost reductions. The combination of these two aspects results in a lower impact on the Gross Profit Margin.

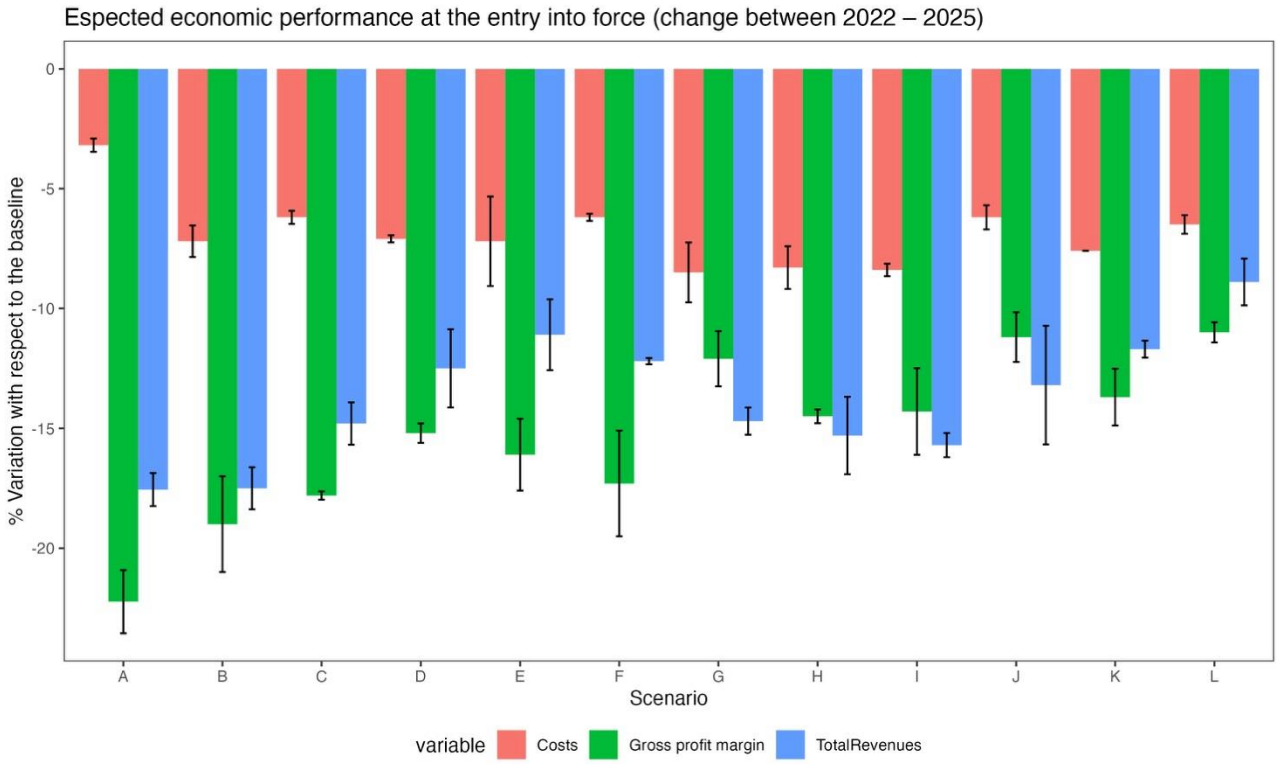


Figure 6.4.2.2.1 – Barplot of the main economic indicators by GSA in the different scenarios

### 6.4.2.3 Effects on the stocks: fishing mortality (F)

The effects of the new fishing effort pattern (as predicted by SMART after the estimation of the effort displacement) on the exploited stocks are summarized in Figures 6.4.2.3.1. The graph does not show anything interesting because, as explained in section 5.4.2, the application of SMART to the EWG 23-11 scenarios was implemented by constraining fishing mortality values and using the SMART simulator to identify the most plausible fishing effort configurations that were consistent with the management measures specific to each scenario.

### 6.4.2.4 Effects on the stocks: spawning stock biomass (SSB)

The effects of the new fishing effort pattern (as predicted by SMART after the estimation of the effort displacement) on the exploited stocks, in terms of predicted Spawning Stock Biomass (SSB) are represented in Figure 6.4.2.4.1. Here, it is important to remember that SMART is a multi-species model where trophic relationships between stocks are considered. This is reflected in the results in two ways: 1) typically important fluctuations in the abundance of different stocks are observed, as a result of predation and competition between them; 2) even when (as in EWG 23-11) fishing mortality is fixed and remains constant, stock conditions can vary widely. All this can be largely justified from an ecological point of view. More specifically:

- For four of the five stocks (ARS, DPS, HKE, and MUT) the scenarios associated with the best effect on the stock are A, C, D, E and L;
- For NEP, the situation seems to be much more complex and only scenario A allows you to get close to the BPA (Precautionary Biomass Level) value.

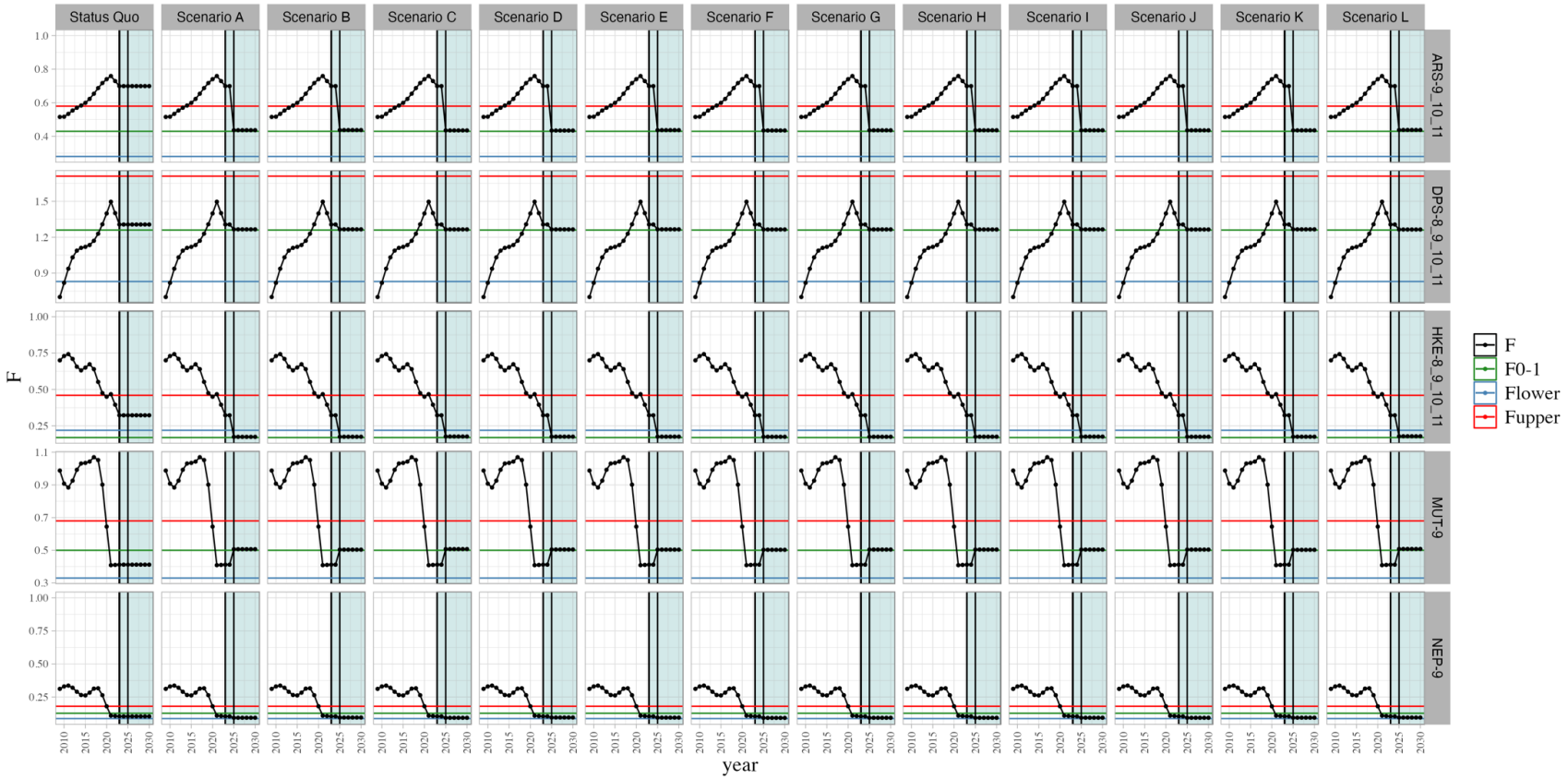


Figure 6.4.2.3.1. EMU 2 (SMART model). Predicted Fishing mortalities (Fbar) by modelled stock (in row) under alternative scenarios (in column). The stocks are as follow (from top to bottom): Giant red shrimp ARS in the GSAs9-10-11, Deep-water rose shrimp in the GSAs9-10-11, European hake HKE in the GSAs9-10-11, Red mullet MUT in GSA9 and Norway lobster NEP in the GSA9. Historical values of Fbar are given in the white areas and simulated values in the blue area. Estimated F 0-1, Flower and Fupper from EWG 23-09 stock assessments are represented. Simulations run until 2030 and vertical black lines indicate the year 2025.

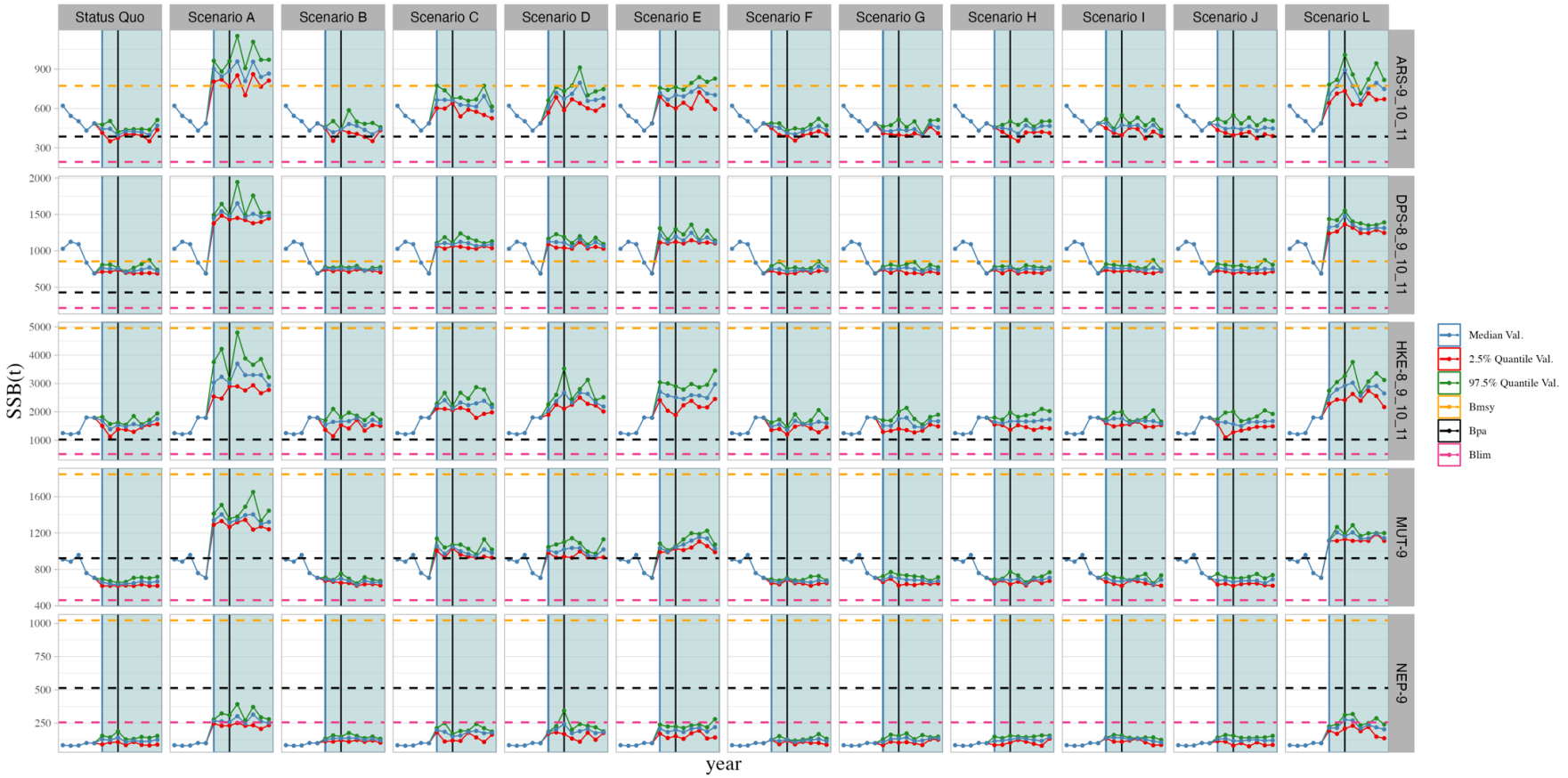


Figure 6.4.2.4.1. EMU 2 (SMART model). Predicted Spawning Stock Biomass (SSB) by modelled stock (in row) under alternative scenarios (in column). The stocks are as follow (from top to bottom): Giant red shrimp ARS in the GSAs9-10-11, Deep-water rose shrimp in the GSAs9-10-11, European hake HKE in the GSAs9-10-11, Red mullet MUT in GSA9 and Norway lobster NEP in the GSA9. Historical values of Fbar are given in the white areas and simulated values in the blue area. Simulations run until 2030 and vertical black lines indicate the year 2025. Estimated Bmsy, Bpa and Blim from EWG 22-09 stock assessments are represented.

**RESULTS SUMMIRIZED FOLLOWING THE TEMPLATE REQUESTED BY DGMARE D1**

Table 6.4.2.1: Total catches by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock catch advice for 2024 | Catches per scenario 2024 (in tons) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k | l |
| ARS-8_9_10_11 | 279 | 263.1 | 453.4 | 384.4 | 352.3 | 425.7 | 322.6 | 478.5 | 409.0 | 436.3 | 509.1 | 392.7 | 505.1 |
| DPS-8_9_10_11 | 1586 | 1160.8 | 1812.9 | 1298.3 | 1624.7 | 1537.9 | 1307.3 | 1543.9 | 1342.9 | 1396.4 | 1313.7 | 1345.5 | 1510.8 |
| HKE-8_9_10_11 | 1183 | 1612.5 | 3126.5 | 2845.9 | 1859.9 | 2240.5 | 2541.7 | 3097.7 | 2375.9 | 2631.6 | 2348.7 | 3573.4 | 2807.6 |
| MUT_9 | 976 | 616.5 | 887.1 | 646.1 | 643.1 | 649.9 | 642.8 | 706.2 | 661.8 | 647.7 | 646.2 | 710.5 | 713.8 |
| NEP_9 | 128 | 248.6 | 389.3 | 292.9 | 290.4 | 276.1 | 221.9 | 284.6 | 250.7 | 294.5 | 187.2 | 293.2 | 250.1 |

Table 6.4.2.2: Fishing Mortality (F) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice F for 2024 | F(2024) resulting from scenario | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k | l |
| ARS-8_9_10_11 | 0.43 | 0.523 | 0.498 | 0.474 | 0.354 | 0.356 | 0.352 | 0.435 | 0.411 | 0.382 | 0.382 | 0.381 | 0.439 |
| DPS-8_9_10_11 | 1.26 | 1.281 | 1.080 | 0.877 | 0.660 | 0.660 | 0.658 | 1.265 | 0.768 | 0.714 | 0.714 | 0.713 | 0.969 |
| HKE-8_9_10_11 | 0.17 | 0.225 | 0.224 | 0.221 | 0.166 | 0.164 | 0.164 | 0.175 | 0.193 | 0.179 | 0.179 | 0.178 | 0.195 |
| MUT_9 | 0.5 | 0.475 | 0.378 | 0.281 | 0.214 | 0.213 | 0.215 | 0.503 | 0.246 | 0.231 | 0.231 | 0.230 | 0.345 |
| NEP_9 | 0.13 | 0.099 | 0.088 | 0.075 | 0.055 | 0.059 | 0.053 | 0.092 | 0.064 | 0.059 | 0.060 | 0.059 | 0.078 |

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.4.2.3: Fishing Mortality (F) by management scenarios for 2025 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice F for 2024 | F(2025) resulting from scenario | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k | l |
| ARS-8_9_10_11 | 0.43 | 0.437 | 0.437 | 0.435 | 0.435 | 0.437 | 0.435 | 0.436 | 0.436 | 0.436 | 0.436 | 0.436 | 0.438 |
| DPS-8_9_10_11 | 1.26 | 1.266 | 1.266 | 1.265 | 1.265 | 1.266 | 1.265 | 1.265 | 1.265 | 1.265 | 1.265 | 1.266 | 1.264 |
| HKE-8_9_10_11 | 0.17 | 0.175 | 0.175 | 0.177 | 0.176 | 0.176 | 0.175 | 0.175 | 0.176 | 0.176 | 0.175 | 0.176 | 0.179 |
| MUT_9 | 0.5 | 0.507 | 0.504 | 0.507 | 0.505 | 0.504 | 0.503 | 0.504 | 0.504 | 0.504 | 0.504 | 0.503 | 0.508 |
| NEP_9 | 0.13 | 0.093 | 0.095 | 0.093 | 0.095 | 0.094 | 0.092 | 0.093 | 0.093 | 0.093 | 0.093 | 0.094 | 0.095 |

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.4.2.4: Fishing Mortality (F) by management scenarios for 2030 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice F for 2024 | F(2030) resulting from scenario | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k | l |
| ARS-8_9_10_11 | 0.43 | 0.437 | 0.437 | 0.435 | 0.435 | 0.437 | 0.435 | 0.436 | 0.436 | 0.436 | 0.436 | 0.436 | 0.438 |
| DPS-8_9_10_11 | 1.26 | 1.266 | 1.266 | 1.265 | 1.265 | 1.266 | 1.265 | 1.265 | 1.265 | 1.265 | 1.265 | 1.266 | 1.264 |
| HKE-8_9_10_11 | 0.17 | 0.175 | 0.175 | 0.177 | 0.176 | 0.176 | 0.175 | 0.175 | 0.176 | 0.176 | 0.175 | 0.176 | 0.179 |
| MUT_9 | 0.5 | 0.507 | 0.504 | 0.507 | 0.505 | 0.504 | 0.503 | 0.504 | 0.504 | 0.504 | 0.504 | 0.503 | 0.508 |
| NEP_9 | 0.13 | 0.093 | 0.095 | 0.093 | 0.095 | 0.094 | 0.092 | 0.093 | 0.093 | 0.093 | 0.093 | 0.094 | 0.095 |

Legend:

| | |
|---|---|
| | F2024 < Flower |
| | Flower < F2024 < Fmsy |
| | Fmsy < F2024 < Fupper |
| | F2024 > F upper |

Table 6.4.2.5: Spawning stock biomass (SSB) by management scenarios for 2024 for single-stock advice (based on STECF 23-09 outputs) and scenarios:

| Stock | Single-stock advice SSB for 2024 | SSB(2024) resulting from scenario | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k | l |
| ARS-8_9_10_11 | 772 | 844.1 | 418.3 | 665.3 | 719.7 | 667.5 | 452.9 | 427.0 | 449.6 | 434.4 | 444.6 | 767.7 | 445.1 |
| DPS-8_9_10_11 | 855 | 1543.6 | 751.8 | 1107.1 | 1120.0 | 1121.5 | 746.5 | 748.7 | 740.0 | 761.1 | 752.4 | 1340.8 | 751.3 |
| HKE-8_9_10_11 | 4950 | 3235.4 | 1648.1 | 2413.6 | 2380.7 | 2574.4 | 1555.3 | 1505.5 | 1601.3 | 1766.3 | 1633.8 | 2788.5 | 1388.4 |
| MUT_9 | 1846 | 1405.0 | 676.6 | 971.1 | 985.5 | 996.3 | 655.2 | 722.0 | 688.8 | 671.6 | 683.2 | 1207.1 | 638.7 |
| NEP_9 | 1021.5 | 262.7 | 135.3 | 184.5 | 202.8 | 182.3 | 115.0 | 129.7 | 118.6 | 140.7 | 132.8 | 213.6 | 121.0 |

Legend:

| | |
|---|---|
| | SSB2024 >Bpa |
| | SSB2024 > Blim |
| | Blim < SSB2024 < Bpa |
| | SSB2024 < Blim |

Table 6.4.2.6: Gross profit margin by scenario in 2025. The median values are used. The % of change between 2025 and the baseline is calculated as GPM(2025)-GPM(2020).

| Estimated % Gross profit margin 2020-2025 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** |
| -23 | -18.5% | -17.5% | -15.4% | -16% | -16.2% | -12.4% | -14.9% | -14.8% | -11.4% | -14.6% | -11.3% |

### 6.4.3 Discussion

Overall, the simulations conducted on all the scenarios envisaged by the TORs of EWG 23-11 indicate that:

- Most of the scenarios (which are also very similar to each other) would have almost indistinguishable effects on stocks in terms of Fbar and SSB. The only significant exceptions are represented by scenarios A and L;
- From an economic point of view, the differences between the scenarios (at least in terms of immediate impact on fleets) are more pronounced. Scenarios A, B, C and D are those associated with the greatest profit losses, while scenarios G, L and J are those that would have the least negative impact;
- The main characteristics of these scenarios are that, in them, improvements are expected in terms of selectivity, while the constraints in terms of fishing mortality are less stringent than those of other scenarios;

However, scenario A is the one that would most quickly lead to a better condition of all stocks, but with the highest price from an economic point of view (-22% of profits) for the fleet.

# 7 REMAINING ISSUES AND FUTURE STEPS

## 7.1 Issues important for the advice and the interpretation of results

### 7.1.1 IAM in EMU 1

It is important to note that, as indicated in section 6.1.3., the revenues, and consequently the Gross Value Added (GVA) of the different fleet segments assessed in IAM are likely underestimated. This is because the revenues of the fleet segments from landings of species that are not modelled in IAM are based on landings per unit of effort (LPUE) parametrised using 2022 FDI data and these values are constant throughout the simulations. Therefore, potential future increases in biomass of these non-dynamically modelled species/stocks are not reflected in fleet revenue estimates. The percentage of revenue from non-dynamically modelled stocks is more or less important depending on the fleet segment, Figure 5.1.4.2 presents these shares per fleet segment. We can observe that almost 80% of the revenues of Spanish trawlers above 24 meters are based on modelled species, hence biomass changes are taken into account in the profit estimates, whereas for French trawlers above 24 meters, this proportion is only around 30%. For netters and vessels using hooks, these proportions are very low (overall less than 10%), so their profits are most likely really underestimated.

In addition, doubts and concerns about crew cost estimates were expressed in section 6.1.3, and should be taken into account when considering results such as Gross Profit, Gross Profit margin, average salary and CR/BER. This problem of estimating crew costs needs to be resolved, and to do so, qualitative and quantitative information is required before future groups.

### 7.1.2 BEMTOOL in EMU 2

It should be also noticed that the GP and the GPM do not take into account possible subsidies received by operators to face the recent fuel costs increase and the decrease in the number of effort quotas, because this information was not available. This may have impacted negatively on the economic indicators, projecting a worse situation respect to the actual one (e.g. underestimating the GPM).

Moreover, the lack of MEDITS data for 2022 could have increased the uncertainty of the stock assessment results, that feed BEMTOOL model for the biological and pressure component. This issue should be considered as an additional amount of uncertainty on the projections, although limited respect to the process error. Another important aspect is the missing stock assessment for MUT10 and ARA91011. The proxy used in the model for the projections, need to be soon replaced by quantitative updated stock assessment results in order to improve the accuracy of the results.

Finally, in the model, a linear relationship between FTE and total fishing days has been assumed for simplicity. Nevertheless, this assumption should be verified through a specific analysis on the historical data.

It is important to note that the scenarios here presented do not consider the adaptation of the catch limit to the status of the stock (e.g. FMSY, SSB) that is expected to change during the application of management measures.

### 7.1.3 ISIS-Fish in EMU 1

Effort reductions are simulated as if a monthly effort quota was implemented and the monthly distribution is based on the observations for each fleet (2020 values). It is likely that the simulation results would be very different if a « race for effort» is assumed and the effort grouped at the beginning of the year.

Similarly, we assumed that effort quotas are distributed among vessels in proportion of their historical effort.

Because of the discrete nature of the model spatial and temporal resolution, approximations were needed to represent the spatio-seasonal closures both in terms of their spatial and temporal coverage. An assumption was needed to report effort when an area was closed. We assumed that it was reported in the remaining zone of the métier if it was not completed covered by the closure and cancelled otherwise. Analyses of VMS data, and Fishers' interviews would help build more realistic assumptions.

Recruitment has been forced to a constant value (average 2018-2022) in projection. The results in terms of population dynamics and stock rebuilding necessarily depend on this assumption. If a stock recruitment actually exists, even faster rebuilding is expected. It also explain partly why the effect of effort reduction is more

### 7.1.4 SMART in EMU 2

It is very important to reiterate that the forecasts provided by SMART are "pessimistic" in the long term (and this is also why profit forecasts beyond 2025 have been omitted). It is entirely reasonable to hypothesize that, in the short term, the better condition of the stocks can support higher catches and therefore higher profits. This obviously would not solve the problem of immediate losses but, with an adequate fleet support strategy, it could allow the system to move towards conditions of real bio-economic sustainability in a reasonable time.

Another important caveat is linked to the fact that, once a certain fishing mortality value and the ancillary measures associated with it have been established, there may be innumerable "configurations" of the fishing effort which are consistent with it but which differ in terms of the economic performance of the fleet. During EWG 23-11 it was decided to prioritize coverage of all scenarios while limiting the number of simulations for each scenario. This, together with the great complexity in the management definition of the different scenarios, has limited the exploration of the possible effects.

A new version of SMART is being prepared that allows you to integrate the activity of passive tools. It will be based on a recent methodology (Henriques et al., 2023) which allows estimating the fishing effort of gillnets and other gear which, historically, are very difficult to model using VMS/AIS data.

The SMART core team is also planning to develop the economic part of the model through a partnership with expert colleagues.

The only critical aspect remains the possibility of "closing the loop" and projecting the responses of the stocks (for example their increase in biomass) into the LPUE.

#### 7.1.4.1 References

Henriques NS, Russo T, Bentes L, Monteiro P, Parisi A, Magno R, Oliveira F, Erzini K, Goncalvese JMS (2023). An approach to map and quantify the fishing effort of polyvalent passive gear fishing fleets using geospatial data. ICES Journal of Marine Science , 2023, 0 , 1–12. DOI: 10.1093/icesjms/fsad092.

## 7.2 Stakeholder engagement – First meeting with MEDAC

During the EWG meeting the two EWG chairs met with representatives of MEDAC to discuss the implementation of the management plan. The intention was to get, firstly, a general feeling how representatives from the fishing sector and other interest groups see the implementation and, secondly, to get direct feedback of the participants regarding questions of the modellers in the EWG (e.g. how the sectors deals with the issue of minimum wages). MEDAC will provide an extra document with more comprehensive answers to the questions before the STECF winter plenary meeting. This document together with an internal document of the chairs on the meeting results will be background document for the planning of the stakeholder engagement in 2024. It will be important to start the interaction with MEDAC earlier in the year so that modellers are able to implement the results of discussions into their models.

**CONTACT DETAILS OF EWG-23-11 PARTICIPANTS**

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## 8 LIST OF ANNEXES

Electronic annexes are published on the meeting's web site on:
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List of electronic annexes documents:

EWG-23-11 – Annex I – TOR1 Graphs and tables
EWG-23-11 – Annex II – IAM Additional results
EWG-23-11 – Annex III – ISIS-Fish calibration

## 9 LIST OF BACKGROUND DOCUMENTS

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List of background documents:

EWG-23-11 – Doc 1 - Declarations of invited and JRC experts (see also section XX of this report – List of participants)

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