DORY - Capitalization actions for aDriatic marine envirOnment pRotection and ecosYstem

PA 3 – Environment and cultural heritage
Specific Objective 3.2 - Contribute to protect and restore biodiversity
Application ID – 10041641

Title of the deliverable	D2.2.2 Articles and Publications
Work Package:	WP2 - Communication activities
Activity	Publications & Media Relations
Partner in charge (author)	P4 – CNR – IRBIM National Research Council - Institute for Biological Resources and Marine Biotechnologies, IOF Institute of Oceanography and Fisheries
Status	Final
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1. Introduction

The following report is corresponding to the deliverables **“D2.2.2 Articles and Publications”** which foresees the publication on a EU relevant paper of an articles regarding the projects, published by the Scientific Institutions members of the Partnership (P4 – CNR – IRBIM National Research Council - Institute for Biological Resources and Marine Biotechnologies, IOF Institute of Oceanography and Fisheries).

This publication could be considered one the mots relevant achievement of the project, since the results and the scenarios tested by meas of the advanced MSP tool “DISPLACE” were borugh to the attention of the European Commission. Indeed the results of the tested scenario model for the setting up of shared cross-border management measures has been included in the scientific publication of the **JRC science for Policy Report - Multiannual Plan for the fisheries exploiting demersal stocks in the Adriatic Sea (STECF-19-02).**

The publication is edited by the Scientific, Technical and Economic Committee for Fisheries (STECF) and is a Science for Policy report by the Joint Research Centre (JRC), the European Commission’s science and knowledge service. **It aims to provide evidence-based scientific support to the European policy-making process.**

2. The scientific publication on the MSP advanced tool DISPLACE testing on target species

JRC SCIENCE FOR POLICY REPORT

Scientific, Technical and Economic Committee for Fisheries (STECF) - Multiannual Plan for the fisheries exploiting demersal stocks in the Adriatic Sea (STECF-19-02)

Edited by Ernesto Jardim & Paris Vasilakopoulos

Report EUR 29757 EN

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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 explores the effect of different decisions and management options, with regards to the implementation of a multiannual management plan for the Adriatic hake, red mullet, sole, deepwater rose shrimp, and spottail mantis shrimp stocks.

Authors:

STECF advice:

Ulrich, C., Abella, J. A., Andersen, J., Arrizabalaga, H., Bailey, N., Bertignac, M., Borges, L., Cardinale, M., Catchpole, T., Curtis, H., Daskalov, G., Döring, R., Gascuel, D., Knittweis, L., Lloret, J., Malvarosa, L., Martin, P., Motova, A., Murua, H., Nord, J., Prellezo, R., Raid, T., Sabatella, E., Sala, A., Scarcella, G., Soldo, A., Somarakis, S., Stransky, C., van Hoof, L., Vanhee, W., van Oostenbrugge, H. , Vrgoc, N.

EWG-19-02 report:

Jardim, E., Accadia, P., Avdic Mravlje, E., Bastardie, F., Bolognini, L., Daskalov, G., Grati, F., Isajlovic, I., Konrad, C., Mannini, A., Mantopoulou-Palouka, D., Mihanovic, M., Mosqueira, I., Pinto, C., Raid, T., Vasilakopoulos, P.

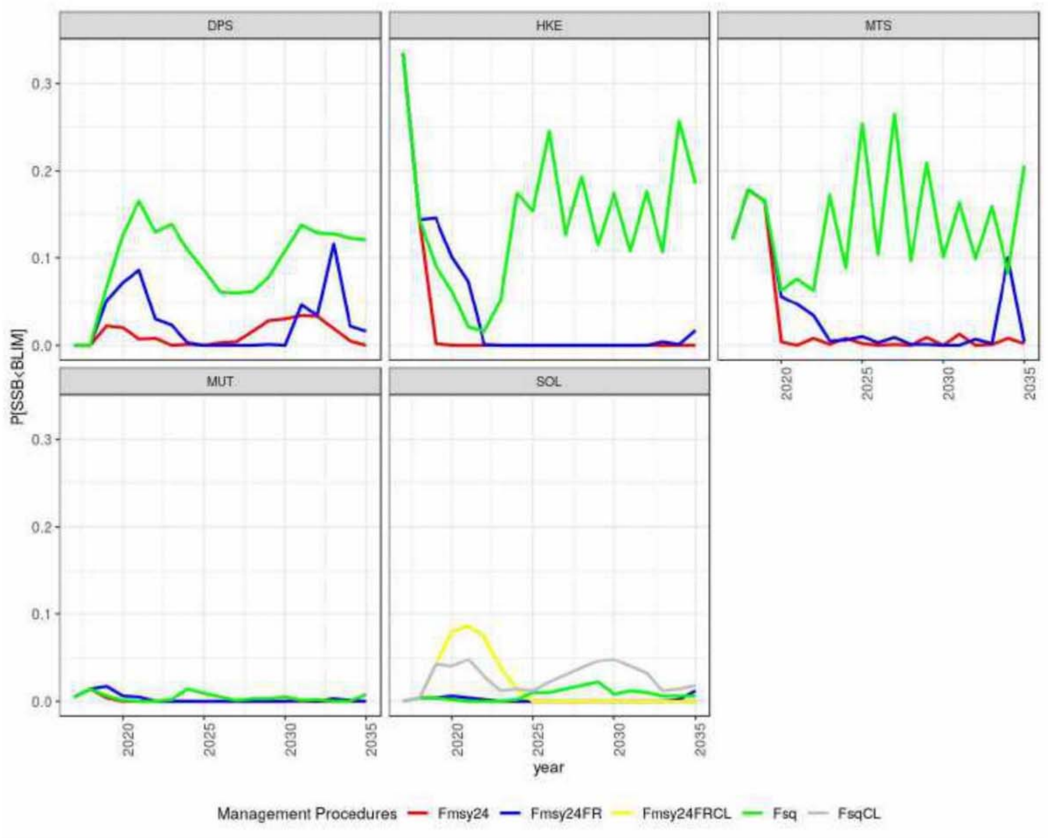

Figure 5.7.2 The temporal development of the probability of falling below Blim (SSBBLIM) by stock, for each management scenario.

6 ToR 4 – Management procedure B

6.1 Spatial management scenarios

6.1.1 Sole sanctuary

The fishing restricted area (FRA) is defined by two areas where fishing activities are not allowed: (a) the polygon identified as area of high persistence in front of the Venice lagoon in Scarcella et al. 2014 and (b) the polygon proposed for the sole sanctuary in Bastardie et. al 2017 (Figure 6.1.1.1).

The closure to OTB of Area B of the Sole Sanctuary would generate a general decrease in sole CPUE, total landings and sole landings (Figure 6.1.3.3). An increase of sole discard would be expected. In this case, it should be considered that the common sole is not the target species of OTB and it represents a small fraction of the total landing of this gear.

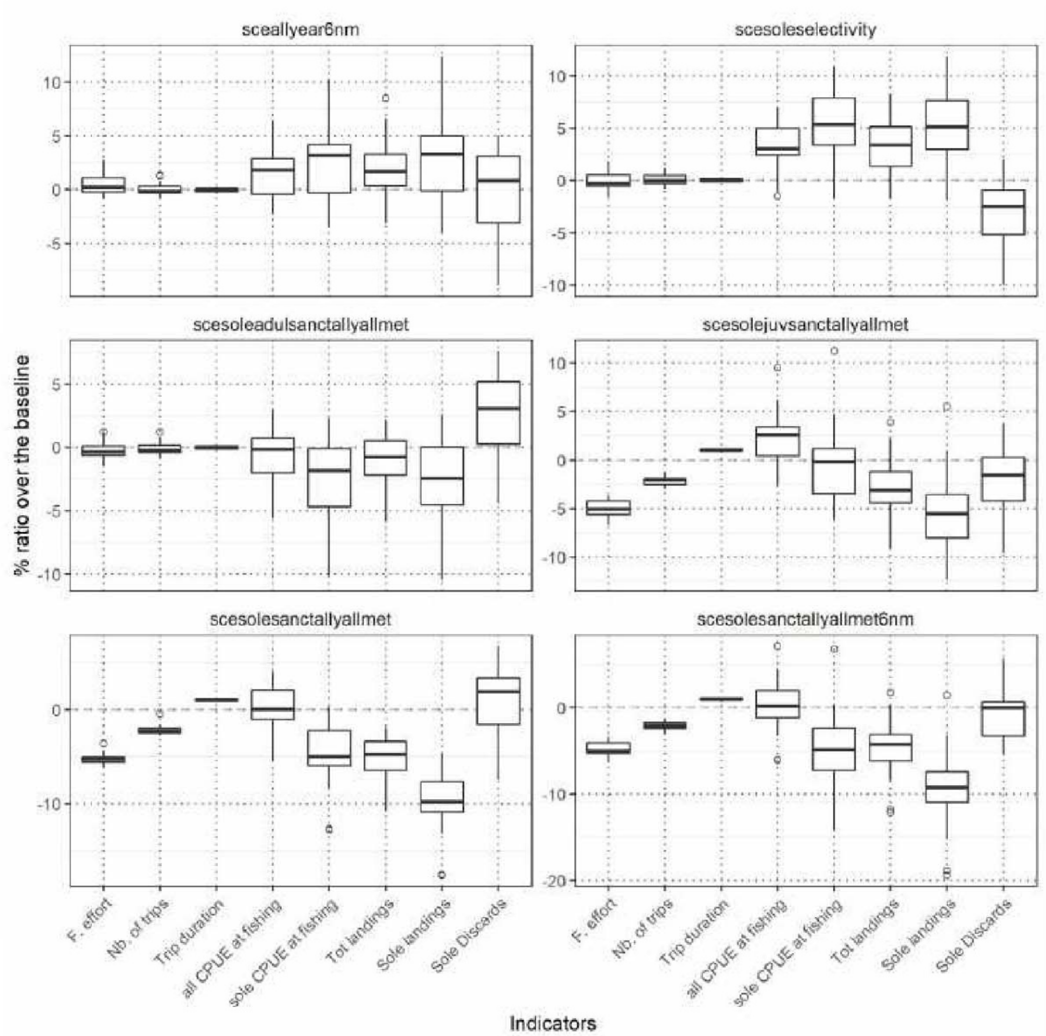

Figure 6.1.3.3 Comparison of aggregated scenario outcomes (20 stochastic replicates per scenario) on the vessel performance indicators (percent relative to the baseline) for bottom otter trawlers. The percentages are relative to the baseline condition for fishing effort (F. effort), number of trips (Nb. of trips), trip duration, all CPUE at fishing, Sole CPUE at fishing, total landings all stocks pooled, common sole landings (Sole landings) and discard rates for common sole (Sole discards).

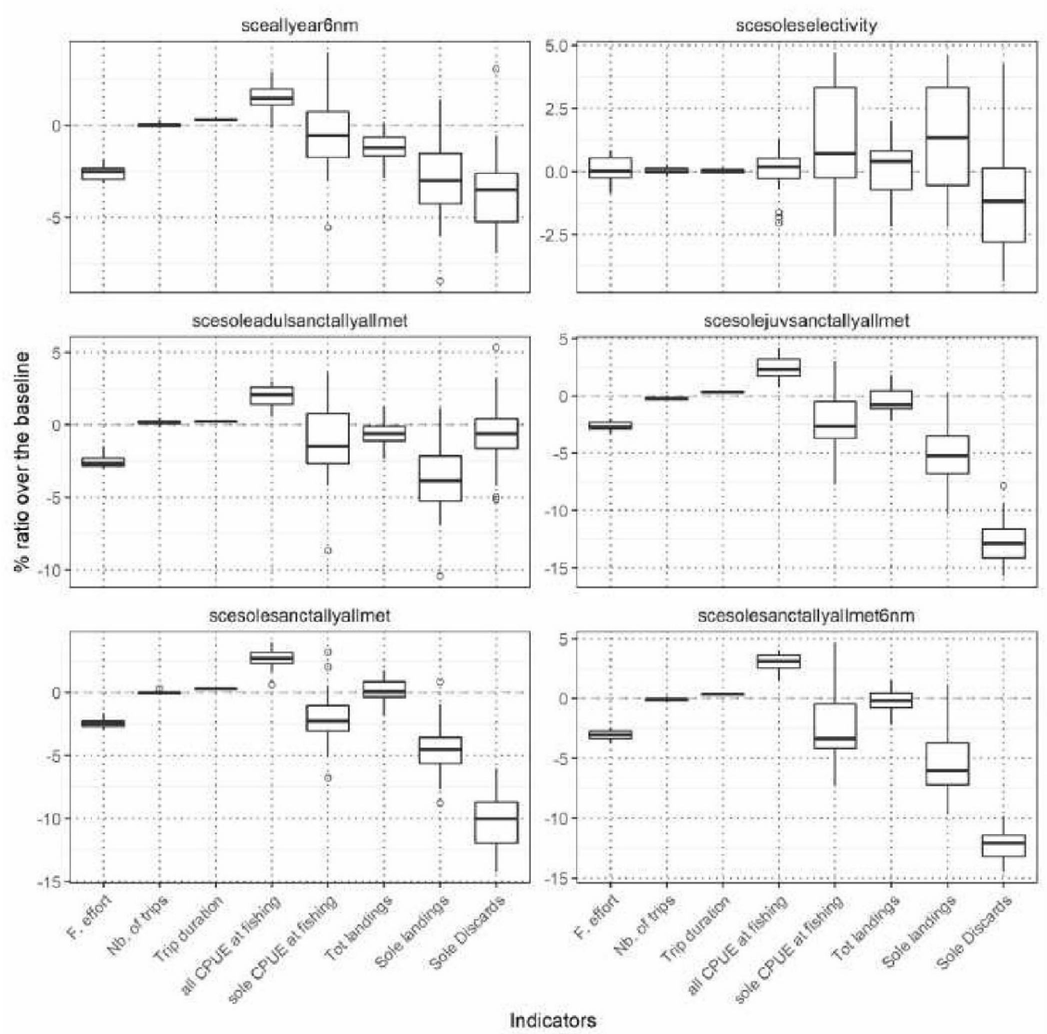

Figure 6.1.3.2 Comparison of aggregated scenario outcomes (20 stochastic replicates per scenario) on the vessel performance indicators (percent relative to the baseline) for rapido trawlers. The percentages are relative to the baseline condition for fishing effort (F. effort), number of trips (Nb. of trips), trip duration, all CPUE at fishing, Sole CPUE at fishing, total landings all stocks pooled (Tot land.), common sole landings (Sole landings) and discard rates for common sole (Sole discards).

The effects of the "sole selectivity" scenario on bottom otter trawl fishery (OTB) refer to an increase in total CPUE, CPUE of common sole, total landings and landings of common sole (Figure 6.1.3.3). A decrease in discard rates would be expected.

The closure to OTB of Area A of the Sole Sanctuary would generate a general decrease in fishing effort, number of trips, total landings, sole landings and sole discard (Figure 6.1.3.3).

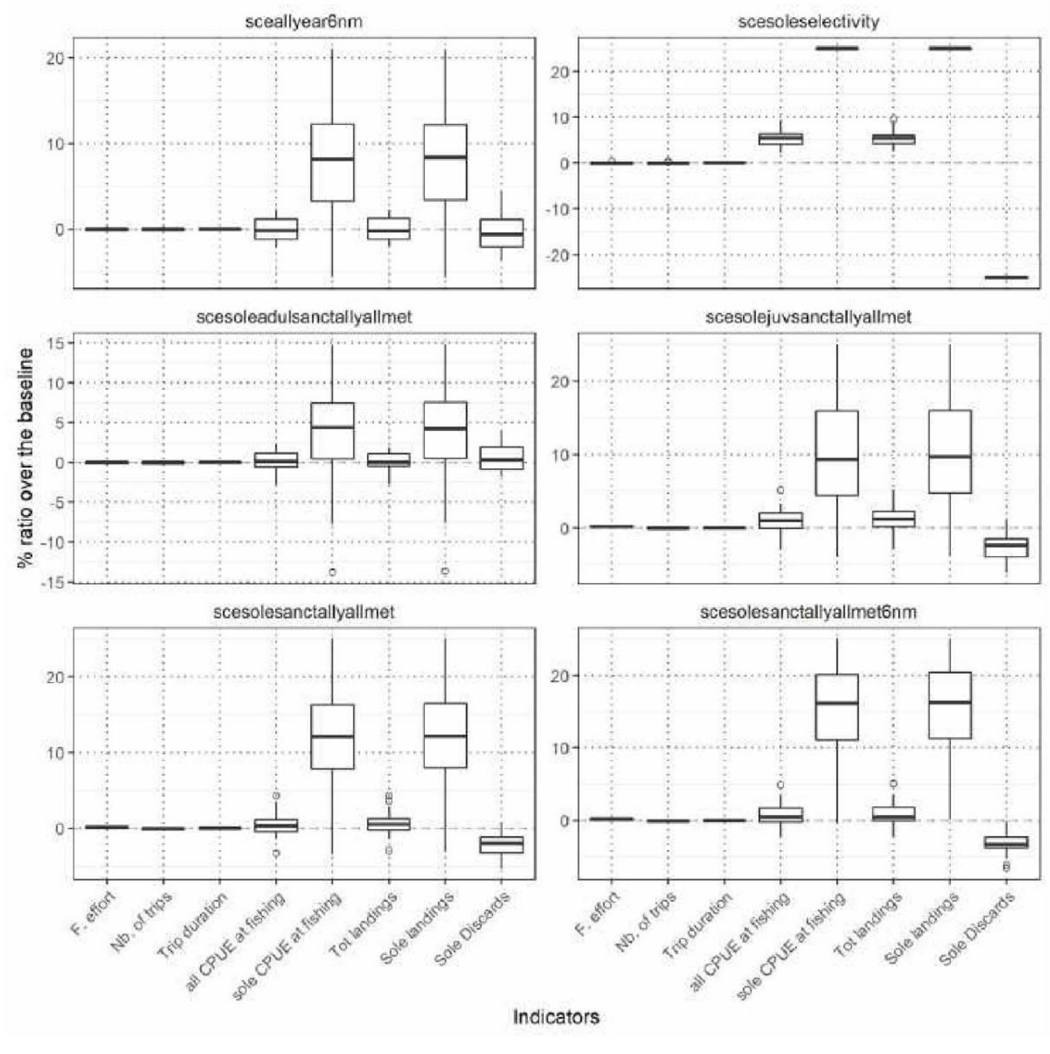

Figure 6.1.3.1 Comparison of aggregated scenario outcomes (20 stochastic replicates per scenario) on the vessel performance indicators (percent relative to the baseline) for gillnet vessels. The percentages are relative to the baseline condition for fishing effort (F. effort), number of trips (Nb. of trips), trip duration, all CPUE at fishing, Sole CPUE at fishing, total landings all simulated stocks pooled (Tot land.), common sole landings (Sole landings) and discard rates for common sole (Sole discards).

The effects of the "sole selectivity" scenario on rapido trawl fishery (TBB) refer to a decrease in discard rate for the common sole would be also expected (Figure 6.1.3.2).

The closure of Area A and B of the Sole Sanctuary would generate similar results. A general decrease would be expected in fishing effort, common sole CPUE, total landings, common sole landings and sole discard, the latter is more evident in the case of area A closure (Figure 6.2.2). A general increase in the total CPUE would be expected.

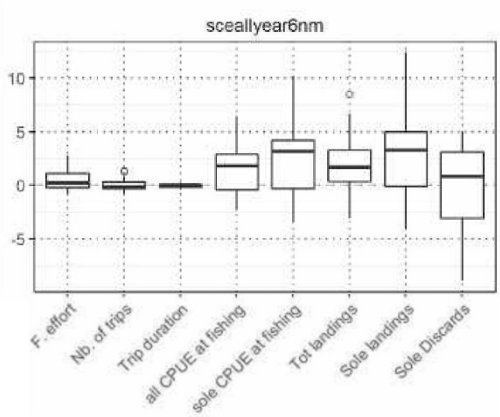

Figure 6.1.2.3 Effects of the 6nm OTB and TBB fishing closure on OTB.

6.1.3 Additional tests

Tests were carried out for a set of additional management measures to better understand the sole sanctuary, its combination with the 6nm closure and implementation of non-spatial selectivity measures:

Spatial measure scenarios:

- scesoleadulsanctallyallmet - it represents a projection of the previous "sole sanctuary" scenario, splitting A area and B area separately (Figure 6.1.1.1). This scenario refers to the B area, were a high persistence of common sole adults was identified;
- scesolejuvsanctallyallmet - as above, but this scenario refers to the A area, were a high persistence of common sole adults was identified;
- scesolesanctallyallmet6nm – this scenario is a combination of the "sole sanctuary" scenario (A and B area both combined) + the "6nm" scenario;

Non-spatial measure scenarios:

- scesoleselectivity – this scenario includes two measures which are not related to spatial measures. It refers to the adoption of a 72 mm minimum stretched mesh size for gillnet, in order to increase the selectivity of the gear, oriented to avoid undersized catch of common sole. In addition it includes the adoption of a minimum landing size for the common sole set at 25 cm TL.

The effects of the "sole selectivity" scenario on gillnet fishery refer to an increase of the CPUE of both the total catch and the common sole, total landings and common sole landings (Figure 6.2.1). A strong decrease in discard rate for the common sole would be also expected.

The closure of Area A of the Sole Sanctuary would increase the CPUE of both the total catch and the common sole, total landings and common sole landings (Figure 6.1.3.1). A slight decrease in discard rate for the common sole would be also expected. The closure of Area B of the Sole Sanctuary would increase the common sole CPUE and the common sole landings (Figure 6.1.3.1).

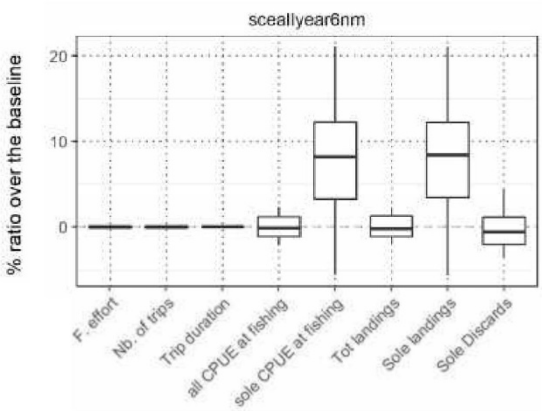

Figure 6.1.2.1 Effects of the 6nm OTB and TBB fishing closure on gillnet fisheries.

Rapido trawlers (TBB) will suffer a decrease of the fishing effort, as well as the total landings and sole landings (Figure 6.1.2.2). Discard rates for common sole will decrease and a general increase of the total CPUE would occur.

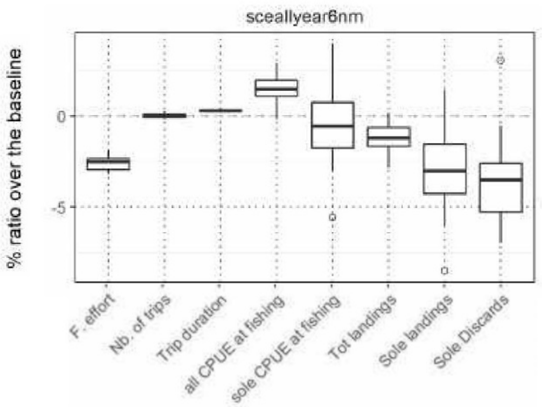

Figure 6.1.2.2 Effects of the 6nm OTB and TBB fishing closure on TBB.

For bottom otter trawlers (OTB) this scenario would produce a general increase in the CPUE of the total catch and the sole, total landings, as well as of sole landings (Figure 6.1.2.3).

would be expected close to border of Area B and westwards from Istria Peninsula (Figure 6.1.1.6).

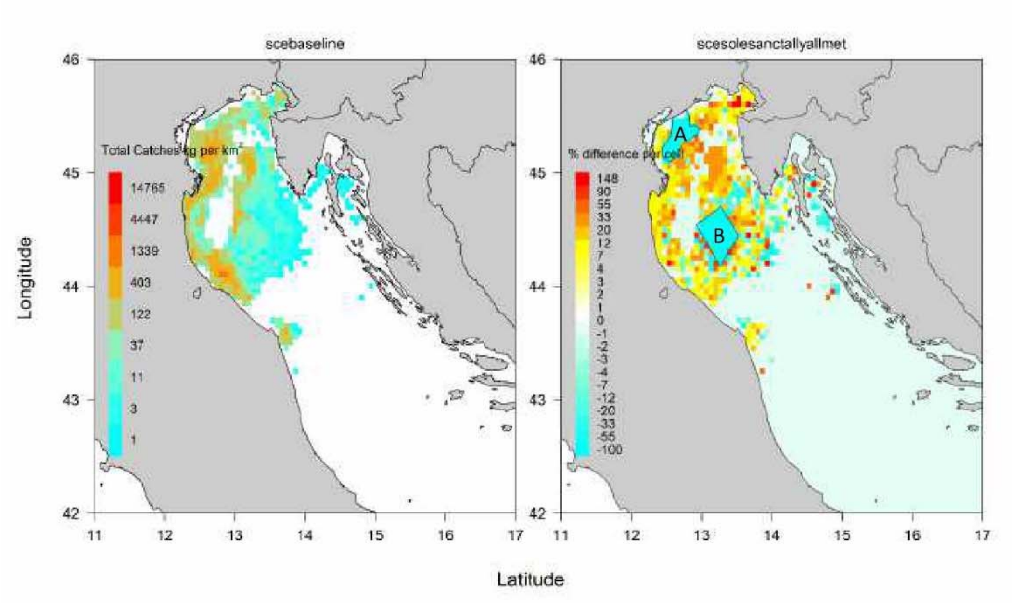

Figure 6.1.1.6 Spatial distribution of simulated common sole catches. Map on the left shows the baseline and map on the right shows the simulated redistribution of common sole catches after the institution of the "Sole Sanctuary".

6.1.2 Protection of 6nm

To test the effect of restricting the coastal zone up to 6 nautical miles to all active towed gears (OTB and TBB), the EWG used a previously set DISPLACE scenario. This scenario excluded Croatia and Slovenia's waters due to existing strict fisheries regulations and complex geomorphological characteristics of eastern Adriatic coast, as well as the Maritime Departments of Monfalcone and Trieste due to the limited presence of juveniles in the area. Annex 5 includes detailed information about these options.

EWG 19-02 notes that the proposed management scenario may generate conflicts between small-scale trawlers and large-scale trawlers. Currently, Italian small-scale trawlers (e.g. IV category fishing license "coastal fishery") operate between 3 and 6 nautical miles. Large-scale OTB generally exploit offshore fishing grounds, with the exception of large-scale TBB, which usually operates in shallow water fishing grounds (depth < 50 m). The closure of coastal waters may force the small-scale trawlers to relocate their activities outside 6 nautical miles, potentially generating conflicts with the large-scale TBB fleet.

Gillnetters will benefit from the 6nm closure to OTB and TBB in terms of higher sole CPUE and sole landings (Figure 6.1.2.1).

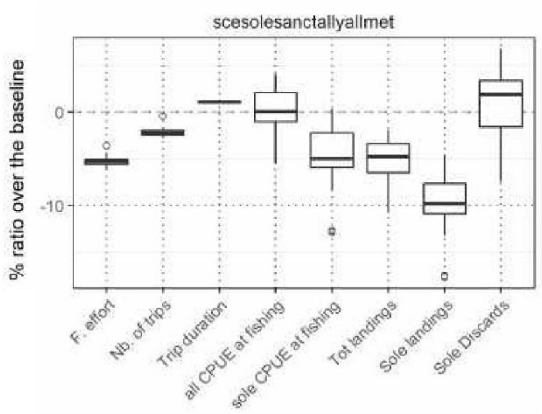

Figure 6.1.1.4 Effects of the "Sole sanctuary" on bottom otter trawlers (OTB).

Figure 6.1.1.5 shows how the total fishing effort (gillnets + OTB + TBB) will redistribute in case of the FRA's enforcement. The highest increase of fishing effort would be expected close to the NE side of area A and SW and NE sides of area B (Figure 6.1.1.5).

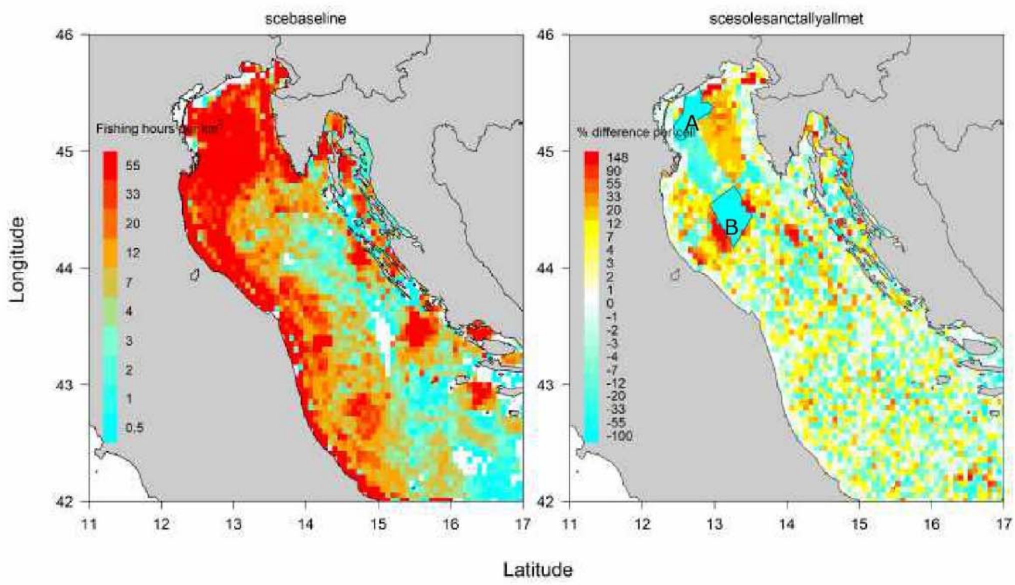

Figure 6.1.1.5 Spatial distribution of simulated fishing effort (hours). Map on the left shows the baseline and map on the right shows the redistribution of fishing effort after the institution of the "Sole Sanctuary".

Figure 6.1.1.6 shows how the common sole catches (from gillnets + OTB + TBB) will redistribute in case of fishing ban inside the Sole Sanctuary. The highest increase of common sole catches

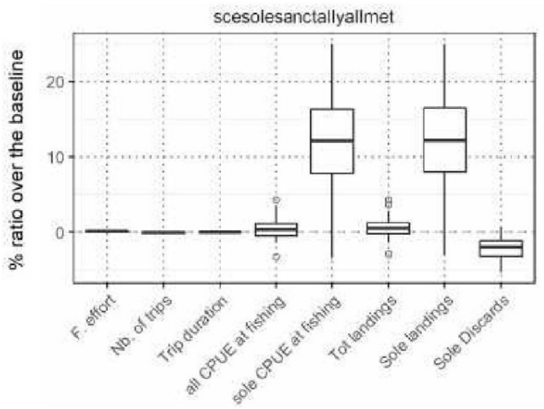

Figure 6.1.1.2 Effects of the "Sole Sanctuary" on gillnet fisheries.

The exclusion of rapido trawlers (TBB) from the Sole Sanctuary would decrease the total fishing effort, the CPUE and landings of common sole, and the discard rates of this species (Figure 6.1.1.3). On the other hand, this scenario would increase the total CPUE. Common sole is the main target species for TBB.

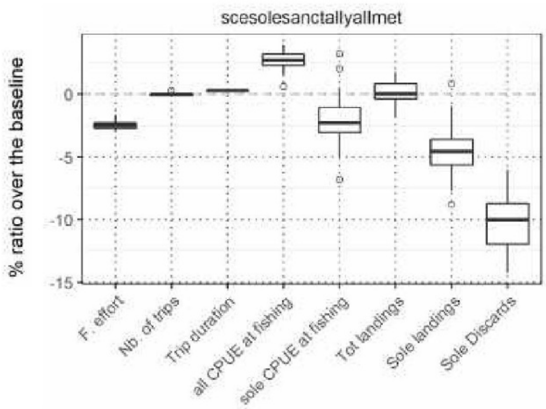

Figure 6.1.1.3 Effects of the "Sole sanctuary" on rapido trawlers (TBB).

The exclusion of bottom otter trawlers (OTB) from the Sole Sanctuary would decrease the total fishing effort, the total number of trips, CPUE and landings of common sole, and total landings (Figure 6.1.1.4). On the other hand, the trip duration and common sole's discards would increase. It should be mentioned that common sole is not a target species for OTB, as it contributes for a very small fraction of the total landings.

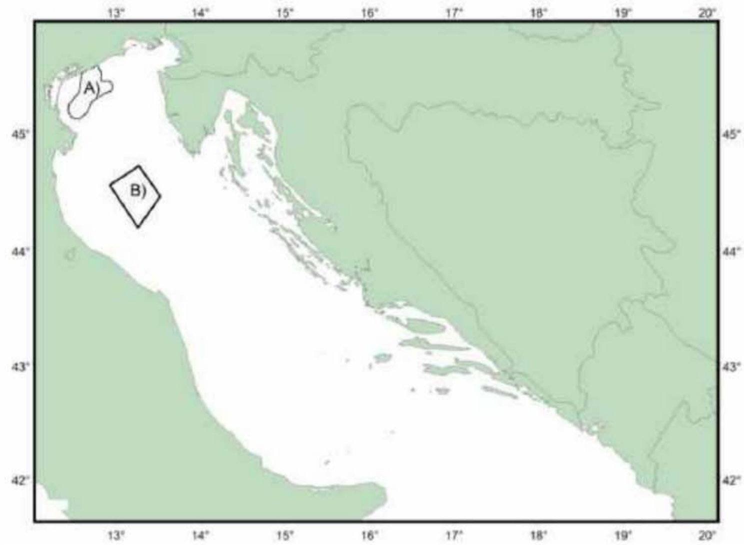

Figure 6.1.1.1 A) Northern portion of the area described by Scarcella at al. (2014) concerning the spatial and temporal persistency of the adult common sole; B) revised version of the "Sole Sanctuary" presented at the FAO AdriaMed/MedReAct Workshop "Essential Fish Habitats and Sensitive Habitats of the Adriatic Sea: state of knowledge and conservation opportunities" (WS-EFH; 20-21st February 2018, FAO-HQs) by CNR, ISPRA, IOF and FRI.

It is important to note that the areas in Figure 6.1.1.1 were recently updated during the FAO AdriaMed / MedReAct Workshop "Essential Fish Habitats and Sensitive Habitats of the Adriatic Sea: state of knowledge and conservation opportunities" (WS-EFH; 20-21st February 2018, FAO-HQs), and presented to GFCM's Working Group on VME as well as at the SubRegional Coordination meeting for the Adriatic Sea. Furthermore, a stakeholder consultation regarding the perception of the management measure related to the permanent closure of the high persistency area for common sole spawners named "sole sanctuary" is in progress in the DORY project (2014 - 2020 Interreg V-A Italy - Croatia CBC Programme).

The results obtained through the application of the bio-economic model DISPLACE refer to a cumulative effect of the Sole Sanctuary over a period of 6 years.

The exclusion of gillnetters from the Sole Sanctuary would increase the CPUE and the landings of common sole (Figure 6.1.1.2). In addition, a reduction of common sole discard would be also expected.

The spatial distribution of effort and catches resulting from the application of these scenarios are depicted in Figure 6.1.3.4 and Figure 6.1.3.5, respectively. Average fishing mortality at age estimated by each scenario run, to be used in the MSE analysis, are reported in Table 6.1.3.1.

C_{low}	1176	1177	1067	658	647	603
FFMSY	1.30	1.32	1.29	0.66	0.61	0.66
SSB	3828	5025	5419	7944	8191	8357
SSBBLIM	0.00	0.01	0.01	0.00	0.00	0.00
SSBBLIMmax	0.43	0.36	0.27	0.18	0.18	0.18

Figure 6.2.1, Figure 6.2.2, Figure 6.2.3, present summaries of spatial closures effects.

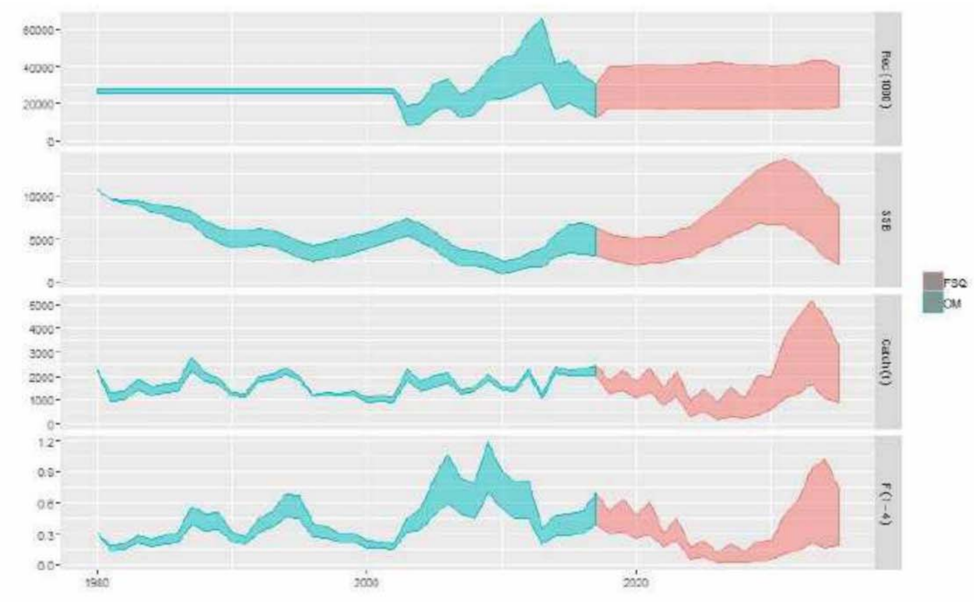

Figure 6.2.1 Projections from the baseline OM on a baseline scenario where F was modified in order to account for a spatial closure up to 6 nautical miles (Fsq6nm). SSB is the product of fecundity times the mean weight at age.

Table 6.1.3.1 Final (i.e. in year 6) simulated average fishing mortalities-at-age for GSA 17 common sole. Additional scenarios are shaded in gray.

Scenario	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9
scebaseline	2.76	2.10	1.95	1.40	0.23	0.20	0.20	0.20	0.20	0.20
scesolesanctallyallmet	2.52	1.79	1.64	1.19	0.13	0.10	0.10	0.10	0.10	0.10
sceallyear6nm	2.61	1.99	1.87	1.37	0.22	0.19	0.19	0.19	0.19	0.19
scesoleselectivity	2.74	2.12	1.88	1.40	0.23	0.20	0.20	0.20	0.20	0.20
scesoleadulsanctallyallmet	2.66	2.00	1.90	1.32	0.16	0.13	0.13	0.13	0.13	0.13
scesolejuvsanctallyallmet	2.52	1.79	1.64	1.22	0.18	0.15	0.15	0.15	0.15	0.15
scesolesanctallyallmet6nm	2.47	1.79	1.62	1.18	0.13	0.09	0.09	0.09	0.09	0.09

6.2 MSE analysis for Sole 17

Changes in fishing mortality at age estimated by DISPLACE for each scenario, were introduced in the MSE runs in 2020, therefore the analysis will focus on results in 2014 and long-term (2025-2035).

The introduction of spatial closures on the baseline scenarios (F_{SQ}) does not show an improvement of the F/Fmsy relationship. A slight improvement is instead observed when spatial closures and effort reduction are combined with the 6nm closure, which seems to amplify F reductions (Table 6.2.1).

In the long term there's indications that combining effort reductions with spatial measures may increase SSB levels (Table 6.2.2). Nevertheless, it is important to note that sole results are not robust to mis-specifications of the stock-recruitment relationship and F_{SQ} estimates are optimistic.

Furthermore, it should be kept in mind that if selectivity changes, due to management measures like spatial closures, a new F_{MSY} should be calculate since a different proportion of the population will be targeted by the fleet.

Table 6.2.1 Indicators calculated only for 2024 in the scenario without and with spatial closures

	Fsq	Fsq6nm	FsqFRA	Fmsy24FR	Fmsy24FR6nm	Fmsy24FRFRA
FFMSY	1.03	0.87	0.94	0.47	0.38	0.41
SSBBLIM	0.00	0.01	0.01	0.00	0.00	0.00

Table 6.2.2 Indicators from the long-term (2025-2035) projections of spatial scenarios accounting for a variation of F depending on the spatial closure.

	Fsq	Fsq6nm	FsqFRA	Fmsy24FR	Fmsy24FR6nm	Fmsy24FRFRA
C	1589	1623	1519	1180	1177	1097
C_{hi}	2061	2116	1997	1650	1750	1635

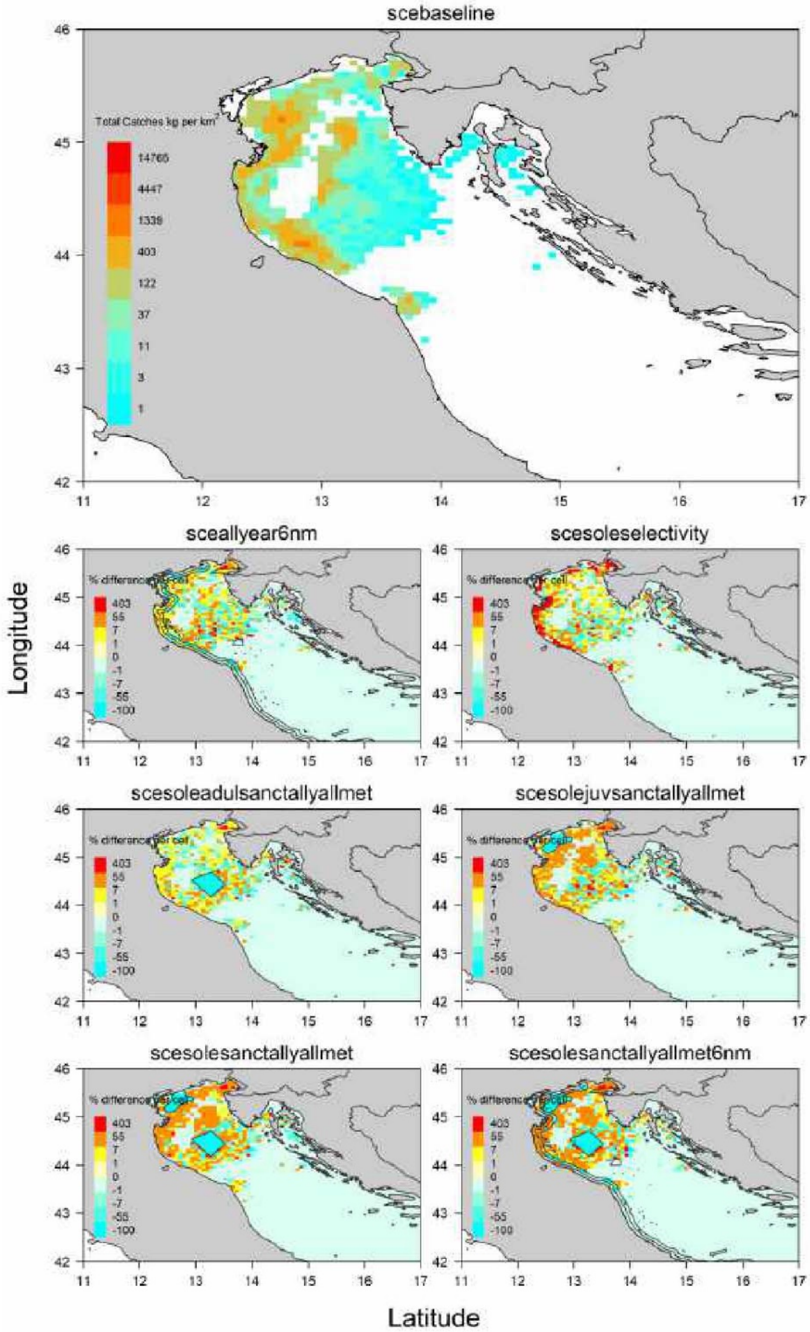

Figure 6.1.3.5 Baseline spatial distribution of the Italian and Croatian catches and the percentage of relative change per scenario. Catches are given as the accumulated tons over the six-year simulation horizon averaged over the 20 replicates per scenario

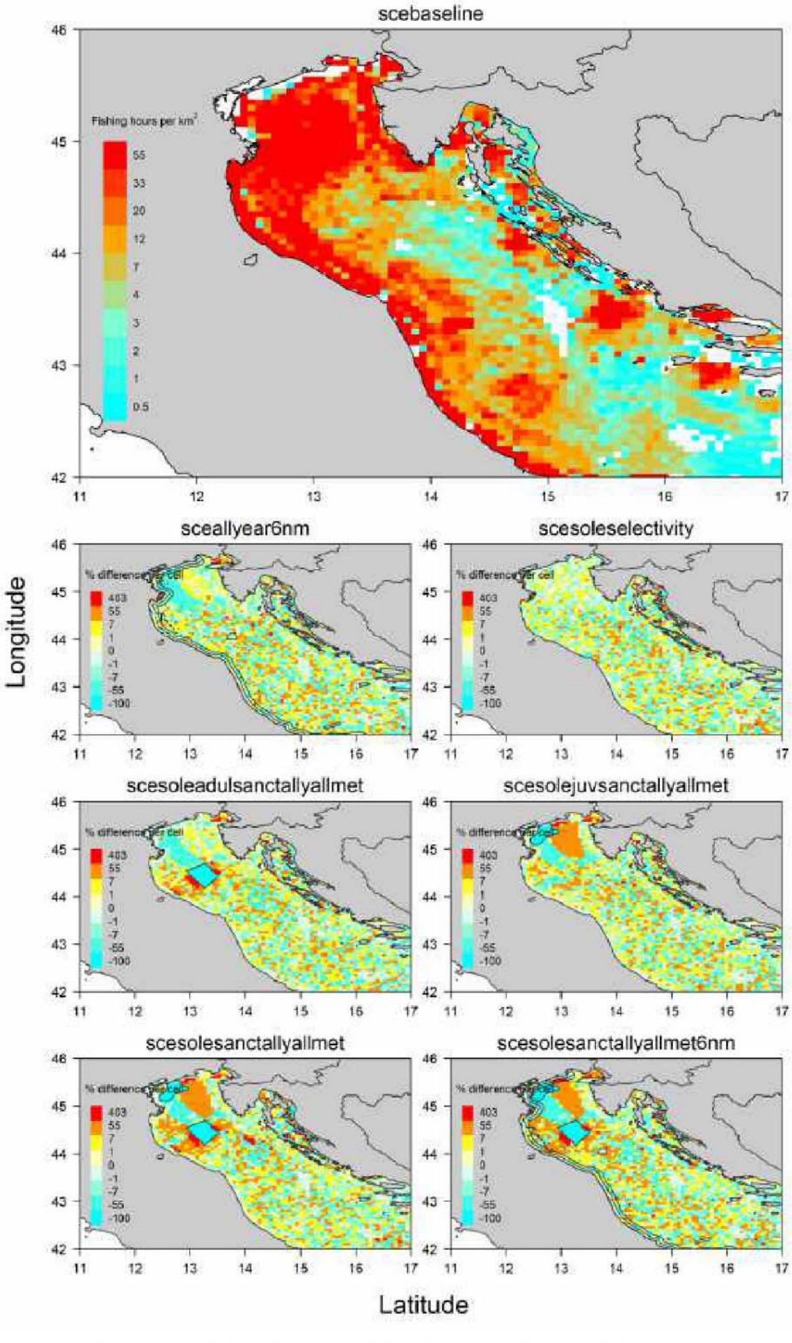

Figure 6.1.3.4 Baseline spatial distribution of the fishing effort and the percentage of relative change per scenario. Fishing efforts are given as the accumulated hours over the six-year simulation horizon averaged over the 20 replicates per scenario.

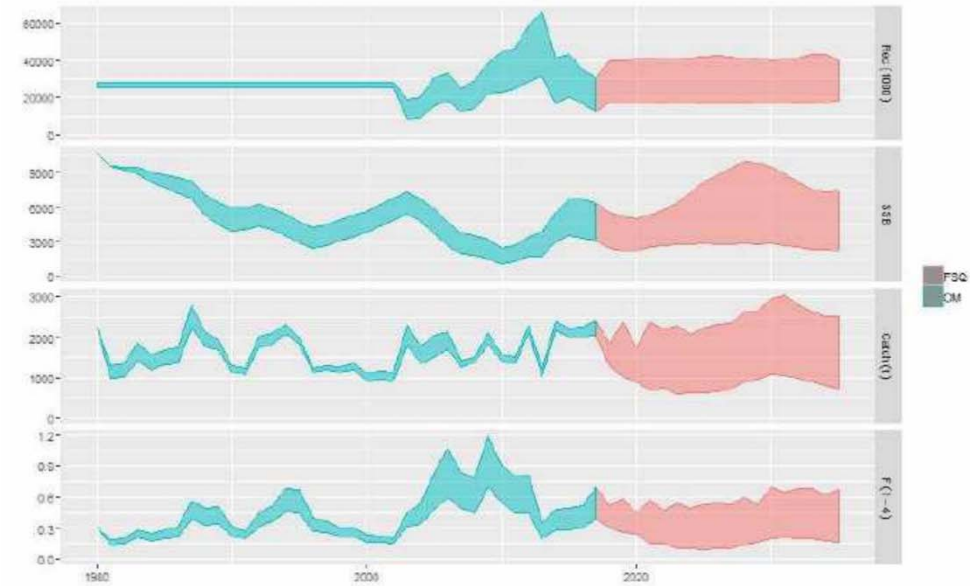

Figure 6.2.2 Projections from the baseline OM on a baseline scenario where F was modified in order to account for a spatial closure over the "sole sanctuary" (FsqFRA). SSB is the product of fecundity times the mean weight at age.

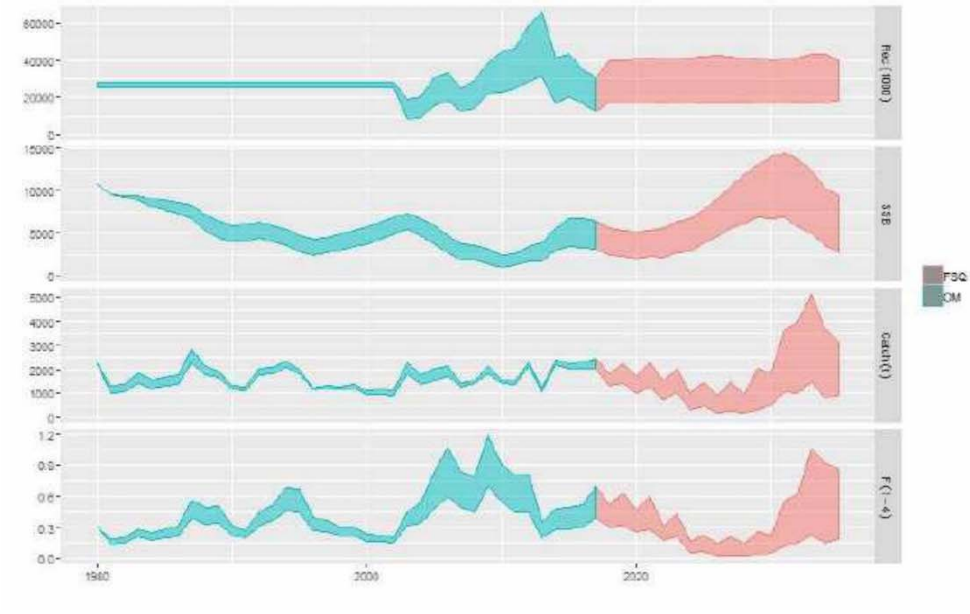

Figure 6.2.3 Projections from the baseline OM with a stepwise reduction of F up to 2024 scenario where F was modified in order to account for a spatial closure up to 6 nautical miles (Fsq6nm). SSB is the product of fecundity times the mean weight at age.