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Scientific, Technical and Economic Committee for Fisheries (STECF)

Western Mediterranean Multi-annual Plan

(STECF-15-09)

Edited by Ernesto Jardim & Giacomo Chato Osio

This report was reviewed by the STECF during its 49th plenary meeting held from 6 to 10 July 2015 in Varese, Italy

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Abstract

In response to TORs from DG MARE concerning GSA 06 and 07, the objectives of the EWG were: the computation and testing of Fmsy ranges for the relevant stocks that had stock assessments and reference points, (ii) the evaluation of the management options suggested by DGMARE; (iii) the analysis of the economic dependency of the fleet on the stocks included in the MAP and the employment generated by these fleets. In cases (i) and (ii) the simulations were ran using Management Strategies Evaluation (MSE) algorithms, developed during the group. STECF concluded that the exploitation levels of the stocks studied are very high (F > 1) and concentrated on young ages. This substantial over-exploitation is severely undermining the potential yield that could be obtained from these stocks and is likely to keep the biological risk of collapse at high levels. STECF also concludes that hake in GSA 6 shows a clear pattern of decreasing recruitment and a high exploitation rate, which is estimated to be approximately 10 times FMSY (STECF-14-17), and focused on recruits and individuals of age 1. This situation requires immediate reduction in fishing mortality to try to prevent further deterioration in the state of the stock. STECF considers that management actions to halt the current decline and rebuild stocks be identified and implemented as quickly as possible. STECF concludes that, although differences between the implementation of a MAP (option 3) and not implementing a MAP (option 2) are not clear, a MAP may be a more effective tool to steer the fishery towards achieving the CFP objectives. STECF notes that despite the requirement for the sustainable exploitation has been a requirement under the CFP 2002 (Article 2.1., Council Regulation (EC) No 2371/2002), no decrease in F is apparent for that period in the assessments performed by the EWG. STECF concludes that achieving the MSY policy targets will require a large cut in catches either through substantive reductions in effort or the introduction of catch limits. STECF notes that, although in the long term catches are expected to recover, as a result of the increase in biomass, in the short term the benefits of rebuilding will not be immediate, because there is a delay in rebuilding stocks, and therefore there may be considerable short term implications for the sector, namely in terms of revenues and employment.

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Western Mediterranean Multi-annual Plan (STECF-15-09)

THIS REPORT WAS REVIEWED DURING THE PLENARY MEETING HELD IN Varese, Italy, 6-10 July 2015

Request to STECF

STECF is requested to review the report of the STECF Expert Working Group meeting, evaluate the findings and make any appropriate comments and recommendations.

Observations of the STECF

Given the generic approach undertaken for the evaluation of Multi-annual plans associated with the North Western Waters and the South Western Waters Region, the STECF evaluation of the relevant sections North Western Mediterranean of EWG 15-09 are considered here in the following evaluation. STECF evaluation of Multi-annual plans for the North Western and South Western Waters (EWG 15-09/EWG 15-04) can be found in Section **Error! Reference source not found.** of his report.

STECF observes that in all stocks tested the exploitation rate is largely above the targets and would benefit from the implementation of a MAP that aligns the exploitation with the CFP objectives.

STECF observes that the difference between reaching F_{MSY} in 2020 or 2018 is most likely an overestimation due to the lack of mixed fisheries interactions, which would constrain the intended decrease. In the cases tested the distinction between the baseline scenario and the MAPs was not very evident. The large decrease in F required to align the exploitation with MSY, blurs the effects of exploiting the stocks at relatively small differences in F that the F_{MSY} ranges provide.

STECF notes that the Spanish economic fleet segments of demersal trawls and seiners (DTS) with length overall 12-18m, 18-24m and 24-40m, are among the largest employers and are very dependent on the species likely to be under the MAP.

STECF notes that there are areas of non-overlapping between the target stocks (hake, mullet, etc.) and *cephalopods* and *sparidae*, which suggests that managing the target species will only have a limited constraint on the exploitation of these groups.

STECF observers that most fleets concentrate their exploitation on young ages: age-classes 0, 1 (e.g. hake in GSA 6), although in the case of crustaceans, age classes 2 and 3 are also important if not dominant (e.g. *Parapenaeus, Nephrops*).

STECF notes that for the stocks hake in GSAs 6 and 7, red mullet in GSA 6, deep water rose shrimp in GSA 6 and red shrimp in GSA 6, the EWG computed proxies for F_{MSY} ranges using a meta-analysis, and tested the robustness of the upper levels to mis-specifications of M and S/R. In the case of deep water rose shrimp the upper range was not robust as there remains a relatively high probability of $SSB < B_{lim}$, which means that the upper level of the F_{MSY} range is not precautionary.

As the safeguards do not operate in the cases studied, STECF notes that this is due to the large increase in biomass that the simulations show. As such, the impact of having safeguards could not be evaluated.

STECF observes that mixed fisheries methods dealing with all the relevant species in the areas of the MAP were not available. The EWG developed single species, single fleet MSEs in FLR/a4a to deal with the ToR.

As for the stocks studied there are no biological management references set, e.g. B_{pa} or B_{lim}, STECF notes that the approach applied was to compute B_{pa} using a multiplier (1.4) of the minimum biomass observed.

In most cases explored, the distance between current F and the F_{MSY} targets is very high. Therefore, STECF observes that the decrease in F simulated, drives the stocks to biomasses unseen in the recent past, which raises concerns about the assumptions made for population dynamics, in n particular for the hake stocks. STECF notes that the absolute values in future stock size and associated catches should therefore be treated with some caution, and should be used as indicative of possible stock and catch developments if fishing mortality were reduced to F_{MSY} levels.

STECF observes that building a time series of catch at age by fleet will provide the basis for fleet based forecasts and management testing. This task would require considerable effort of digitizing and exploiting existing length frequency data in specific fisheries research centres.

STECF notes that the analysis was limited by availability of data, assessments and time, while the economic analysis was limited due to inconsistencies in the data.

STECF observes that the analysis spatial persistence of abundance suggests that the FRA overlaps with an area of high abundance of hake, blue whiting, red shrimp and *Nephrops*, although the models used by the EWG were not suited to estimate the precise impact of this area.

STECF conclusions

STECF concludes that the exploitation levels of the stocks studied are very high ($F > 1$) and concentrated on young ages. This substantial over-exploitation is severely undermining the potential yield that could be obtained from these stocks and is likely to keep the biological risk of collapse at high levels.

STECF concludes that hake in GSA 6 shows a clear pattern of decreasing recruitment and a high exploitation rate, which is estimated to be approximately 10 times F_{MSY} (STECF-14-17), and focused on recruits and individuals of age 1.

STECF concludes that this situation requires immediate reduction in fishing mortality to try to prevent further deterioration in the state of the stock. STECF considers that management actions to halt the current decline and rebuild stocks be identified and implemented as quickly as possible.

STECF concludes that, although differences between the implementation of a MAP (option 3) and not implementing a MAP (option 2) are not clear, a MAP may be a more effective tool to steer the fishery towards achieving the CFP objectives. STECF notes that despite the requirement for the sustainable exploitation has been a requirement under the CFP 2002 (Article 2.1., Council Regulation (EC) No 2371/2002), no decrease in F is apparent for that period in the assessments performed by the EWG.

STECF concludes that achieving the MSY policy targets will require a large cut in catches either through substantive reductions in effort or the introduction of catch limits. STECF notes that, although in the long term catches are expected to recover, as a result of the increase in biomass, in the short term the benefits of rebuilding will not be immediate, because there is a delay in rebuilding stocks, and therefore there may be considerable short term implications for the sector, namely in terms of revenues and employment.

REPORT TO THE STECF

EXPERT WORKING GROUP ON
Western Mediterranean Multi-annual Plans.
(EWG-15-09)

Varese, Italy, 6-10 July 2015

1 EXECUTIVE SUMMARY

2 INTRODUCTION

2.1 Background

2.1.1 Current management framework

Regulation (EU) No 1380/2013 (the new common fisheries policy – CFP "basic regulation") establishes the objectives and means for ensuring sustainable fisheries, including achieving maximum sustainable yield (MSY) with an exploitation rate (F_{MSY}) consistent with MSY by 2020 at the latest for all stocks.

Technical measures concerning management for sustainable exploitation of fishery resources in the Mediterranean Sea were established through a specific Regulation (Council Regulation (EC) No 1967/2006[1] - the "MEDREG") which was adopted by the Council in December 2006 and entered into force in January 2007. In addition to technical measures, the MEDREG contains management measures to be adopted by the Member States (e.g. obligation to adopt national management plans for certain fisheries and/or specific gears).

The new CFP also introduces a landing obligation, which means that unwanted catches of species that are subject to catch limits and, in the Mediterranean, also catches of species which are subject to minimum sizes as defined in Annex III of the "MEDREG", can no longer be discarded. The entry into force of this obligation is phased-in according to a specific calendar but the latest deadline is 1 January 2019.

2.1.2 National management plans

Under Article 19 of the "MEDREG", Member States shall adopt management plans for fisheries conducted by trawl nets, boat seines, shore seines, surrounding nets and dredges within their territorial waters. Measures to be included shall pursue a

[1] COUNCIL REGULATION (EC) No 1967/2006 of 21 December 2006 concerning management measures for sustainable exploitation of fishery resources in the Mediterranean Sea. OJ L 409, 30.12.2006, p. 11.

sustainable exploitation of the marine biological resources, while minimising the impact on marine ecosystems. After revision by the STECF, Member States have adopted 34 "national" management plans for fisheries conducted with trawl nets, purse seiners, shore seines, boat seines and dredges. In particular, in the geographical area which would be covered by this initiative, the following national management plans are currently in force and cover most of the species that would be relevant for the proposed multiannual plan: (i) French management plan for trawlers; and (ii) Spanish management plan for purse seines, trawlers, longliners and smaller gears. Supporting documents listed in Annex I to this Report provide more information.

2.1.3 International dimension

In 2009, the General Fisheries Commission for the Mediterranean (GFCM) adopted a recommendation establishing a Fisheries Restricted Area in the Gulf of Lions (GFCM-geographical sub area 7[2]) with a surface of 2051 km^2, to protect spawning aggregations and deep sea sensitive habitats. The recommendation froze the fishing effort for demersal stocks of vessels using towed nets, bottom and mid-water longlines, bottom-set nets at the level applied in 2008[3].

2.2 Commission proposal for a multiannual plan for demersal fisheries in the North-western Mediterranean waters

2.2.1 Scope

The geographical scope is the North-Western Mediterranean waters, meaning the GFCM-Geographical Sub-Areas 6 (Northern Spain) and 7 (Gulf of Lions).

The plan shall cover demersal stocks, in particular the stocks of hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), blue whiting (*Micromesistius poutassou*), monkfishes (*Lophius spp.*), poor cod (*Trisopterus minutus*), and the

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[2] GFCM Geographical Sub-Area' means General Fisheries Commission for the Mediterranean (GFCM) Geographical Sub-Area as defined in Annex I to Regulation (EU) No 1343/2011 of the European Parliament and of the Council of 13 December 2011 on certain provisions for fishing in the GFCM (General Fisheries Commission for the Mediterranean) Agreement area and amending Council Regulation (EC) No 1967/2006 concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea (OJ L 347, 30.12.2011, p. 44).

[3] Rrecommendation GFCM/33/2009/1 on the establishment of A Fisheries Restricted Area in the Gulf Of Lions to protect spawning aggregations and deep sea sensitive habitats

crustaceans deep-water rose shrimp (*Parapenaeus longirostris*), blue and red shrimp (*Aristeus antennatus*) and Norway lobster (*Nephrops norvegicus*).

The main fishing gears involved are trawlers, netters, and longliners.

2.2.2 General objective, targets and timeframe

To restore and maintain fish stocks above levels capable of producing maximum sustainable yield (MSY) by 2020 at the latest.

2.3 Terms of Reference

ToR 1. The STECF is requested to carry out quantitative analysis to support an impact assessment to assess the biological, economic and social consequences of implementing the various possible options described below, compared to the status quo/current scenario (or baseline). STECF is requested to indicate the potential advantages, disadvantages, synergies and trade-offs of those options.

OPTION 1 (baseline) – The current management framework will continue to apply. This includes the CFP Basic Regulation (1380/2013), the Mediterranean Regulation (1967/2006), as well as the national management plans adopted under the framework of its Article 19, and the Recommendation GFCM/33/2009/1.

OPTION 2 - Amending of the existing national management plans following the current CFP rules. Aspects that should be considered are: (i) scope in terms of stocks, fisheries and area (as indicated in the background section); (ii) introduction of MSY targets; (iii) time-frame to reach MSY (i.e. by 2018 and 2020); and (iv) objectives for conservation and technical measures to be taken (such as a reduction of fishing effort or spatio-temporal closures during the spawning period).

OPTION 3 – Adoption of an EU multiannual plan. The basic elements of the plan would contain all earlier mentioned elements (defined scope in terms of stocks, fisheries, area; introduction of MSY target; time-frame to reach MSY; objectives for conservation and technical measures to be taken and their timeframe, inclusion of provisions for the proper implementation of the landing obligation.), plus:

i. Descriptors for the MSY targets (in principle, FMSY-ranges, but it could also include other descriptors recommended by science and applicable when F estimates are not available).

ii. Safeguards or reference values associated with undesirable stock developments, below which specific and strong management action would be required. Normally, these would be measured in terms of spawning stock biomass, but again, science could indicate other possible safeguards than biomass.

Under Option 3, further sub-options shall be considered, especially in terms of: (i) to achieve MSY level by 2018 or 2020 at the latest (with diversity per stock); (ii) to rebuild a stock that is outside safe biological limits (in short/medium/long term); and (iii) the mixed nature of the fisheries concerned, i.e. whether and how the plan will be governed by one, two or more exploited stocks acting as target or by-catch.

ToR 2. The expert is also requested to evaluate whether other stocks such as cephalopods and species of family Sparidae will be sufficiently protected through the management measures proposed to achieve FMSY for the stocks mentioned in the scope. Identify those stocks that would need specific conservation measures.

2.4 Addressing the ToRs

To address the first ToR the EWG split the analysis in three tasks: (i) the computation and testing of Fmsy ranges for the relevant stocks that had stock assessments and reference points, (ii) the evaluation of the management options suggested by DGMARE; (iii) the analysis of the economic dependency of the fleet on the stocks included in the MAP and the employment generated by these fleets. In cases (i) and (ii) the simulations were ran using Management Strategies Evaluation (MSE) algorithms, developed during the group.

With regards to the ToR 2, the EWG used the persistent spatial distribution computed from MEDITS and compared the overlap across the main stocks and the stocks of cephalopods and sparidae. The existence of non-overlapping areas will show evidence about the fleet's capacity of decoupling the effort allocated to the main species from the one allocated to these stocks. If such cases exist, the management measures targeting the main species are not likely to protect these stocks.

2.5 Description of the fisheries

The description of the fisheries was focused on GSA06 due to time constraints. Annex I presents more detailed information about the fisheries and the stocks.

2.5.1 The stocks

Although low primary production in the Mediterranean determines that fisheries are not of great importance from the point of view of catches when compared to Europe's Atlantic fisheries, fishing has a long tradition, which combined with the diversity of habitats has led to the variety of fisheries that we can currently observe. Moreover, the Mediterranean coast is an touristic area of great importance, which means that the commercial value of the species is high, although the amount of catches is relatively moderate compared to other marine areas of high productivity.

For example, the total landings, accounting for all species in the GSA 6 show a decreasing trend in the period studied (1998-2013). Starting from a peak of nearly 100 000 t in 2000, slowly decreasing to 63 000 t in 2013, with an average of 75 000 t in the considered period.

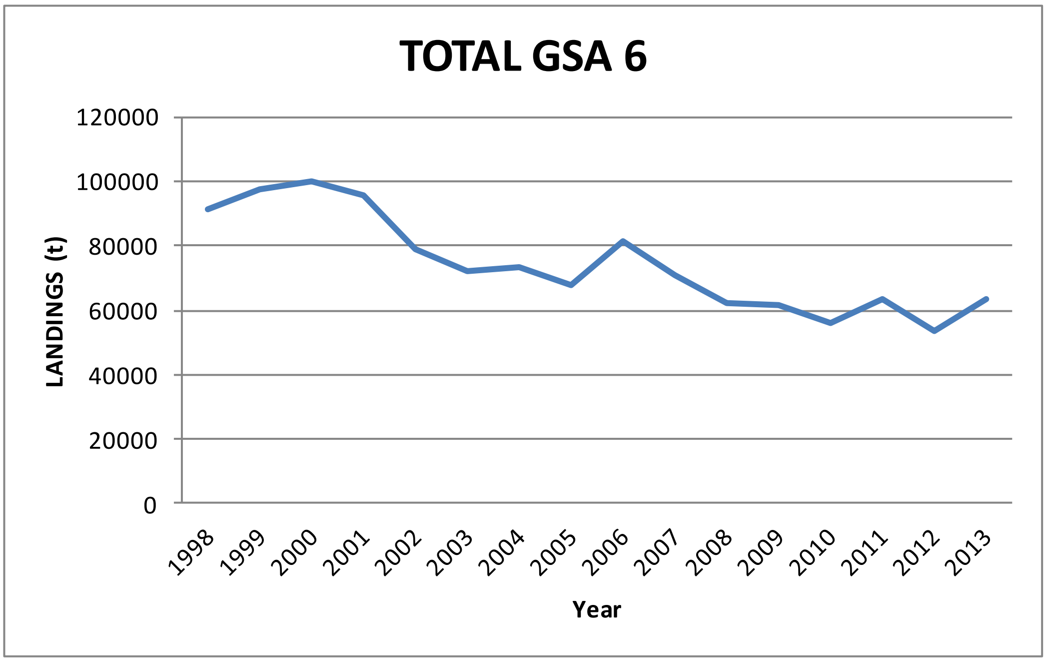


Figure 2.1 Total landings evolution in GSA 6 in the period comprised between 1998 and 2013.

Nevertheless, despite the decline in landings, the economic volume generated at first sale was stable in the same period, with an average total value of 221 million Euros per year.

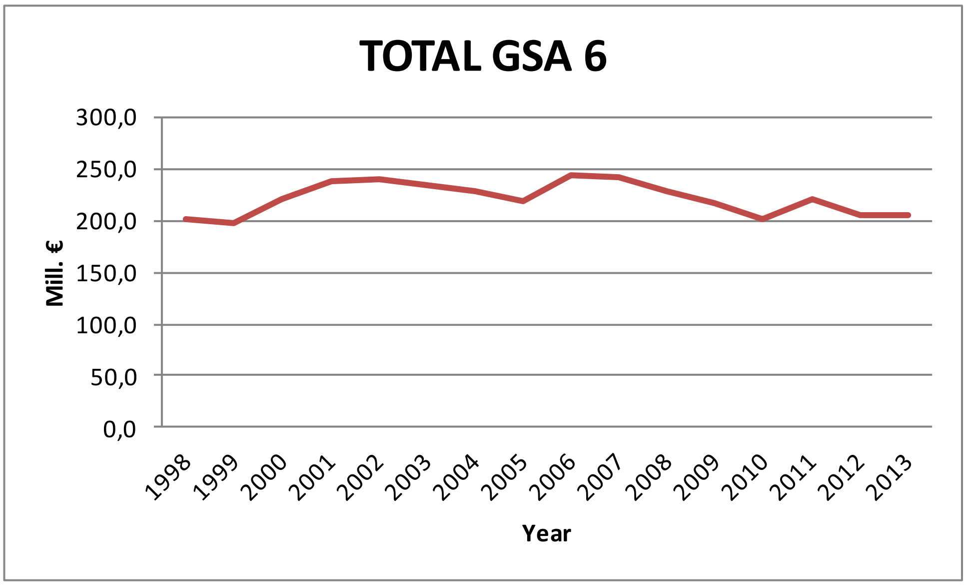


Figure 2.2 Evolution of total value of landings in GSA 6 in the period comprised between 1998 and 2013.

Species composition

The main target species of the demersal trawl fisheries are hake (*Merluccius merluccius*), red mullets (*Mullus spp*), white shrimp (*Parapenaeus longirostris*), Blue and red shrimp (*Aristeus antennatus*), Norway lobster (*Nephrops norvegicus*), octopus (*Octopus vulgaris* and *Eledone cirhosa*) and anglerfishes (*Lophius spp.*).

Benthic and demersal species are exploited by the semi-industrial trawler fleets as well as artisanal vessels. Artisanal fisheries are characterized by high diversity of species caught and by the absence of large monospecific stocks. Although the number of artisanal vessels is important in some areas with high social impact, catches account for only a very small part of the total. Overall, artisanal fishing is characterized by the diversity of fishing gears and caught species, the high market value thereof, almost no incidence of discards and the form of exploitation of resources, more selective and adapted to the seasonal changes of abundance. The dominant gears are gillnets, trammel nets and other nets.

2.5.2 Fishery

The Gulf of Lions supports fisheries that include bottom and pelagic trawls, purse seines, gill nets and longlines, and is furthermore an important spawning area for many pelagic and demersal species. The demersal fisheries are multi-species and multi-gears fisheries. The marine living resources of the Gulf of Lions are a “shared stock” which is essentially exploited by French and Spanish fishing boats. The main part of the fishing grounds exploited by these boats cover the entire continental shelf from the coastline to the 200 m isobath, with an area of some 14 000 km^2 covered by sandy deposits. This particular geomorphology has been conducive to the development of trawling. Off the French coasts, the Spanish fishing activity was confined at first to a restricted zone included between 6 and 12 miles, from the French-Spanish border up to Cap Leucate (the so called "zone of the border treaty" 1967-68). At the beginning of the 80s this activity extended offshore and to the east of the continental shelf.

Benthic and demersal species are exploited by the semi-industrial trawler fleets as well as artisanal vessels. Artisanal fisheries are characterized by high diversity of species caught and by the absence of large monospecific stocks. Although the number of artisanal vessels is important in some areas with high social impact, their catches account for only a very small part of the total.

Most of the landings of demersal species come from the bottom trawl fleets. The multispecies nature of the bottom trawl fishery is evident if we consider that catches can produce several hundreds of species from different taxonomic groups. Consequently, the proportion of discards is very high, up to 77% of species and 30-40% of the total weight caught. The exploitation extends to both the continental shelf and the continental slope, the predominant species at landings vary with depth.

Discard rates for target species such as blue and red shrimp, white shrimp, mullets and octopus are very low, typically less than 10% for fish species and lower for the two shrimp species (<2%). Discards of red mullet in GSA 6 represent less than 2.5% of the total catch (STECF 2014).

2.5.3 Historical Landings

Current stock assessments performed by STECF or GFCM mostly rely on time series of fisheries data starting around year 2000 or later. Generally historical catches are not considered as background information but can be informative of the past exploitation history and can be a proxy of the stock productivity. In the context of projecting forward population trajectories and catches under the different options in TOR 1, the historical landings can be of use for checking if the projected catches are in the order of magnitude of the past landings.

The official landings from GFCM were downloaded from FAO FISTATJ and only data from Gulf of Lions and Balearic were retained. The first area coincides with GSA 07, the second is a wider area than just GSA 06, but the bulk of the catches is from GSA 06, so the trends in landings should be representative of the area.

Hake landings show cyclical oscillating patterns with a steady decline for the Gulf of Lions since 1994, while in the Balearic area there does not appear to a trend over time (Figure 2.3).

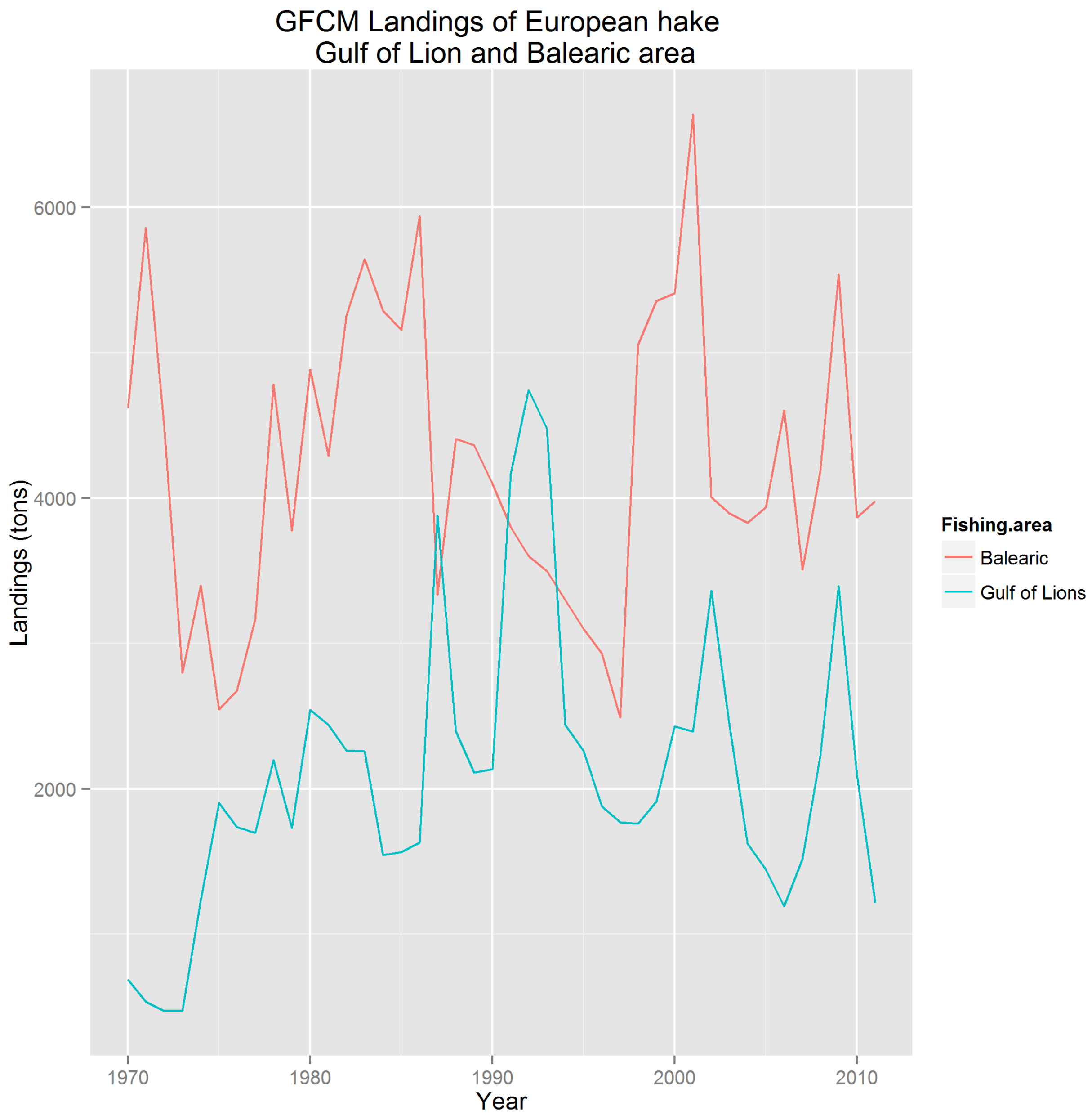


Figure 2.3 Historical GFCM landings for European Hake

Landings of Norway lobster show increasing trend in recent years in the Balearic area and no major trend in Gulf of Lions (Figure 2.4).

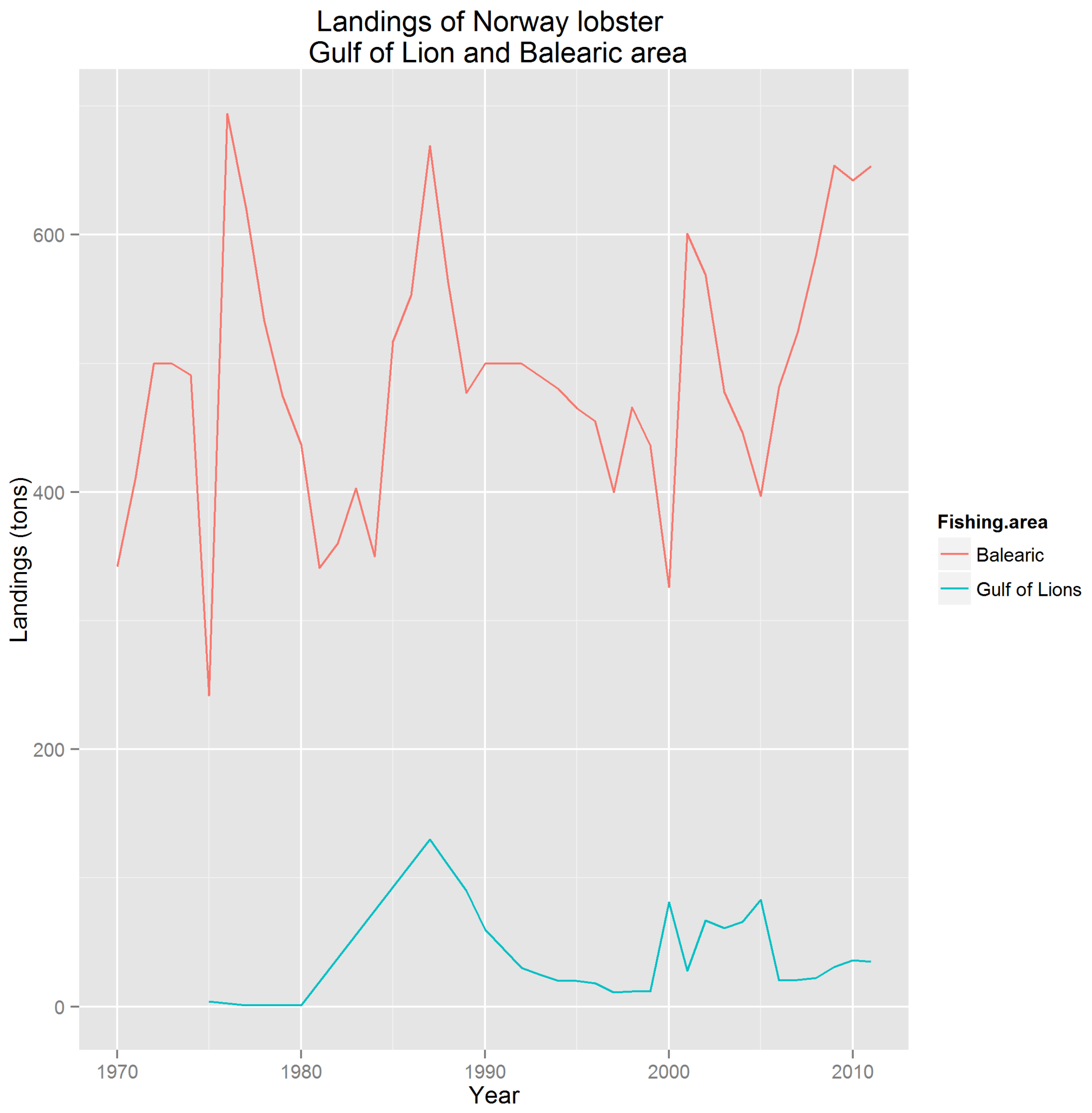


Figure 2.4 Historical GFCM landings for Norway lobster

Landing of Monkfish nei. show increasing trends in recent years in both areas (Figure 2.5).

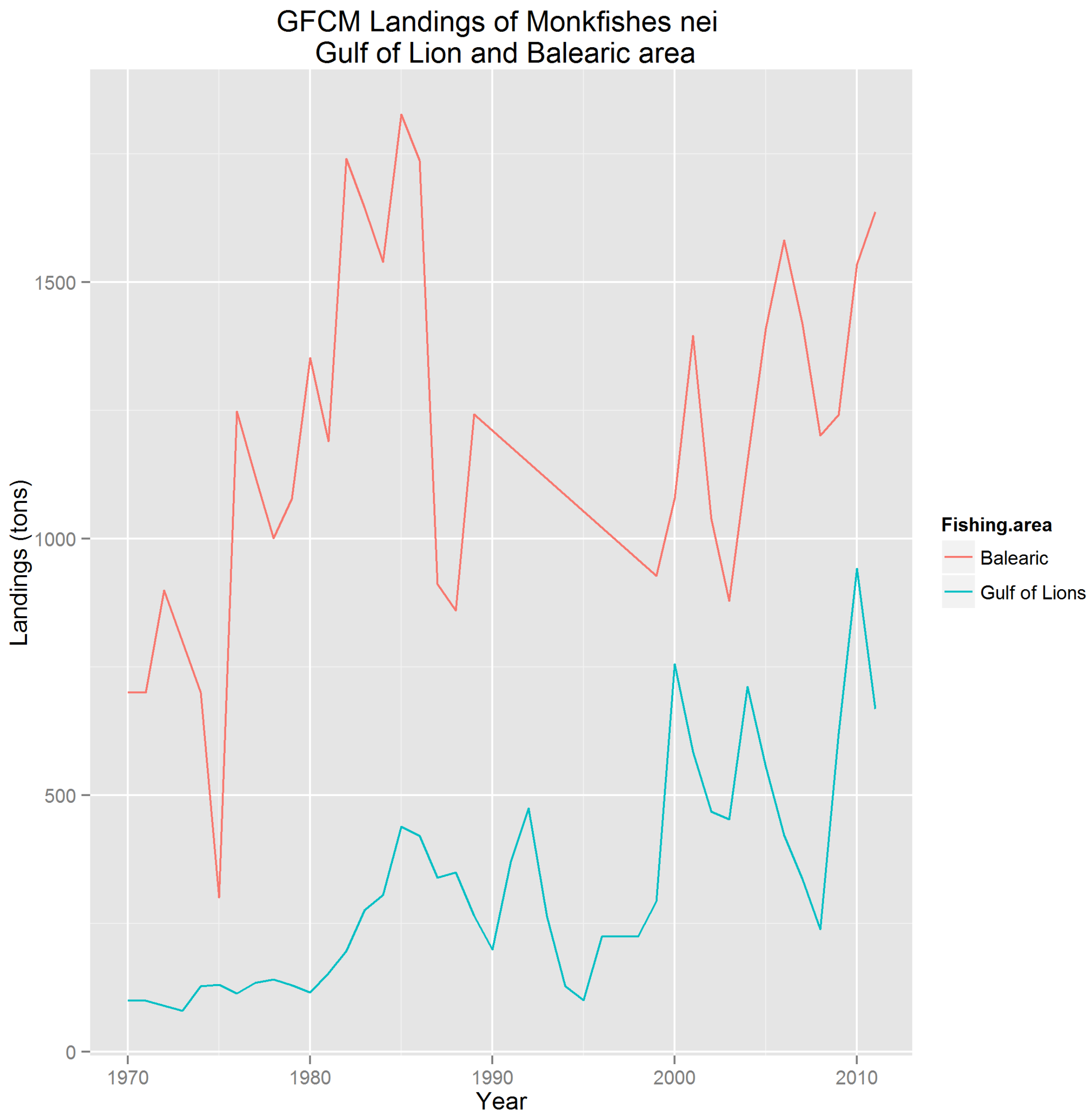


Figure 2.5 Historical GFCM landings for Monkfish nei

Historical landings of Red mullets reconstructed from GFCM series show a steep decline in the Balearic area and low levels in the Gulf of Lions (Figure 2.6).

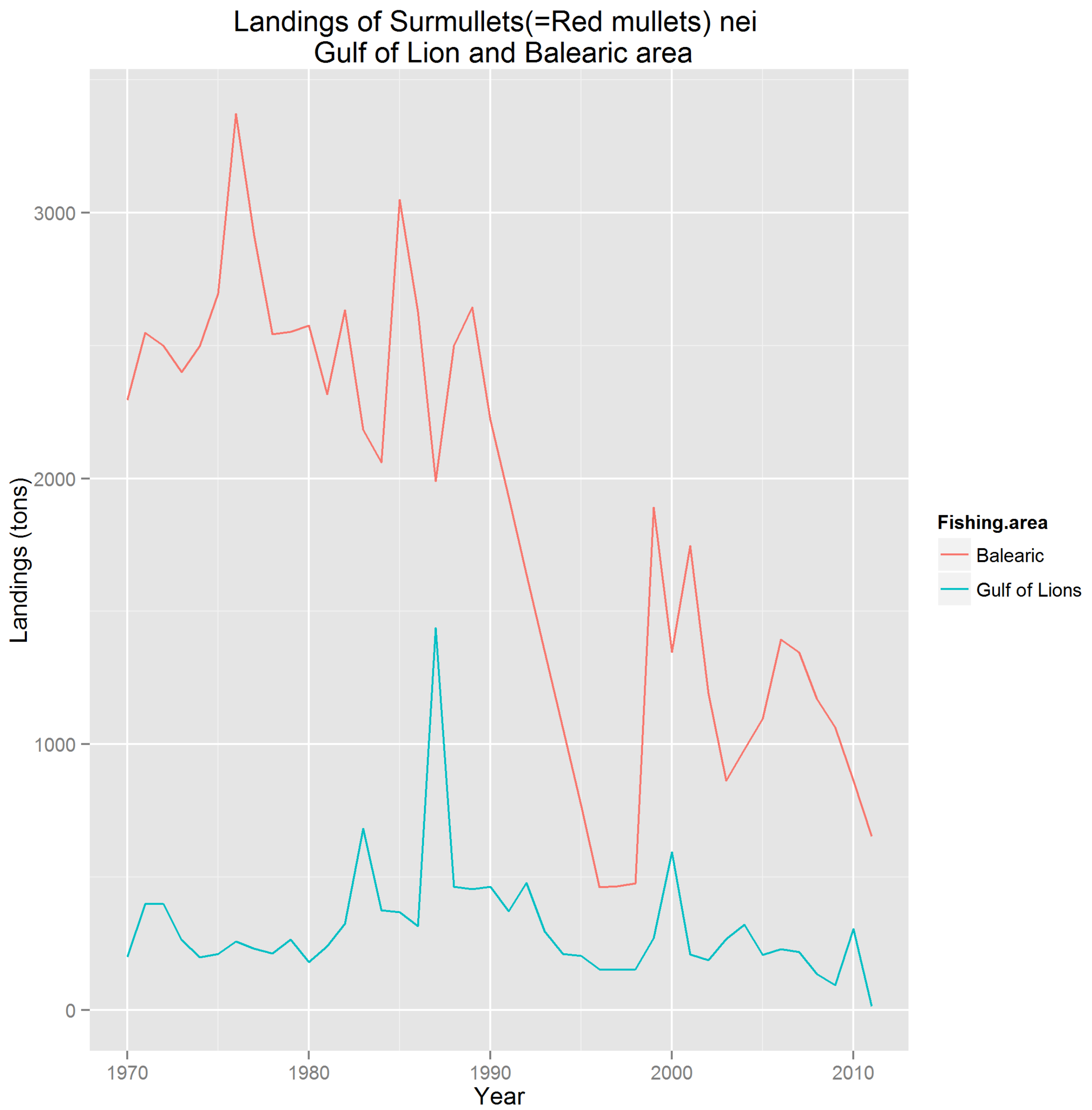


Figure 2.6 Historical GFCM landings of Red mullets

Deep water rose shrimp from GFCM show negligible landings values in Gulf of Lions and high past landings in the Balearic area (Figure 2.7).

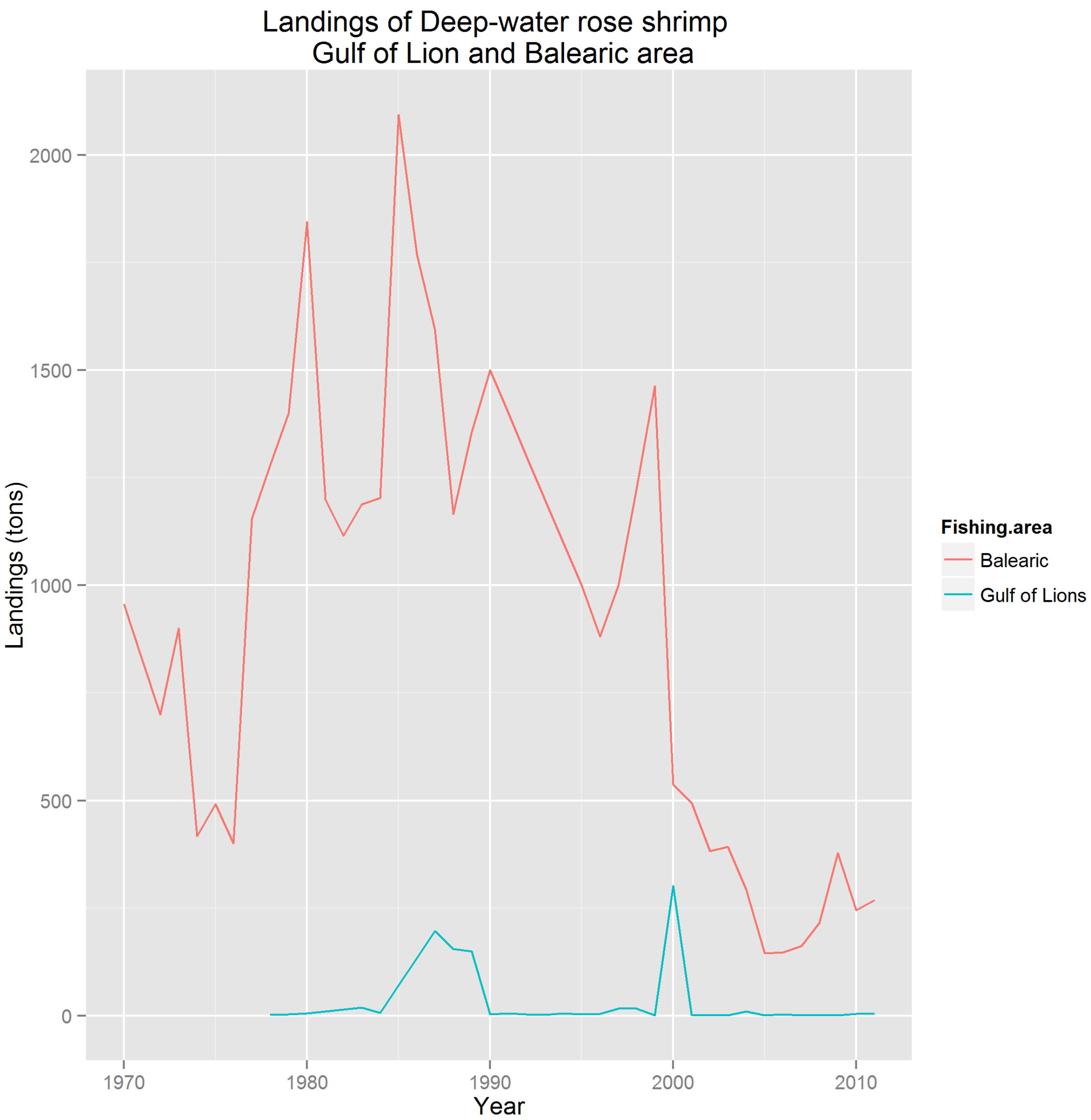


Figure 2.7 Deep water rose shrimp landings from GFCM.

Time series of landings from GFCM for Blue whiting show a historical high peak in 1978 and then a much lower level of landings in the Balearic FAO area, while in the Gulf of Lions landings stayed low with some fluctuations (Figure 2.8).

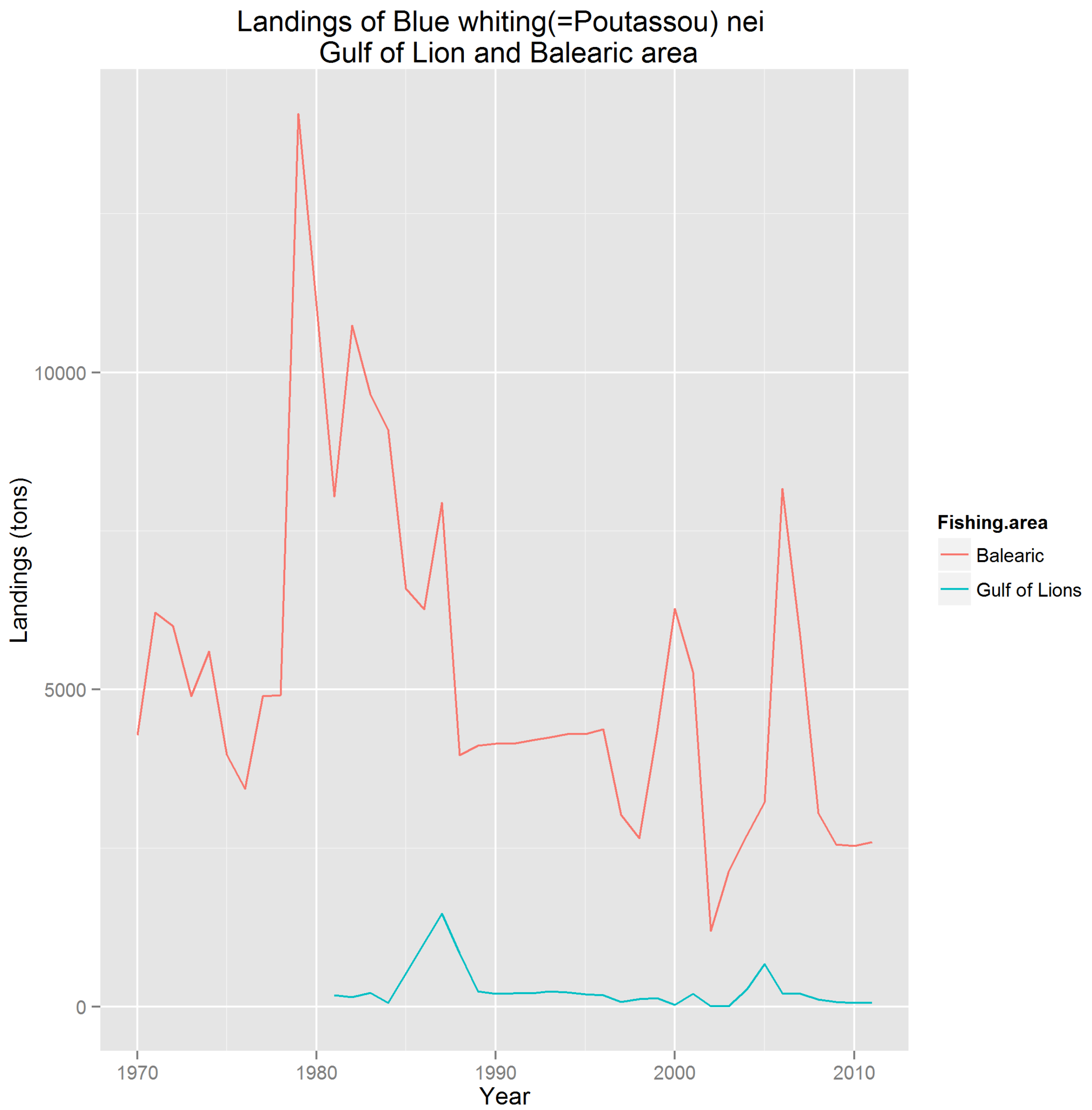


Figure 2.8 GFCM Landings of Blue whiting.

2.5.4 The fleet

The fishing activities (métiers) considered for reporting catch and effort data in the GSA 06 are shown in the following table:

Gear Group	Metier	Target species
	OTB-DES	Demersal species
Bottom otter trawl	OTB-DWS	Deep water species
	OTB-MDD	Mixed demersal and deep water species

Trammel nets	GTR-DES	Demersal species
Pots and Traps	FPO	Demersal species
Surrounding nets	PS-SPF. Purse seine	Small pelagic species
	PS-LPF. Purse seine	Large pelagic species
Longlines	LLD. Drifting longline	Large pelagic species
	LLS. Set longline	Demersal species

According to the more recent data of the Spanish Ministry Fleet register, the total fleet in the GSA06 accounts for a total of 1313 vessels. The fleet is composed mainly by artisanal vessels between 6 and 12 m of Overall length (LOA), and trawlers between 18 and 24 m of Overall length (Table 2.1).

Table 2.1 GSA 06 Mediterranean fleet. Source of data: Spanish Ministry fleet register (January 2015)

	Vessel Length	Nº vessels	Average GT	Average LOA	Average Kw
Artisanal fleet	VL<06	57	0.96	5.36	13.23
	VL0612	533	3.78	8.79	52.38
	VL1218	97	11.10	13.23	95.27
	VL1824	-	-	-	-
	VL2440	2	197.75	27.00	570.00
	Total	**689**	**5.14**	**9.18**	**56.88**
Otter bottom trawl	VL0612	15	8.35	10.33	47.20
	VL1218	111	24.15	15.56	99.11
	VL1824	215	58.95	21.10	262.05
	VL2440	107	99.28	25.54	430.43
	Total	**448**	**58.27**	**20.43**	**254.70**
Purse seine	VL0612	3	5.97	10.64	87.00
	VL1218	36	27.12	16.25	236.78
	VL1824	59	46.26	20.78	307.04
	VL2440	20	76.07	25.20	379.70
	Total	**118**	**44.45**	**19.89**	**292.33**
Purse seine (BFT)	VL2440	4	228.19	36.31	1175.75
	VL>40	2	349.80	43.43	1622.00
	Total	**6**	**268.73**	**38.68**	**1324.50**
Set longline	VL0612	21	4.29	9.01	75.05
	VL1218	10	14.39	13.29	140.50
	VL1824	1	33.69	18.00	270.00
	Total	**32**	**8.36**	**10.63**	**101.60**
Drifting longline	VL1218	16	14.95	13.97	89.12
	VL1824	4	47.76	19.40	225.75
	Total	**20**	**21.51**	**15.06**	**116.45**
TOTAL		**1313**	**28.33**	**14.24**	**153.62**

The number of vessels in this area has been continuously decreasing in the last decade, from more than 2080 vessels in 2004 to 1313 in 2015. The biggest reductions have taken place in the set longliners, the artisanal fleet and the bottom trawlers. Also the purse seine fleet has been continuously decreasing, from 164 vessels in 2004 to 118 in 2015. The number of drifting longliners and the purse seine for bluefin tuna is constant in these years (Figure 2.9).

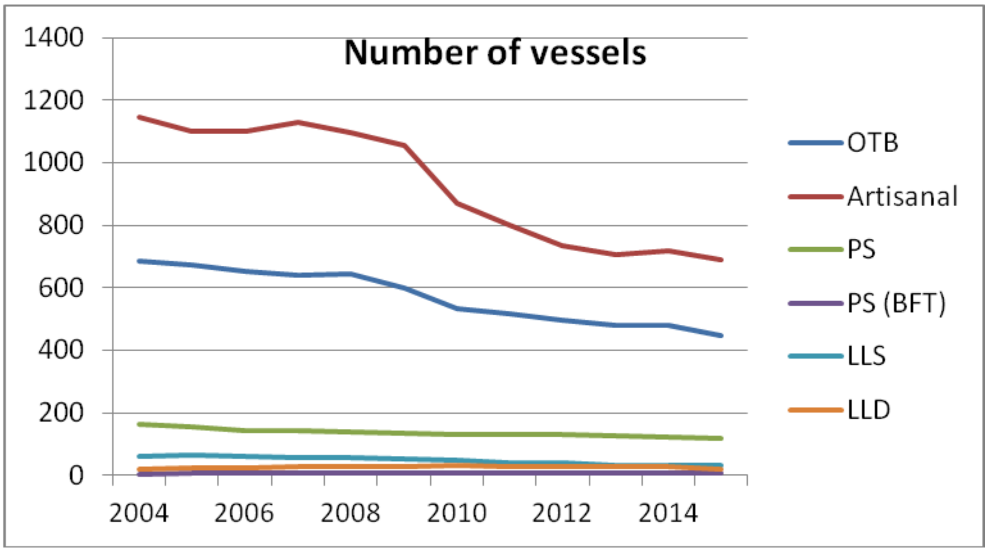


Figure 2.9 Evolution of the number of vessels in the GSA06. OTB: Bottom otter trawl; Artisanal: artisanal fleet; PS: purse seine; PS (BFT): purse seine for bluefin tuna; LLS: set longline; LLD: drifting longline.

2.5.5 Age composition of landings by species, sub-area and gear

Catches are given in weight (tonnes) and numbers (thousands).

Red mullet (*Mullus barbatus*) in GSA 6

Red mullet in GSA 6 is basically exploited by the Spanish bottom trawl fleet. Catches by other Spanish fishing fleets are low (GTR) or almost nil (GTN), according to official data.

	OTB	OTB	GTR	GTR	GTN	GTN
	Catch (t)	Number	Catch (t)	Number	Catch (t)	Number
2002	303.1	2305.1				
2003	1381.0	3384.0				
2004	1662.6	3666.6	30.2			
2005	569.5	2574.5	7.6			
2006	819.4	2825.4	7.3			
2007	712.8	2719.8	8.3			

2008	548.7	2556.7	10.1			
2009	509.2	2518.2	11.7	159.9		
2010	503.2	2513.2	11.3	280.9		
2011	928.5	2939.5			1.5	
2012	1014.5	3026.5	76.1	981.5	0.1	
2013	1160.9	3173.9	98.6	1745.3		

Catch-at-age data are available for OTB for the period 2002- 2013, and for GTR for the years 2009- 2010 and 2012- 2013. Considering the available data, the distribution of the catch-at-age, by gear, was the following:

Catch-at-age in numbers by gear expressed in %					
	age0	age1	age2	age3	age4+
OTB	3	67	23	2	0
GTR	0	3	2	0	0

Red mullet (*Mullus barbatus)* in GSA 7

Red mullet in GSA 7 is basically exploited by the French and Spanish bottom trawl fleets. Catches by other gears are low or nil.

	OTB-FR	**OTB-FR**	**OTB-SP**	**OTB-SP**	**GNS-FR**	**GTN-SP**
	Catch (t)	Number	Catch (t)	Number	Catch (t)	Catch (t)
2002	111.42		11.1			
2003	164.14		11.9			
2004	151.65		20.0	691.5		
2005	148.09		18.8	402.2		
2006	183.48	5133.1	29.9	1042.3		
2007	171.53	4835.0	34.7	766.2		
2008	110.49	2286.4	42.2	906.7		
2009	122.55	3438.2	26.0	670.7		
2010	218.03	6960.5	28.1	739.4		
2011	168.71	5341.6	22.1		30.0	0.125
2012	150.10	5399.6	29.3	756.1		0.168
2013	227.33	6801.1	37.5	1109.5		6.180

Catch-at-age data are available for OTB-FR for the period 2006- 2013, and for OTB-SP for 2004- 2013 (2011 excluded). Considering the available data, the distribution of the catch-at-age, by gear, was the following:

Catch-at-age in numbers by gear expressed in %					
	age0	age1	age2	age3	age4+
OTB-FR	30	35	16	3	1
OTB-SP	5	5	3	1	0

Blue and red shrimp (*Aristeus antennatus*) in GSAs 6 and 7

Blue and red shrimp in GSAs 6 and 7 is fished by Spanish OTB. Data for the French fleets was not available.

	OTB-SA6	**OTB-SA6**	**OTB-SA7**	**OTB-SA7**
	Catch (t)	Number	Catch (t)	Number
2002	198.0	6412.9	56.9	
2003	317.0	9442.0	59.6	
2004	377.3	34661.1	46.5	
2005	266.7	25092.1	10.7	
2006	365.4	33150.6	15.7	
2007	489.1	42989.8	43.7	
2008	552.6	54370.2	105.4	
2009	515.0	41298.9	85.1	3639.2
2010	508.9	39234.9	39.3	2319.3
2011	669.5	44453.4	54.5	4046.0
2012	718.2	49677.0	33.3	1587.5
2013	691.0	56793.0	51.7	2851.2

Blue and red shrimp catch-at-age in GSAs 6 over 2002- 2013, expressed in percentage, was the following:

Catch-at-age in numbers by gear expressed in %					
	age0	age1	age2	age3	age4+
OTB-SA6	35	59	6	1	0

Blue whiting (*Micromesistius poutassou*) in GSAs 6 and 7

Blue whiting GSAs 6 and 7 is fished by Spanish OTB. Data for the French fleets was not available.

	OTB-SA6	OTB-SA6	OTB-SA7	OTB-SA7
	Catch (t)	Number	Catch (t)	Number
2002	2409.3		97.0	
2003	1275.7		95.8	
2004	2591.3		84.3	
2005	2222.2		271.8	
2006	4722.8		292.2	
2007	4447.7		226.6	
2008	2194.2		269.7	
2009	1527.8	30911.1	92.0	34.1
2010	1321.3	31725.0	79.5	457.9
2011	2041.8	39521.8	118.7	685.6
2012	875.6	13968.3	110.3	648.3
2013	1173.7	19819.4	96.3	619.0

Blue whiting catch-at-age in GSAs 6 over 2009- 2013, expressed in percentage, was the following:

	Catch-at-age in numbers by gear expressed in %					
	age0	age1	age2	age3	age4	age5
OTB-SA6	2	85	12	1	0	0

Deep water pink shrimp (*Parapenaeus longirostris*) in GSAs 6 and 7

Deep water pink shrimp in GSAs 6 and 7 is fished by Spanish OTB. Data for the French fleets was not available.

	OTB-SA6	OTB-SA6	OTB-SA7	OTB-SA7
	Catch (t)	Number	Catch (t)	Number
2002	144.1	15831.9		
2003	116.0	10678.4		
2004	88.7	6968.1		
2005	35.3	2910.0		
2006	32.2	2650.6		
2007	31.8	2758.1		
2008	32.8	3350.5	0.01	
2009	49.1	3645.5	0.15	6.0
2010	72.2	5416.9	0.36	22.4
2011	68.5	4597.1	2.98	15.2
2012	86.4	6144.6	2.25	78.0
2013	87.6	6727.4	2.59	130.2

Deep water pink shrimp catch-at-age in GSAs 6 over 2002- 2013, expressed in percentage, was the following:

Catch-at-age in numbers by gear expressed in %							
	age0	age1	age2	age3	age4	age5	age6
OTB-SA6	0	25	55	17	3	1	0

Hake (*Merluccius merluccius*) in GSA 6

Hake in GSA 6 is exploited by the Spanish bottom trawl, gillnet and long-line fleets.

	GNS		LLS		OTB	
Year	Catch (t)	Number	Catch (t)	Number	Catch (t)	Number
2002	84.3		184.2		2566.3	150389.3
2003	159.2	336.1	123.9		4349.6	107999.5
2004	350.1	896.4	204.2		4836.2	49576.5
2005	179.0	383.9	134.6		2715.1	18270.4
2006	231.9	439.0	244.7		2961.3	23873.2
2007	187.1	376.0	229.1		2275.4	16496.4
2008	117.5	311.8	122.8		2993.6	22291.9
2009	180.9	570.2	95.4	82.0	3548.3	36040.7
2010	8.1	25.2	206.1	423.3	2601.8	19435.0
2011	91.7	230.6	178.6	294.0	3017.1	22401.1
2012	45.5	104.5	97.6	183.1	2664.9	20434.7
2013	27.5	65.8	200.5	197.3	2844.9	20710.8

Hake catch-at-age in SAs 6 over 2009- 2013, expressed in percentage, was the following:

Catch-at-age in numbers by gear expressed in %						
	age 0	age 1	age 2	age 3	age 4	age 5
GNS	0	0.1	0.2	0.2	0.0	0.0
LLS	0	0.0	0.2	0.2	0.1	0.1
OTB	36.5	49.4	9.6	2.6	0.5	0.2

Hake (*Merluccius merluccius*) in GSA 7

Hake in GSA 7 is exploited by the Spanish bottom trawl and long-line fleets, and the French bottom trawl and gillnet fleet. Catches of other small- scale gears are negligible (< 1 t reported in 2013). French data are presented by fleet segment. Data are presented in the following two tables.

	OTB-FR	OTB-FR	OTB-FR	OTB-FR	OTB-FR	OTB-FR	OTB-SP	OTB-SP
	VL1824 Catch (t)	VL1824 Number	VL1224 Catch (t)	VL1224 Number	Catch (t)	Number	Catch (t)	Number
2002	2385.7	39450.6					217.5	2505.6
2003	2215.1	17676.8					190.7	2125.7
2004			1111.4	11773.2			87.8	368.9
2005			125.5	11307.7			112.9	1121.7
2006			1123.4	7618.2			109.3	554.6
2007			1387.4	10136.3			105.0	653.8
2008			2271.1	23536.0			373.3	3012.2
2009			2694.1	16508.4			245.5	1867.5
2010			1673.0	16149.5			146.4	1035.2
2011			92.7	7980.7			92.7	977.0
2012			930.1	7943.2			162.2	1522.1
2013					1535.2	13960.9	1535.2	1341.8

	GNS-FR	GNS-FR	GNS-FR	GNS-FR	LLS-SP	LLS-SP
	VL1218 Catch (t)	VL1218 Number	VL0012 Catch (t)	VL0012 Number	Catch (t)	Number
2002	183.3	344.1			145.7	110.3
2003	253.8	520.0			59.0	57.1
2004	104.8	232.0			80.1	107.4
2005	3.2				100.8	138.9
2006	152.9	243.4			165.0	194.5
2007	173.2	229.3			142.9	147.6
2008	117.8	214.8			156.3	174.4
2009	247.4	84.4			99.6	157.7
2010	247.5	508.8			49.6	79.8
2011	6.1	715.3			38.8	31.8
2012			0.1	557.5	18.5	25.6
2013	5.8	16.1	155.6	434.2	18.2	

Hake catch-at-age in GSA 7 over 2006- 2011, expressed in percentage, was the following:

Catch-at-age in numbers by gear expressed in %

	age 0	age 1	age 2	age 3	age 4	age 5
LLS-SP	0.0	0.0	0.1	0.2	0.3	0.3
OTB-SP	0.5	6	2	0.4	0.1	0.1
OTB-FR	32.2	50.2	5.6	0.2	0.0	0.0
GNS-FR	0.0	1	1	0.1	0.0	0.0

3 DATA AND METHODS

3.1 Data

Table below shows the data available to the EWG and their sources. The short times series limits the EWG perspective of the stock productivity and fleet exploitation.

	S	Period	Gear	Fishery	Species
Landings	7	2002-	GNS GTR LLD OTB	DEMSP	
Discards (some years	7	2003-			OTB (HKE, MUT, ANK) GNS (HKE)
Effort	7	2009-			
Abundance (MEDITS)	7	1998-			
Economic data	7	2012			
Landings	6	2002-	GNS GTR LLD OTB	DEMSP	
Discards (some years	6	2005-			OTB (HKE, MUT, ANK, ARA, MON, NEP, GTR (MUT, ANK, MON)
Effort	6	2009-			
Abundance (MEDITS)	6	1994-			
Economic data	6	2012			

Data on the Spanish catch at age by fleet segment were submitted to the working group on Friday 19th morning (last day of the meeting). Unfortunately due to time constraint these data were not used in the meeting.

3.1.1 Data quality

A number of inconsistencies were found in the “catch” data of the DCF database. The examples below are taken from MUT and HKE in GSAs 6 and 7, but apply to other species.

Use of different weight units

- OTB MUT in GSA 7 weight by age class was expressed in kg in the period 2006- 2011, and in 2012- 2013 the unit used was g.
- GNS HKE expressed in g in 2011.

Use of different numbers units

- LLS HKE numbers unit in GSA 7 by age class used in 2013 was different from that used in the period 2002- 2012.
- OTB HKE landings unit in GSA 7 used in 2013 was different from that used in the period 2002- 2012.

Contents of the database (data missing)

- no data by age in HKE in GSA 7 from France.

Catch values(t) in the database different from those used in the most recent assessment

- OTB MUT (Spain) in GSA 7 catch data used in EWG14-09 are different from those in the data base in the period 2002- 2011, and the same in 2012- 2013.

3.2 Methods

3.2.1 Fmsy ranges

Provisional Fmsy ranges were computed based on a meta-analysis carried out using the estimates provided by ICES for the Baltic and North Sea. Two linear models were fitted to the data and the fits used to predict the upper and lower limit of the Fmsy ranges. See Annex V for details.

Afterwards, to test if exploiting a stock at the upper limit of the provisional Fmsy ranges obtained through the predictive linear models a MSE was developed. The test included testing the robustness of the upper limit to mis-specifications of natural mortality and low recruitment levels, with regards to keep the stock below 5% of biological risk.

3.2.2 *Management Strategies Evaluation*

To carry out the simulation work needed, the EWG developed a single species MSE (Figure 3.1). Annex IV shows the code, which was slightly adapted for each case.

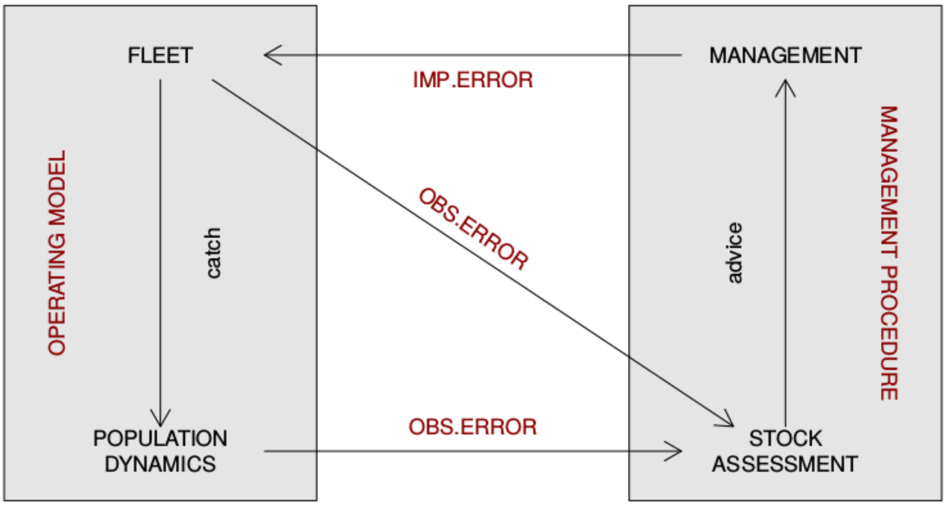


Figure 3.1 Scheme of Management Strategy Evaluation

The management procedures uses a full feedback model, with a a4a stock assessment, and the traditional 2 year forecast carried out by assessment working groups, to provide catch options under different scenarios.

The operating model is based on the official assessment, or an a4a assessment that mimics as close as possible the official assessment. Stock-recruitment is based on segmented regression models, although other models could be used, and error in recruitment is derived from the residuals of the stock-recruitment model fit.

The observation error model included error on survey catchability by age, derived from model estimates.

Implementation error is not considered.

The process is forecasted for 24 years and 250 iterations are used to describe uncertainty.

3.2.3 Testing management options

The options proposed in the ToR were implemented in the MSE's management procedure. The comparison between the results obtained for each option constituted the analysis of the consequences and benefits of each option.

The analysis is limited by the fact that the model used is a single species model, which didn't allow the EWG to fully test the effects of each option. Nevertheless, the results are consistent and valid as indications of the consequences of each option.

3.2.4 Economic dependency and employment

The economic dependency was computed by the percentage of the revenue by fleet that comes from the species likely to be in the MAP in FAO area 37 (Mediterranean sea). Employment was computed as the number of person employed and the full time equivalent in each fleet.

These two indicators allow the identification of fleets that are likely to be more impacted by the MAP and how much employment they provide. This way it will be possible to identify situations that have the potential to become problematic.

3.2.5 Spatial persistency

To address ToR 2, the EWG used the persistent spatial distribution and compared the overlap across the main stocks and the stocks of cephalopods and sparidae. The existence of non-overlapping areas will show evidence about the fleet's capacity of decoupling the effort allocated to the main species from the one allocated to these stocks.

The spatial persistency of a stock was computed by the average yearly abundance (number of individuals/swept area) scaled by the maximum observed abundance in each year, using data from the MEDITS survey. Scaling was used to compare across different species or groups of species in a standardized way.

This indicator provides an overview in space of areas that on average have large concentrations of abundance, independently of the year effect.

Spanish data (GSA 6) from 2009 and 2013 had problems of declaration of the fishing quadrant which was affecting the correctness of the haul positions, thus these years had to be removed from the analysis in from both GSA 6 and 7.

4 ToR 1

The STECF is requested to carry out quantitative analysis to support an impact assessment to assess the biological, economic and social consequences of implementing the various possible options described below, compared to the status quo/current scenario (or baseline). STECF is requested to indicate the potential advantages, disadvantages, synergies and trade-offs of those options.

Table 4.1 shows the reference points and life history parameters used by the assessments working groups to assess the status of the stocks in GSA 6 and 7, with the exception of those stocks that had reference points defined in national regulations. Table 4.2 shows the F reference points set by the regulations and the provisional Fmsy ranges obtained by the EWG.

The first step was to test if the provisional Fmsy ranges were precautionary with relation to keep the stock at levels of biological risk below 5%. Biological risk was defined as the probability in each year of the SSB falling below the minimum biomass estimated.

Secondly, the MSEs were run to forecast the impact of the each option and comparison across options were done.

Finally, the dependency of the fleets operating in the area with relation to the stocks likely to be included in the MAP and the employment each fleet provides, were computed.

Table 4.1 F reference points and life history parameters of assessed stocks in GSA 06-07

Stock	Species	GS	Yea	R	SSB	Landin	F	Fm	Meth	F_Fm	Comments	VBG			LENGTH/WEIGH		First	Report
												Linf	**k**	**to**	**a**	**b**	**length**	
HKE	Merluccius	6	20	1098	14	3119	1.4	0.1	XSA	9.87	F0.1	106	0.2	-	0.0048	3.12	32	HKE_6_EWG14_09
HKE	Merluccius	7	20	2124	78	1690	1.6	0.1	a4a	9.82	F0.1	100	0.2	NA	NA	NA	NA	HKE_7_EWG14_09
HKE	Merluccius	7	20									72.	0.2					HKE_7_EWG14_09
MUT	Mullus barbatus	6	20	8634	20	1245	1.4	0.4	XSA	3.27	F0.1	29	0.6	-0.1	0.0062	3.159	12.2	MUT_6_EWG14_09
MUT	Mullus barbatus	7	20	5312	12	297	0.4	0.1	XSA	3.21	F0.1	29	0.2	-1.28	NA	NA	NA	MUT_7_EWG14_09
WHB	Micromesistius	6	20	1148	34	1021	1.5	0.1	XSA	9.50	F0.1	45.	0.3	0	0.004	3.154	18	WHB_6_EWG14_09
DPS	Parapenaeus	6	20	1261	14	120	1.4	0.2	NA	5.48	XSA. F is	45	0.3	0.10	0.003	2.49	25.65	DPS_6_2013-
ARA	Aristeus	6	20	7545	92	670	1.0	0.3	NA	3.44	XSA. F is	77	0.3	-	0.0023	2.496	23.5	ARA_6_2012-
NEP	Nephrops	6	20	5965	47	497	0.7	0.1	NA	5	VIT. F is	72.	0.1	0	0.0003	3.157	NA	NEP_6_2013-
ANK	Lophius	6	20	9507	48	1048	0.9	0.1	XSA	4.8	XSA	102	0.1	-0.05	0.0232	2.845	NA	ANK_6_2015-
ANK	Lophius	7	20	NA	NA	355	NA	0.2	NA	NA	VIT	103	0.1	-0.05	0.0244	2.845	NA	ANK_7_2012-

4.1 Fmsy ranges

The official documents of French (JOE 2013, for GSA7) and Spanish (BOE 2012, for GSAs 5 and 6) management plans present target reference points for $F_{0.1}$. Since the two countries propose the strategy 0.1 as Target Reference Point we use $F_{0.1}$ in all cases. In the table (Table 4.2) these values are presented with the limits F_{low} and F_{upp} obtained from the parameters provided by EWG 15-06:

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

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

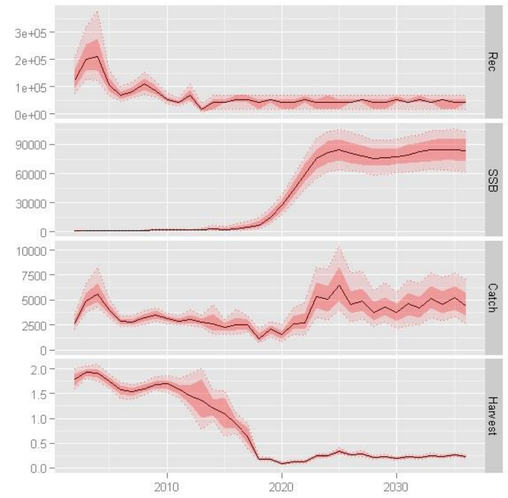
Table 4.2 $F_{0.1}$ estimated ranges

	GSA	$F_{0.1}$	F_{low}	F_{upp}
Mullus barbatus	5	0.33	0.22	0.45
Mullus barbatus	6	0.17	0.11	0.24
Mullus surmuletus	5	0.38	0.25	0.52
Merluccius merluccius	5	0.20	0.13	0.28
Merluccius merluccius	6	0.15	0.10	0.21
Merluccius merluccius	7	0.20	0.13	0.28
Aristeus antennatus	5	0.33	0.22	0.45
Aristeus antennatus	6	0.24	0.16	0.33
Parapenaeus longirostris	5	0.31	0.21	0.43
Parapenaeus longirostris	6	0.30	0.20	0.41
Nephrops norvegicus	5	0.30	0.20	0.41

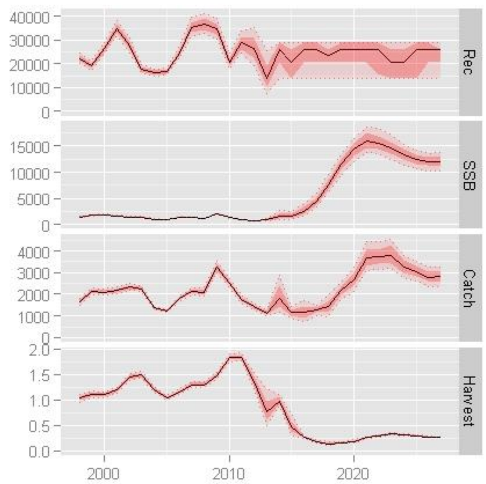
Projections to test the robustness for misspecification of natural mortality (M) and recruitment (R) were carried out. In some cases two runs were performed, one with R following a segmented regression model (or "hockey stick") and the other keeping R at the lower historical levels (Table 4.3). The number represents the probability of SSB to be lower than minimum historical levels of SSB ($B_{lim} = B_{loss}$)

Table 4.3 Projections to test the robustness for misspecification of natural mortality (M) and recruitment (R).

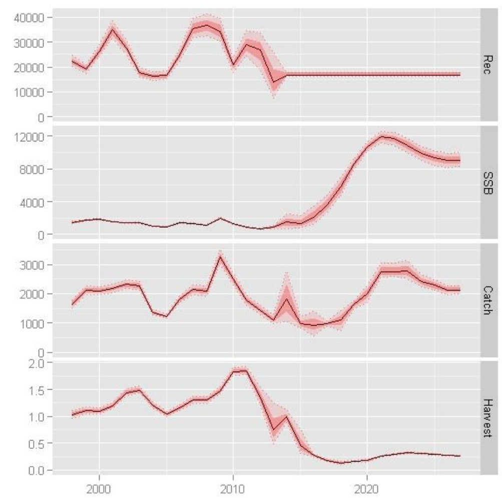
	Sp	GSA	$F_{current}$	$F_{0.1}$	Pr SSB < B_{lim} Robust	Pr SSB < B_{lim} Robust R Low
Merluccius merluccius	HKE	6	1.30	0.15		0
Merluccius merluccius	HKE	7	1.83	0.20	0	0
Mullus barbatus	MUT	6	1.90	0.17	0	0
Mullus barbatus	MUT	7	1.26			
Parapenaeus longirostris	DPS	6	1.402	0.30	0.24	0.14
Aristeus antennatus	ARA	6	1.05	0.24	0	0



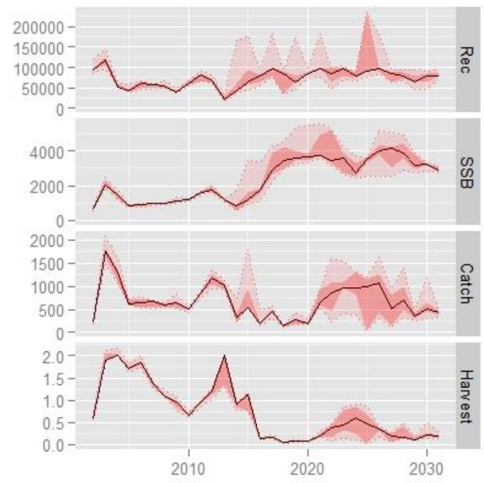
HKE 6 Robust, with low recruitment



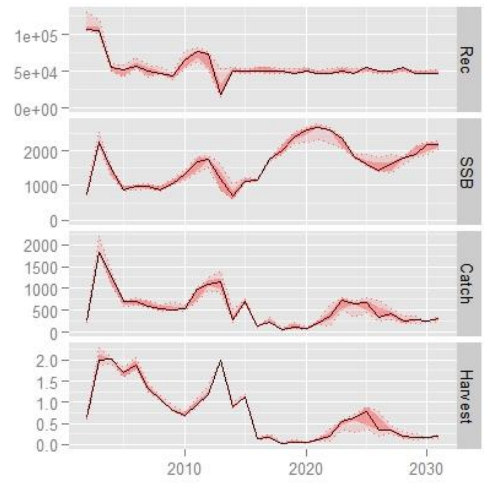
HKE 7 Robust



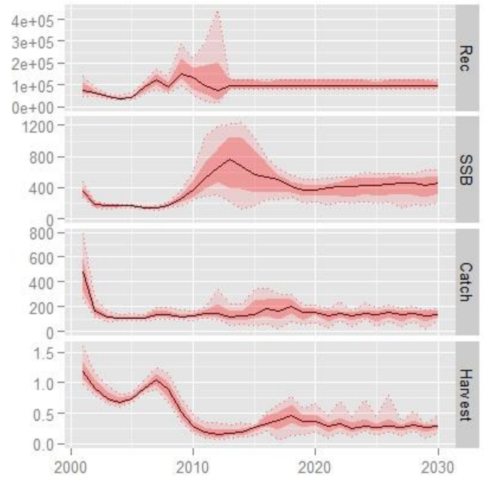
HKE 7 Robust, with low recruitment



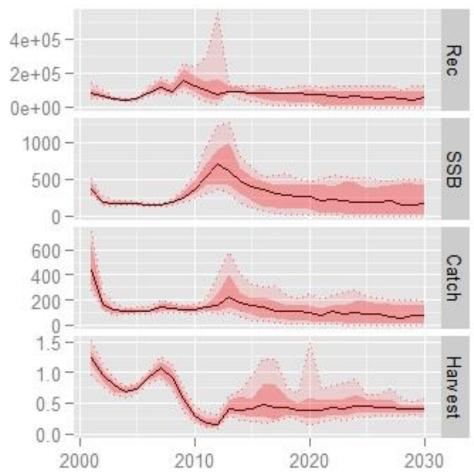
MUT 6 Robust



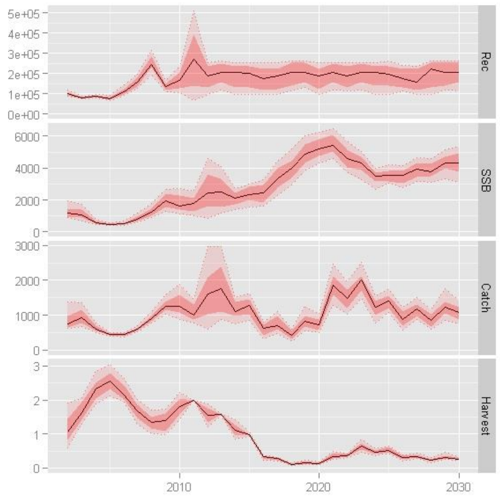
MUT 6 Robust, with low recruitment



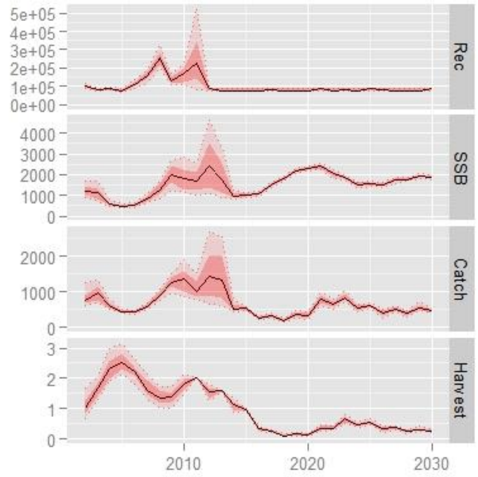
DPS 6 Robust



DPS 6 Robust, with low recruitment



ARA 6 Robust



ARA 6 Robust, with low recruitment

Figure 4.1 Testing of Fmsy ranges for Hake (HKE), Red shrimp (ARA), deep water rose shrimp (DPS) and red mullet (MUT).

With regards to hake in GSAs 6 and 7, the target F ($F_{0.1}$) is much lower than current F, so SSB rebuilds to very high levels and the probability of SSB < B_{lim} is 0 in all simulations.

Red mullet in GSA 6 shows a similar case, where the F target ($F_{0.1}$) is much lower than current F, although SSB rebuilds to levels more consistent with the historical data series. The probability of SSB < B_{lim} is 0 in all simulations.

For red mullet in GSA 7, the assessment results of this working group were not consistent with the official assessment and it was not possible to perform the robustness test.

With regards to deep water shrimp in GSA 6, the target F ($F_{0.1}$) is lower than current F but the biomass does not rebuild to very high levels, particularly under the low recruitment scenario, where both SSB and catch remain at low levels. There remains a relatively high probability of SSB < B_{lim} , which means that the upper level of the Fmsy range is not precautionary.

Blue and red shrimp in GSA 6 also have a target F ($F_{0.1}$) lower than current F but the biomass does not rebuild to a high level, particularly under the low recruitment scenario, suggesting that this robustness test is very sensitive to the recruitment specification. The probability of SSB < B_{lim} is 0 in all simulations.

4.2 Testing management options

4.2.1 Anglerfish in GSA 06

The figures and Table 4.4 below show the results of the MSE forecast of the options proposed by DGMARE applied to the stock of anglerfish (*Lophius piscatorius* and *L. budegassa*) in GSA 06.

Figure 4.2 shows the comparison between fishing at the current F and fishing at Fmsy levels. The reduction of F from the current exploitation to Fmsy, will allow the stock to increase its SSB to higher levels, which will reduce the biological risk from ~0.3 to zero (Table 4.4). Catches will stay at similar levels, although more variable due to the variability of SSB.

Due to the large decrease in F, to values outside the historical estimates, the biomass of the stock is also extrapolated outside historical limits. In this situation the dynamics forecasted are uncertain and should be considered with care.

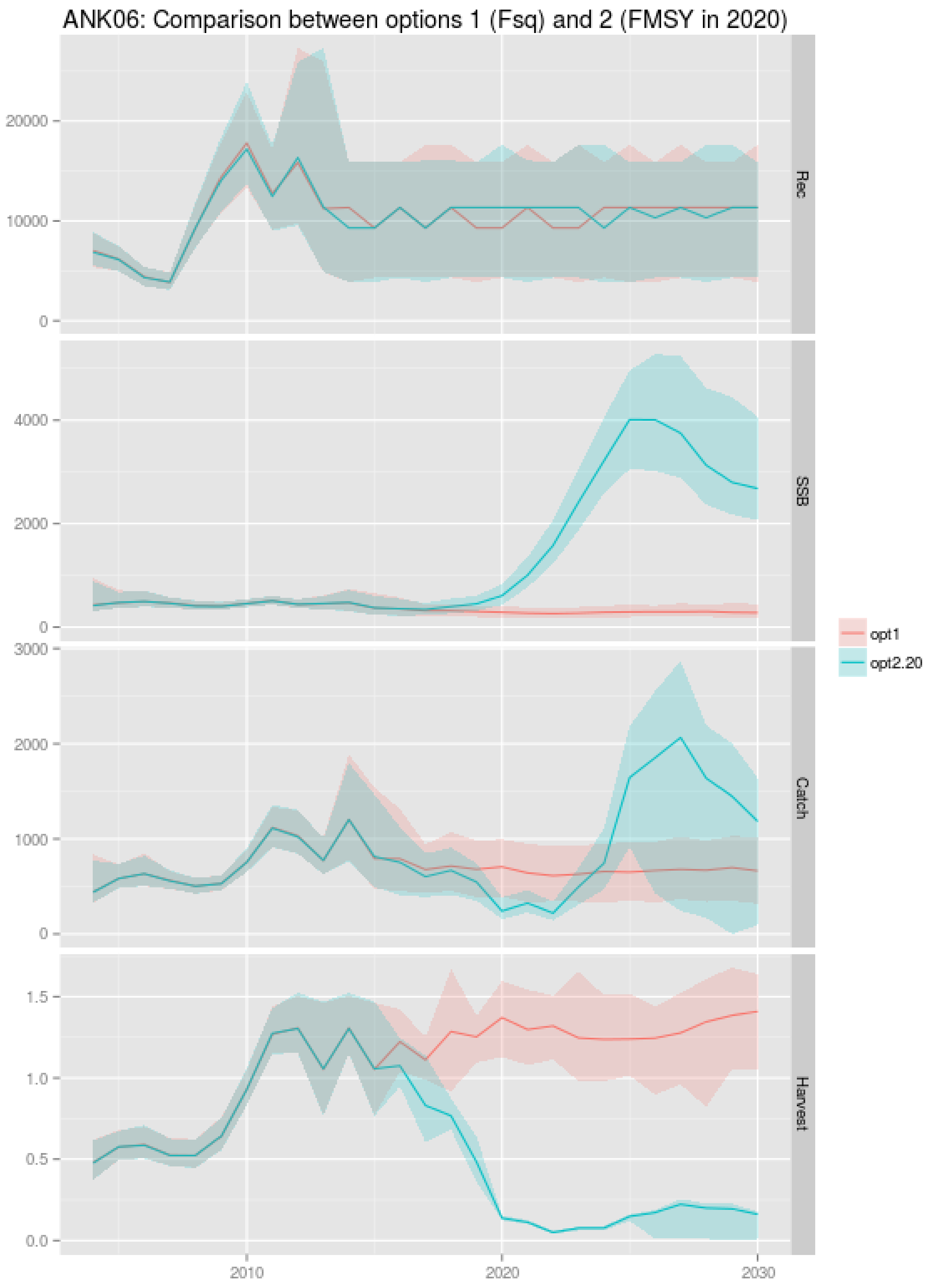


Figure 4.2 Angler in GSA 6, comparison between fishing at the current F and fishing at Fmsy levels.

The simulations in Figure 4.3, show the consequences of achieving the target in 2018 or 2020. Reaching the target earlier will anticipate the recovery of SSB. However, these simulations don't take into account mixed fisheries effects, which are likely to constrain the intended F reduction. As such, the difference between the two scenarios is likely to be smaller than what the simulations show.

Figure 4.3 Anglerfish in GSA 06: consequences of achieving the target in 2018 or 2020

The two MAP scenarios, F targets set at the upper level or the lower level of the Fmsy range, depicted in Figure 4.4, show that exploiting the stock at lower levels will result in larger biomasses, while the catches are similar, being slightly larger when exploiting at the upper limit of the Fmsy range.

As stated above, the dynamics forecasted are uncertain and should be considered with care.

Figure 4.4 Anglerfish in GSA 06: MAP scenarios, F targets set at the upper level or the lower level of the Fmsy range

Table 4.4 Anglerfish in GSA 06:: results of the 5 scenarios simulated for the 3 options suggested. SSB – spawning stock biomass; F – fishing mortality rate; biorisk – risk of SSB being below the minimum historical ssb. In gray the historical assessment period.

Year	Option 01				Option 02 (2018)				Option 02 (2020)				Option 03 (MAP low)				Option 03 (MAP upp)			
	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	Ssb	catch	F	biorisk	ssb	catch	F	biorisk
2004	432	443	0.48	0.44	418	440	0.48	0.45	418	440	0.48	0.45	418	440	0.48	0.45	418	440	0.48	0.45
2005	471	585	0.57	0.20	476	584	0.58	0.19	476	584	0.58	0.19	476	584	0.58	0.19	476	584	0.58	0.19
2006	496	633	0.59	0.13	498	634	0.59	0.13	498	634	0.59	0.13	498	634	0.59	0.13	498	634	0.59	0.13
2007	467	565	0.52	0.18	461	559	0.52	0.21	461	559	0.52	0.21	461	559	0.52	0.21	461	559	0.52	0.21
2008	419	503	0.52	0.44	408	504	0.52	0.48	408	504	0.52	0.48	408	504	0.52	0.48	408	504	0.52	0.48
2009	408	532	0.64	0.50	404	529	0.64	0.50	404	529	0.64	0.50	404	529	0.64	0.50	404	529	0.64	0.50
2010	459	756	0.93	0.20	455	755	0.93	0.18	455	755	0.93	0.18	455	755	0.93	0.18	455	755	0.93	0.18
2011	516	1120	1.27	0.04	509	1113	1.28	0.04	509	1113	1.28	0.04	509	1113	1.28	0.04	509	1113	1.28	0.04
2012	441	1033	1.31	0.29	441	1022	1.30	0.24	441	1022	1.30	0.24	441	1022	1.30	0.24	441	1022	1.30	0.24
2013	453	772	1.05	0.34	459	775	1.06	0.26	459	775	1.06	0.26	459	775	1.06	0.26	459	775	1.06	0.26
2014	472	1205	1.31	0.36	478	1202	1.30	0.28	478	1202	1.30	0.28	478	1202	1.30	0.28	478	1202	1.30	0.28
2015	371	794	1.05	0.62	376	814	1.06	0.57	376	814	1.06	0.57	376	814	1.06	0.57	376	814	1.06	0.57
2016	355	792	1.22	0.66	357	692	0.92	0.63	357	754	1.07	0.63	357	435	0.46	0.63	357	436	0.46	0.63
2017	320	678	1.11	0.83	378	535	0.60	0.60	343	604	0.83	0.78	509	655	0.54	0.16	509	661	0.54	0.16
2018	319	715	1.29	0.80	490	200	0.13	0.23	400	669	0.77	0.52	660	450	0.28	0.06	658	450	0.28	0.07
2019	305	681	1.25	0.88	889	304	0.11	0.00	452	547	0.48	0.33	918	569	0.28	0.02	946	621	0.32	0.02
2020	290	707	1.37	0.88	1445	161	0.04	0.00	609	242	0.14	0.07	1233	193	0.07	0.00	1163	353	0.15	0.01
2021	272	643	1.30	0.92	2227	379	0.06	0.00	1004	325	0.11	0.00	1890	347	0.08	0.00	1643	566	0.17	0.00
2022	263	614	1.32	0.94	3129	578	0.06	0.00	1579	220	0.05	0.00	2574	229	0.03	0.00	2082	516	0.11	0.00
2023	273	630	1.25	0.92	4057	1612	0.14	0.00	2416	497	0.08	0.00	3547	592	0.05	0.00	2585	879	0.15	0.00
2024	288	658	1.24	0.89	4114	1884	0.17	0.00	3219	745	0.08	0.00	4285	830	0.05	0.00	2961	1063	0.15	0.00
2025	295	651	1.24	0.88	3824	2253	0.24	0.00	4012	1645	0.15	0.00	4919	1651	0.10	0.00	3122	1527	0.23	0.00
2026	300	668	1.25	0.87	3166	1680	0.21	0.00	4009	1853	0.17	0.00	4818	1643	0.11	0.00	2887	1392	0.24	0.00
2027	298	680	1.28	0.86	2866	1538	0.21	0.00	3749	2066	0.22	0.00	4633	1761	0.14	0.00	2773	1402	0.25	0.00
2028	304	671	1.35	0.88	2605	1196	0.16	0.00	3132	1639	0.20	0.00	4151	1552	0.12	0.00	2586	1279	0.23	0.00
2029	286	700	1.38	0.83	2600	1125	0.15	0.00	2800	1448	0.19	0.00	4016	1365	0.12	0.00	2352	1129	0.23	0.00
2030	280	665	1.41	0.88	2719	1073	0.14	0.00	2680	1185	0.16	0.00	3770	1260	0.10	0.00	2394	1072	0.22	0.00
2031	279	668	1.40	0.88	2951	1173	0.14	0.00	2741	1143	0.15	0.00	3879	1108	0.10	0.00	2456	1085	0.19	0.00
2032	272	626	1.38	0.88	3144	1219	0.14	0.00	2863	1074	0.14	0.00	4019	1066	0.09	0.00	2587	1075	0.19	0.00
2033	267	624	1.32	0.88	3199	1358	0.15	0.00	3034	1178	0.14	0.00	4296	1115	0.09	0.00	2736	999	0.03	0.00

2034	276	626	1.32	0.88	3196	1379	0.16	0.00	3157	1242	0.15	0.00	4684	1229	0.09	0.00	3179	1085	0.01	0.00
2035	291	664	1.31	0.89	3235	1401	0.17	0.00	3303	1343	0.16	0.00	4634	846	0.01	0.00	3222	910	0.01	0.00

4.2.2 Hake in GSA 06

Hake in GSA 06 shows a similar pattern to anglerfish, although more pronounced due to being exploited at higher rates.

Figure 4.5 and Table 4.5 shows the comparison between fishing at the current F and fishing at Fmsy levels. The reduction of F from the current exploitation to Fmsy, will allow the stock to increase its SSB to very high levels. These results must be taken with care, due to the large extrapolation of SSB outside historical limits and the uncertainty associated with the dynamics forecasted. Catches of above 15000t were also not seen in the past (Figure 2.3). Biological risk is low.

Due to the bias in the assessment, that takes some time to detect the increase in F, the forecast in the short term considers an increase in F until it starts decreasing after 2020.

Clearly, fishing at current levels, concentrated in the smaller individuals (see fishery description in section 2.5) combined with a very clear downwards trend in recruitment, requires quick action.

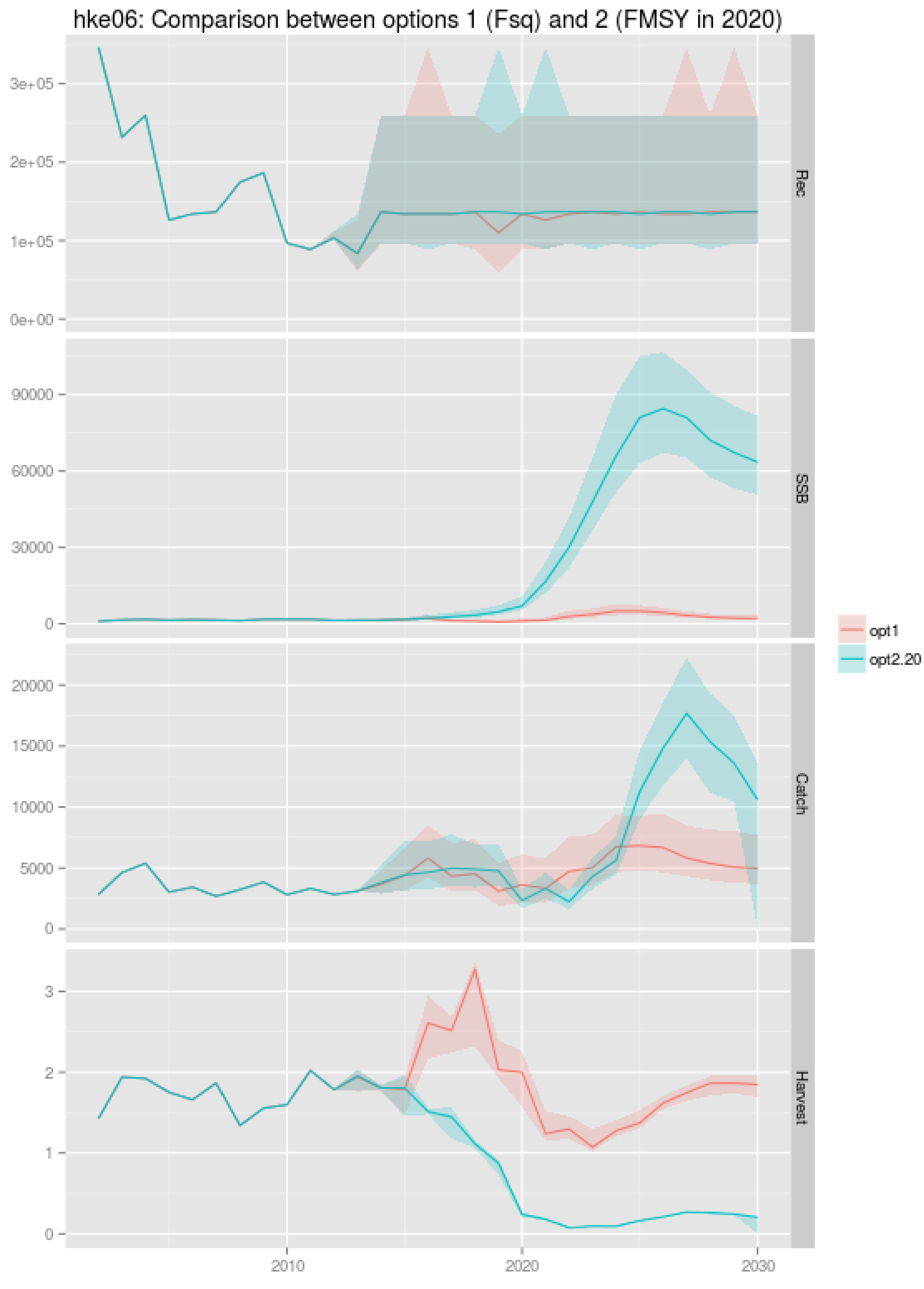


Figure 4.5 Hake in GSA 6, comparison between fishing at the current F and fishing at Fmsy levels.

Figure 4.6 show the consequences of achieving the target in 2018 or 2020. Reaching the target earlier will anticipate the recovery of SSB. However, these simulations don't take into account mixed fisheries effects, which are likely to constrain the intended F reduction. As such, the difference between the two scenarios is likely to be smaller than what the simulations show.

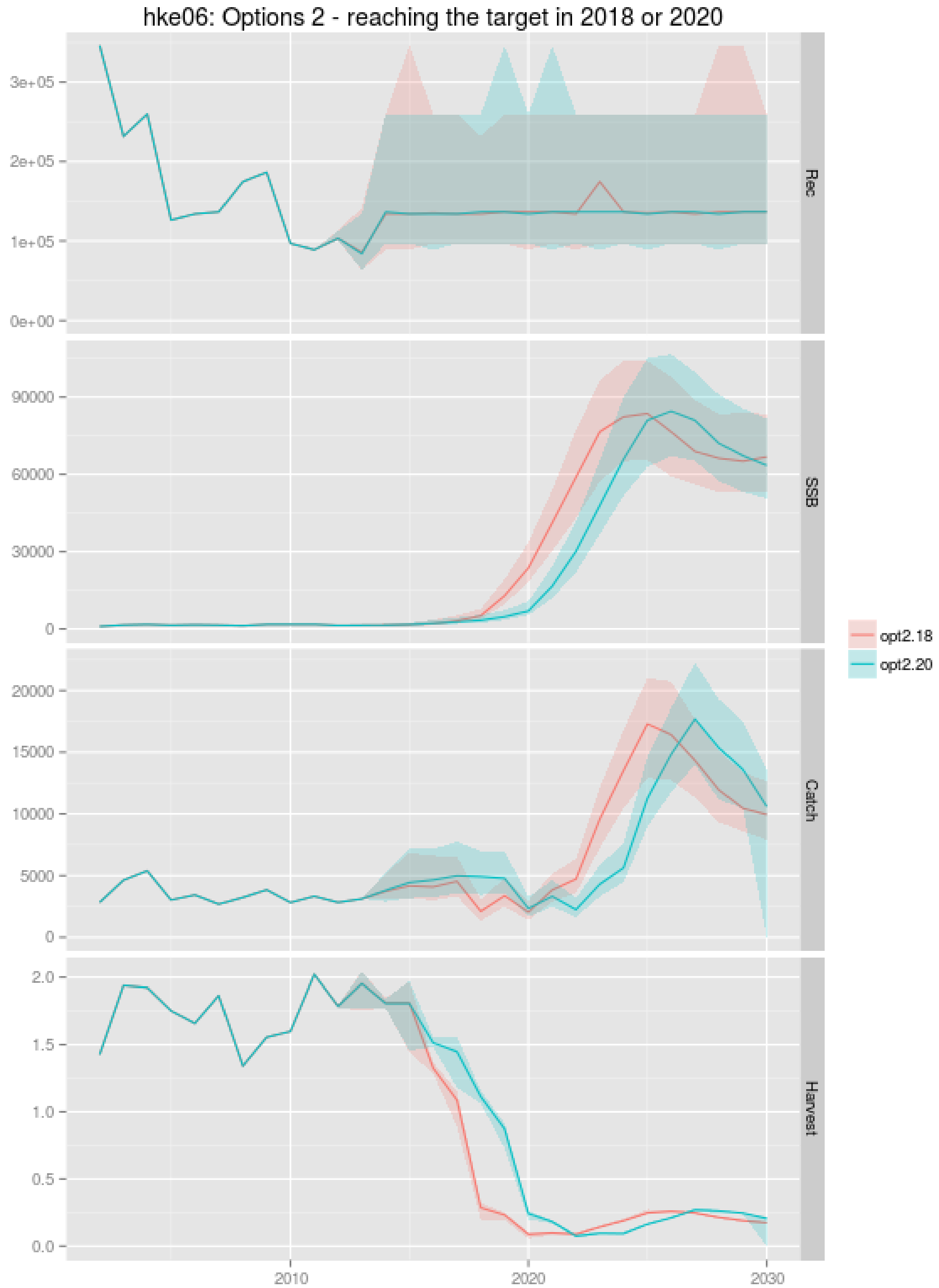


Figure 4.6 Hake in GSA 06: consequences of achieving the target in 2018 or 2020

Figure 4.7 depicts the two MAP scenarios. Due to the large decrease in F required to get to the targets, the contrast between the three options is not very clear. As stated above, the dynamics forecasted are uncertain and the results should be considered with care.

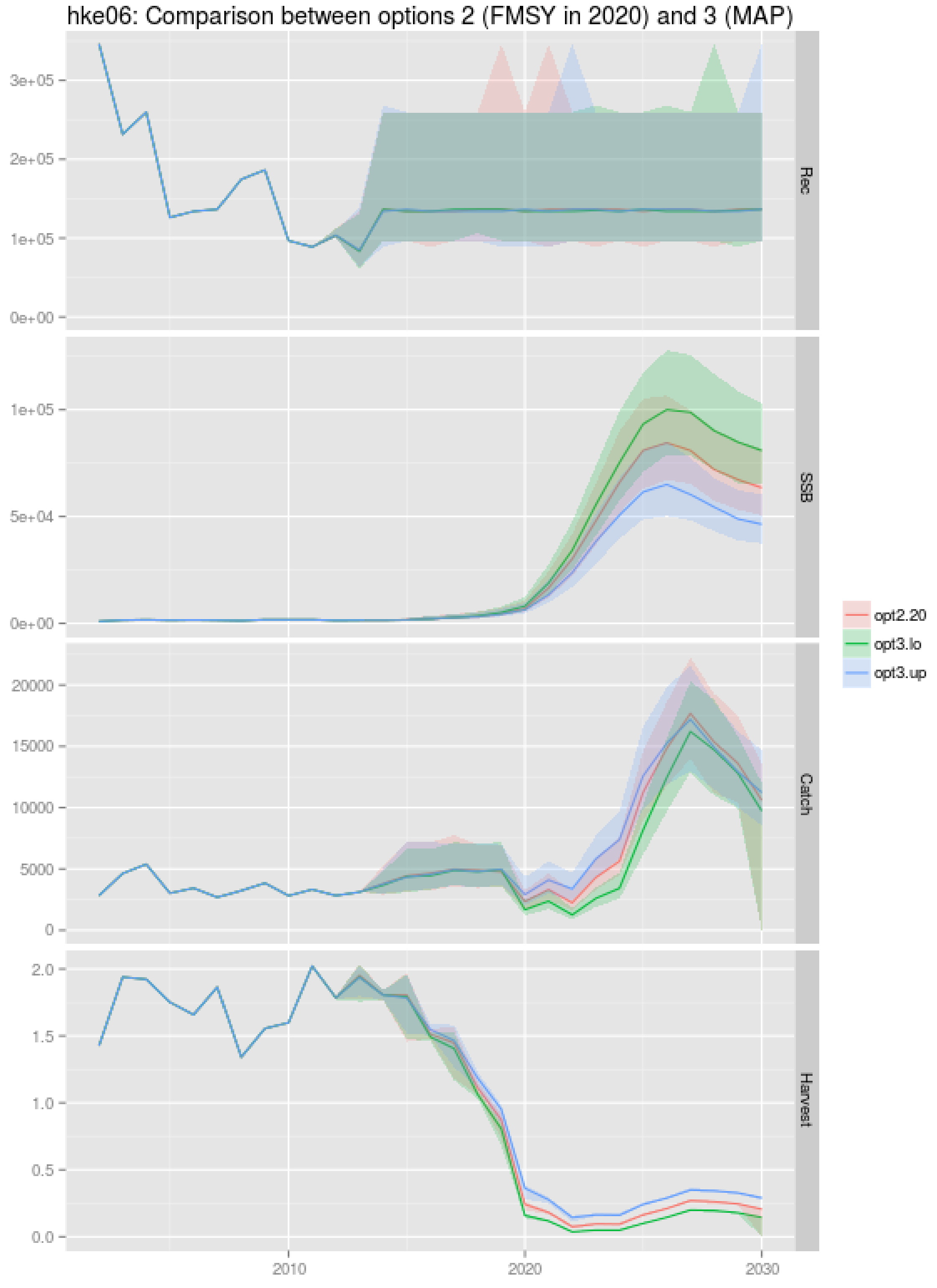


Figure 4.7 Hake in GSA 06: MAP scenarios, F targets set at the upper level or the lower level of the Fmsy range

Table 4.5 Hake in GSA 06: results of the 5 scenarios simulated for the 3 options suggested. SSB – spawning stock biomass; F – fishing mortality rate; biorisk – risk of SSB being below the minimum historical ssb. In gray the historical assessment period.

Year	Option 01				Option 02 (2018)				Option 02 (2020)				Option 03 (MAP low)				Option 03 (MAP upp)			
	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk
2002	1013	2835	1.43	1.00	1013	2835	1.43	1.00	1013	2835	1.43	1.00	1013	2835	1.43	1.00	1013	2835	1.43	1.00
2003	1546	4633	1.94	0.00	1546	4633	1.94	0.00	1546	4633	1.94	0.00	1546	4633	1.94	0.00	1546	4633	1.94	0.00
2004	1737	5390	1.92	0.00	1737	5390	1.92	0.00	1737	5390	1.92	0.00	1737	5390	1.92	0.00	1737	5390	1.92	0.00
2005	1450	3029	1.75	0.00	1450	3029	1.75	0.00	1450	3029	1.75	0.00	1450	3029	1.75	0.00	1450	3029	1.75	0.00
2006	1617	3438	1.66	0.00	1617	3438	1.66	0.00	1617	3438	1.66	0.00	1617	3438	1.66	0.00	1617	3438	1.66	0.00
2007	1486	2692	1.86	0.00	1486	2692	1.86	0.00	1486	2692	1.86	0.00	1486	2692	1.86	0.00	1486	2692	1.86	0.00
2008	1280	3234	1.34	0.50	1280	3234	1.34	0.50	1280	3234	1.34	0.50	1280	3234	1.34	0.50	1280	3234	1.34	0.50
2009	1769	3848	1.56	0.00	1769	3848	1.56	0.00	1769	3848	1.56	0.00	1769	3848	1.56	0.00	1769	3848	1.56	0.00
2010	1740	2822	1.60	0.00	1740	2822	1.60	0.00	1740	2822	1.60	0.00	1740	2822	1.60	0.00	1740	2822	1.60	0.00
2011	1782	3327	2.02	0.00	1782	3327	2.02	0.00	1782	3327	2.02	0.00	1782	3327	2.02	0.00	1782	3327	2.02	0.00
2012	1368	2836	1.79	0.00	1368	2836	1.79	0.00	1368	2836	1.79	0.00	1368	2836	1.79	0.00	1368	2836	1.79	0.00
2013	1468	3119	1.94	0.00	1466	3119	1.95	0.00	1468	3119	1.95	0.00	1469	3119	1.94	0.00	1469	3119	1.94	0.00
2014	1453	3670	1.81	0.18	1448	3731	1.81	0.22	1441	3805	1.81	0.24	1449	3677	1.81	0.20	1458	3778	1.81	0.15
2015	1676	4381	1.79	0.06	1680	4175	1.81	0.04	1735	4442	1.81	0.08	1683	4379	1.79	0.05	1705	4331	1.78	0.04
2016	2169	5816	2.61	0.03	2067	4092	1.32	0.04	2196	4653	1.51	0.05	2107	4449	1.49	0.00	2156	4571	1.55	0.03
2017	1224	4337	2.51	0.54	3180	4538	1.09	0.00	2806	4985	1.45	0.00	2806	4885	1.41	0.00	2733	4942	1.47	0.00
2018	1112	4531	3.27	0.62	5170	2108	0.29	0.00	3402	4918	1.11	0.00	3541	4781	1.06	0.00	3223	4795	1.19	0.00
2019	729	3105	2.03	0.87	12881	3376	0.23	0.00	4774	4782	0.87	0.00	5131	4945	0.81	0.00	4298	4984	0.95	0.00
2020	1151	3639	2.00	0.57	23690	2038	0.09	0.00	6974	2343	0.24	0.00	8133	1684	0.16	0.00	6342	2920	0.36	0.00
2021	1408	3329	1.24	0.39	41169	3840	0.10	0.00	16605	3327	0.18	0.00	18863	2373	0.12	0.00	13325	4104	0.28	0.00
2022	2934	4729	1.30	0.02	58896	4724	0.09	0.00	30137	2245	0.07	0.00	34187	1262	0.04	0.00	23757	3369	0.14	0.00
2023	3701	5029	1.07	0.00	76550	9581	0.14	0.00	47952	4307	0.10	0.00	55468	2606	0.05	0.00	38334	5820	0.16	0.00
2024	5051	6751	1.27	0.00	82333	13526	0.19	0.00	65931	5636	0.09	0.00	75232	3430	0.05	0.00	50664	7396	0.16	0.00
2025	5032	6831	1.37	0.00	83594	17289	0.25	0.00	80959	11246	0.16	0.00	93271	8182	0.10	0.00	61509	12589	0.24	0.00
2026	4412	6686	1.62	0.00	76506	16421	0.26	0.00	84491	14830	0.21	0.00	1E+05	12454	0.15	0.00	64994	15256	0.29	0.00
2027	3317	5825	1.75	0.00	68919	14332	0.25	0.00	80946	17686	0.27	0.00	98769	16209	0.20	0.00	60319	17199	0.35	0.00
2028	2625	5388	1.86	0.00	66293	11945	0.21	0.00	72060	15362	0.26	0.00	90205	14720	0.20	0.00	54487	14929	0.34	0.00
2029	2239	5068	1.86	0.00	65155	10458	0.19	0.00	67256	13590	0.25	0.00	84779	12785	0.18	0.00	48846	12915	0.33	0.00
2030	2149	4991	1.85	0.01	66827	9948	0.17	0.00	63508	10597	0.21	0.00	80887	9733	0.14	0.00	46418	11240	0.29	0.00
2031	2172	5036	1.79	0.01	69449	10244	0.17	0.00	65791	10089	0.19	0.00	82642	8699	0.12	0.00	47299	10162	0.27	0.00
2032	2255	4978	1.74	0.01	72511	10923	0.18	0.00	68731	9467	0.17	0.00	85164	8010	0.11	0.00	51536	11065	0.26	0.00

2033	2393	5071	1.68	0.00	74749	12032	0.19	0.00	72491	10657	0.17	0.00	92079	8637	0.11	0.00	53660	10653	0.26	0.00
2034	2521	5330	1.65	0.00	74813	12580	0.20	0.00	75310	10994	0.18	0.00	94550	9308	0.12	0.00	54753	12540	0.27	0.00
2035	2702	5186	1.63	0.00	74664	12984	0.21	0.00	77146	12432	0.20	0.00	97181	10608	0.13	0.00	56252	12530	0.28	0.00

4.2.3 Hake in GSA 07

The figures and Table 4.6 below show the results of the MSE forecast of the options proposed in the ToRs applied to the stock of hake (Merluccius merluccius) in GSA 07.

Figure 4.7 shows the comparison between fishing at the current F and fishing at Fmsy levels. As in previous analysis, the reduction in F from the current exploitation to Fmsy is very high and will allow the stock to increase its SSB, driving biological risk to values of zero. It must be noted that the SSB reference point is computed based on the minimum SSB estimate and not based on stock-recruitment dynamics.

The forecast must be taken with care due to the large extrapolation of SSB outside historical limits, and the uncertainty associated with the dynamics forecasted.

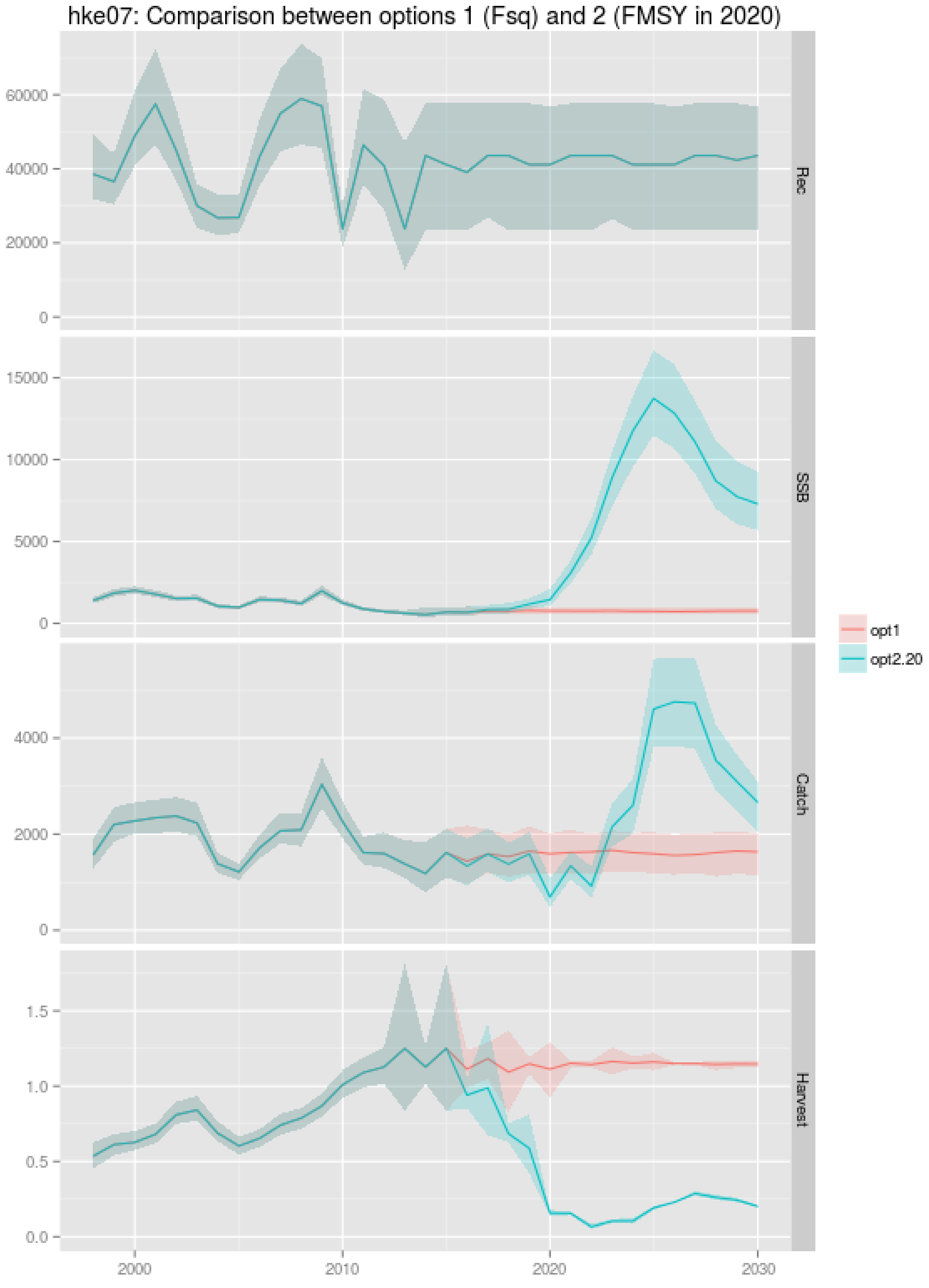


Figure 4.8 Hake in GSA 7, comparison between fishing at the current F and fishing at Fmsy levels.

In Figure 4.9 are presented the consequences of achieving the F target in 2018 or 2020, which show that reaching the target earlier will anticipate the recovery of SSB.

Like for the other stocks, these simulations don't take into account mixed fisheries effects, which are likely to constrain the intended F reduction. As such, the difference between the two scenarios is likely to be smaller than shown.

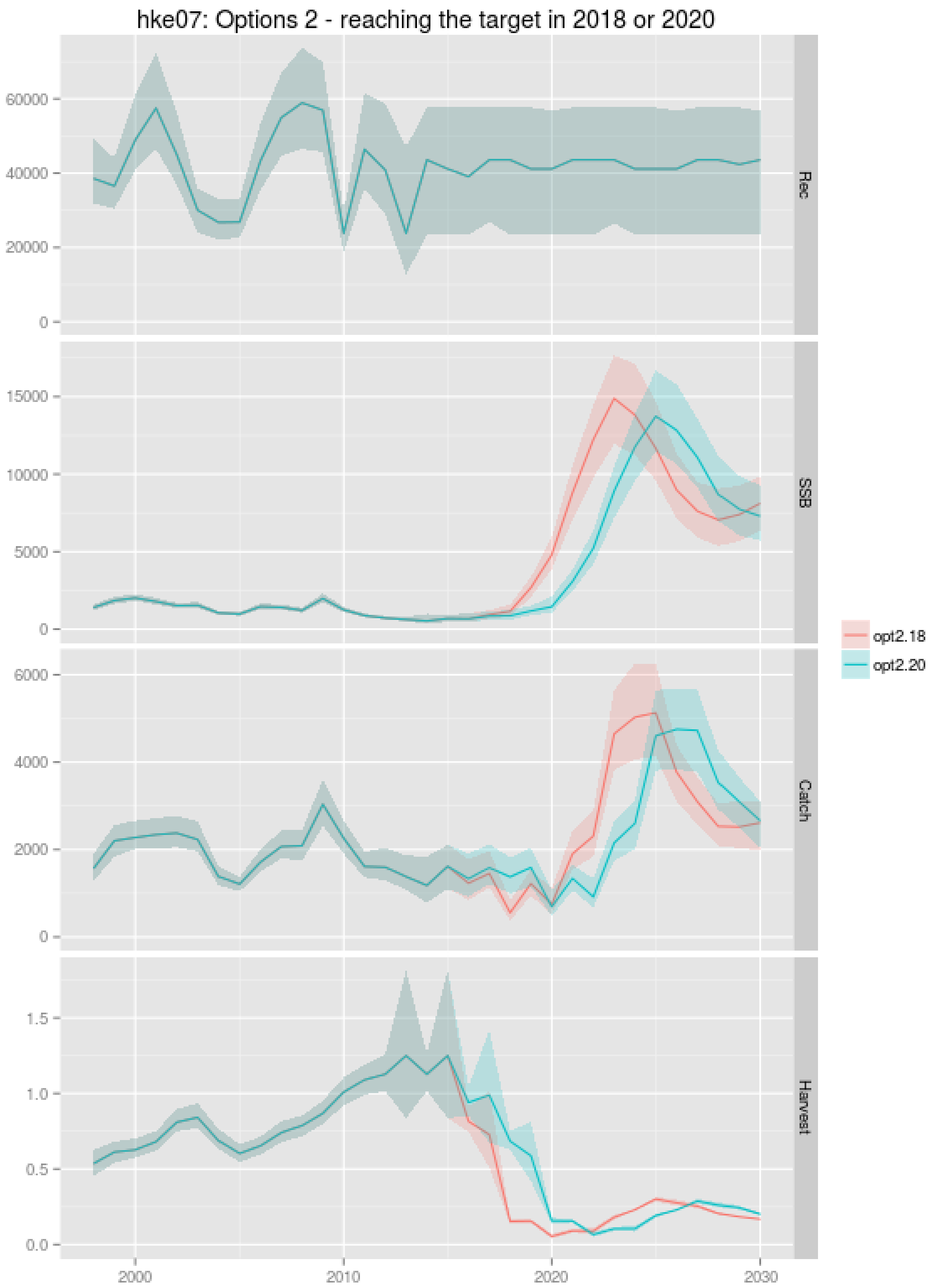


Figure 4.9 Hake in GSA 07: consequences of achieving the target in 2018 or 2020.

Figure 4.10 depicts the two MAP scenarios. Due to the large decrease in F required to get to the targets, the contrast between the three options is not very clear.

As stated above, the dynamics forecasted are uncertain and the results should be considered with care.

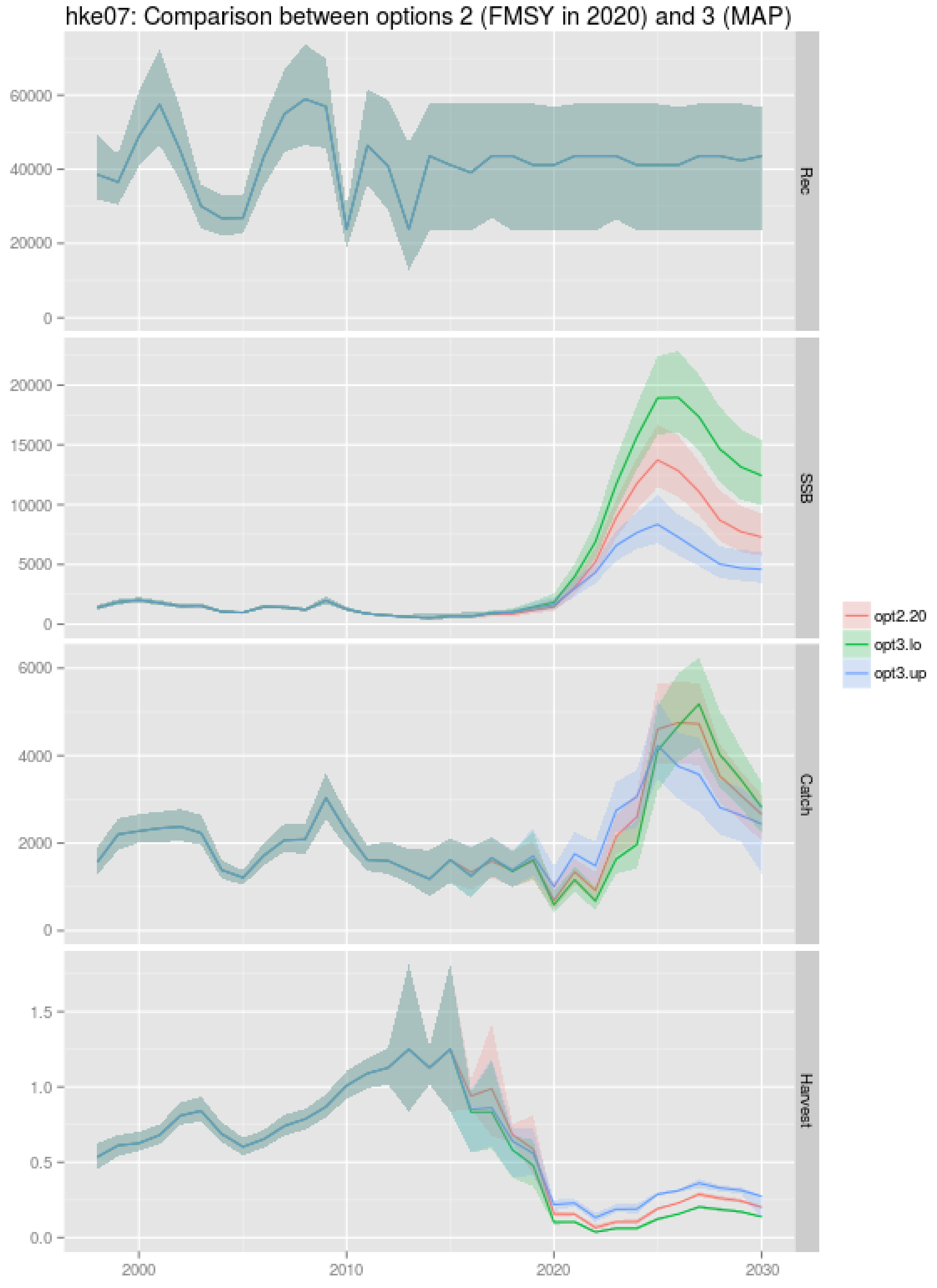


Figure 4.10 Hake in GSA 07: MAP scenarios, F targets set at the upper level or the lower level of the Fmsy range.

Table 4.6 Hake in GSA 07: results of the 5 scenarios simulated for the 3 options suggested. SSB – spawning stock biomass; F – fishing mortality rate; biorisk – risk of SSB being below the minimum historical ssb. In gray the historical assessment period.

Year	Option 01				Option 02 (2018)				Option 02 (2020)				Option 03 (MAP low)				Option 03 (MAP upp)			
	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk
2002	1521	2378	0.81	0.00	1521	2378	0.81	0.00	1521	2378	0.81	0.00	1521	2378	0.81	0.00	1521	2378	0.81	0.00
2003	1546	2233	0.84	0.00	1546	2233	0.84	0.00	1546	2233	0.84	0.00	1546	2233	0.84	0.00	1546	2233	0.84	0.00
2004	1055	1383	0.69	0.00	1055	1383	0.69	0.00	1055	1383	0.69	0.00	1055	1383	0.69	0.00	1055	1383	0.69	0.00
2005	983	1213	0.60	0.00	983	1213	0.60	0.00	983	1213	0.60	0.00	983	1213	0.60	0.00	983	1213	0.60	0.00
2006	1462	1714	0.65	0.00	1462	1714	0.65	0.00	1462	1714	0.65	0.00	1462	1714	0.65	0.00	1462	1714	0.65	0.00
2007	1417	2069	0.74	0.00	1417	2069	0.74	0.00	1417	2069	0.74	0.00	1417	2069	0.74	0.00	1417	2069	0.74	0.00
2008	1220	2088	0.79	0.00	1220	2088	0.79	0.00	1220	2088	0.79	0.00	1220	2088	0.79	0.00	1220	2088	0.79	0.00
2009	1988	3036	0.87	0.00	1988	3036	0.87	0.00	1988	3036	0.87	0.00	1988	3036	0.87	0.00	1988	3036	0.87	0.00
2010	1256	2262	1.01	0.00	1256	2262	1.01	0.00	1256	2262	1.01	0.00	1256	2262	1.01	0.00	1256	2262	1.01	0.00
2011	886	1616	1.09	0.00	886	1616	1.09	0.00	886	1616	1.09	0.00	886	1616	1.09	0.00	886	1616	1.09	0.00
2012	726	1598	1.13	0.12	726	1598	1.13	0.12	726	1598	1.13	0.12	726	1598	1.13	0.12	726	1598	1.13	0.12
2013	628	1382	1.25	0.50	628	1382	1.25	0.50	628	1382	1.25	0.50	628	1382	1.25	0.50	628	1382	1.25	0.50
2014	537	1183	1.13	0.58	537	1183	1.13	0.58	537	1183	1.13	0.58	537	1183	1.13	0.58	537	1183	1.13	0.58
2015	694	1617	1.25	0.34	694	1617	1.25	0.34	694	1617	1.25	0.34	694	1617	1.25	0.34	694	1617	1.25	0.34
2016	676	1438	1.11	0.40	676	1232	0.82	0.40	676	1336	0.94	0.40	676	1244	0.83	0.40	676	1257	0.85	0.40
2017	741	1589	1.18	0.22	948	1456	0.73	0.02	855	1586	0.99	0.12	955	1664	0.83	0.02	950	1669	0.86	0.03
2018	747	1534	1.09	0.19	1158	557	0.15	0.02	871	1377	0.68	0.12	1031	1350	0.58	0.02	1012	1390	0.64	0.04
2019	792	1649	1.15	0.18	2682	1222	0.16	0.00	1182	1591	0.59	0.00	1448	1626	0.48	0.00	1362	1711	0.56	0.00
2020	764	1593	1.11	0.18	4798	749	0.05	0.00	1451	694	0.16	0.00	1839	592	0.10	0.00	1621	1009	0.22	0.00
2021	766	1620	1.15	0.22	8808	1904	0.09	0.00	3081	1343	0.16	0.00	3990	1165	0.10	0.00	2975	1758	0.23	0.00
2022	758	1632	1.14	0.19	12235	2311	0.09	0.00	5230	921	0.07	0.00	6888	678	0.04	0.00	4327	1485	0.13	0.00
2023	774	1664	1.16	0.19	14888	4646	0.18	0.00	8907	2155	0.10	0.00	11694	1637	0.06	0.00	6584	2747	0.19	0.00
2024	742	1617	1.15	0.18	13817	5029	0.23	0.00	11761	2601	0.10	0.00	15665	1968	0.06	0.00	7661	3060	0.19	0.00
2025	744	1592	1.16	0.24	11668	5130	0.30	0.00	13740	4603	0.19	0.00	18925	4114	0.12	0.00	8353	4231	0.29	0.00
2026	722	1559	1.15	0.28	8990	3773	0.28	0.00	12836	4754	0.23	0.00	18963	4675	0.16	0.00	7282	3756	0.31	0.00
2027	734	1575	1.15	0.24	7615	3097	0.25	0.00	11083	4727	0.29	0.00	17339	5182	0.20	0.00	6138	3569	0.36	0.00
2028	757	1617	1.14	0.23	7056	2533	0.21	0.00	8697	3535	0.26	0.00	14649	4021	0.19	0.00	5031	2817	0.33	0.00
2029	767	1651	1.15	0.21	7400	2521	0.18	0.00	7741	3091	0.24	0.00	13154	3453	0.17	0.00	4701	2635	0.31	0.00
2030	762	1632	1.15	0.22	8118	2614	0.17	0.00	7296	2660	0.20	0.00	12425	2818	0.14	0.00	4592	2438	0.27	0.00
2031	763	1632	1.15	0.19	9079	2970	0.17	0.00	7703	2703	0.18	0.00	12686	2742	0.12	0.00	4910	2574	0.26	0.00
2032	755	1636	1.15	0.22	9825	3232	0.18	0.00	8391	2728	0.17	0.00	13787	2723	0.11	0.00	5400	2615	0.25	0.00

2033	765	1658	1.15	0.18	10118	3489	0.20	0.00	9208	3008	0.18	0.00	14845	2950	0.12	0.00	5859	2860	0.26	0.00
2034	768	1633	1.15	0.17	9905	3519	0.21	0.00	9838	3193	0.18	0.00	15753	3209	0.12	0.00	6105	2936	0.26	0.00
2035	750	1600	1.15	0.22	9676	3464	0.22	0.00	10264	3349	0.20	0.00	16452	3366	0.13	0.00	6191	2976	0.28	0.00

4.2.4 Red mullet in GSA 06

The figures and Table 4.7 below show the results of the MSE forecast of the options proposed in the ToRs applied to the stock of red mullet (Mullus barbatus) in GSA 06.

In Figure 4.11 is presented the results of the simulations of options 1 and 2, fishing at the current F and fishing at Fmsy levels, respectively. The reduction in F allows the biomass to increase to levels about twice the current ones and reduce biological risk to zero. Although, it must be noted that the SSB reference point is computed based on the minimum SSB estimate and not based on stock-recruitment dynamics.

Catches stay within the current levels with a period of lower catches between 2020 and 2022.

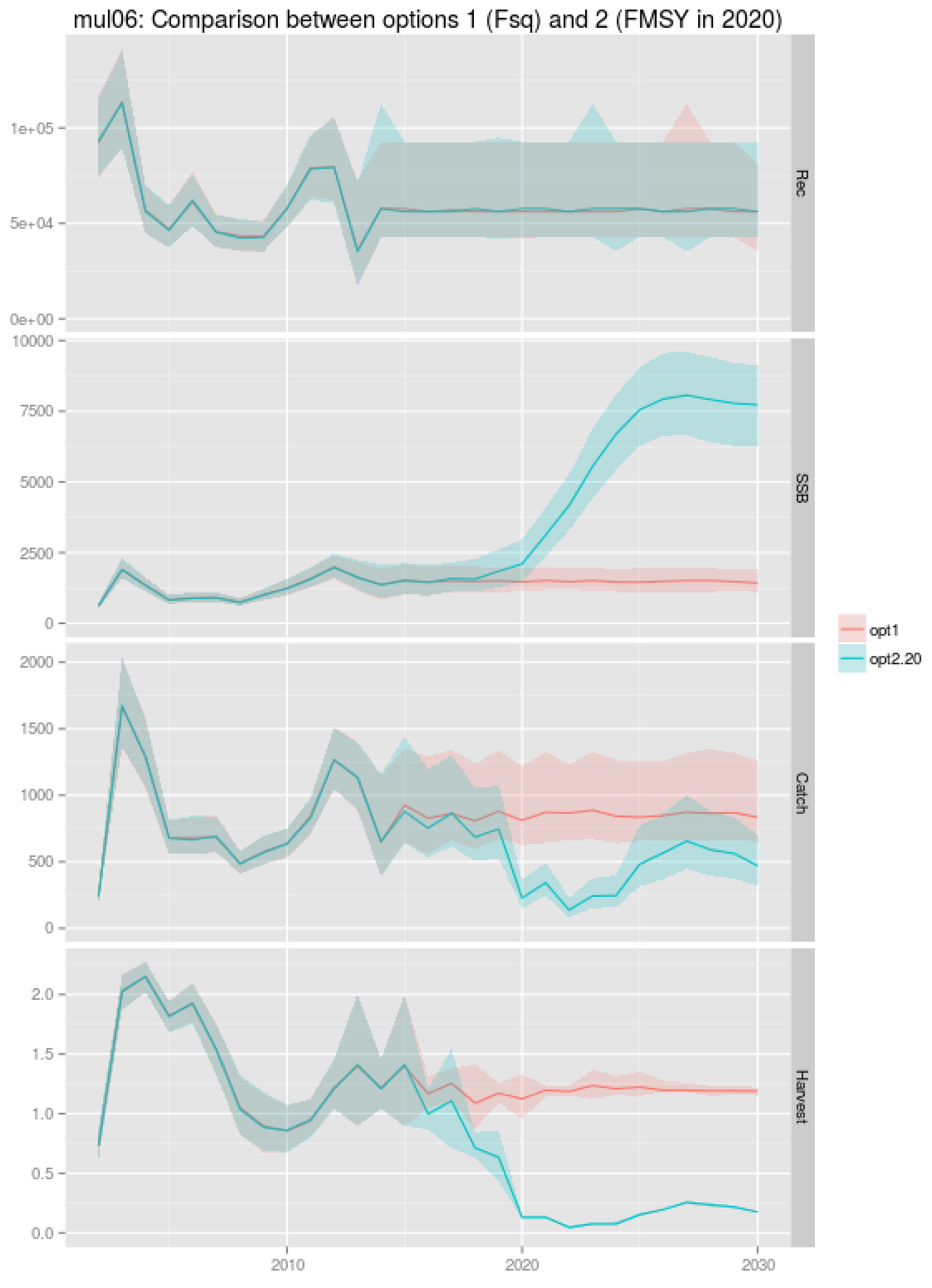


Figure 4.11 Red mullet in GSA 6, comparison between fishing at the current F and fishing at Fmsy levels.

Achieving the F target by 2018 or 2020 is depicted in Figure 4.12. Reaching the target earlier will anticipate the recovery of SSB, keeping catches at similar levels.

However, these simulations don't take into account mixed fisheries effects, which are likely to constrain the intended F reduction. As such, the difference between the two scenarios is likely to be smaller than what the simulations show.

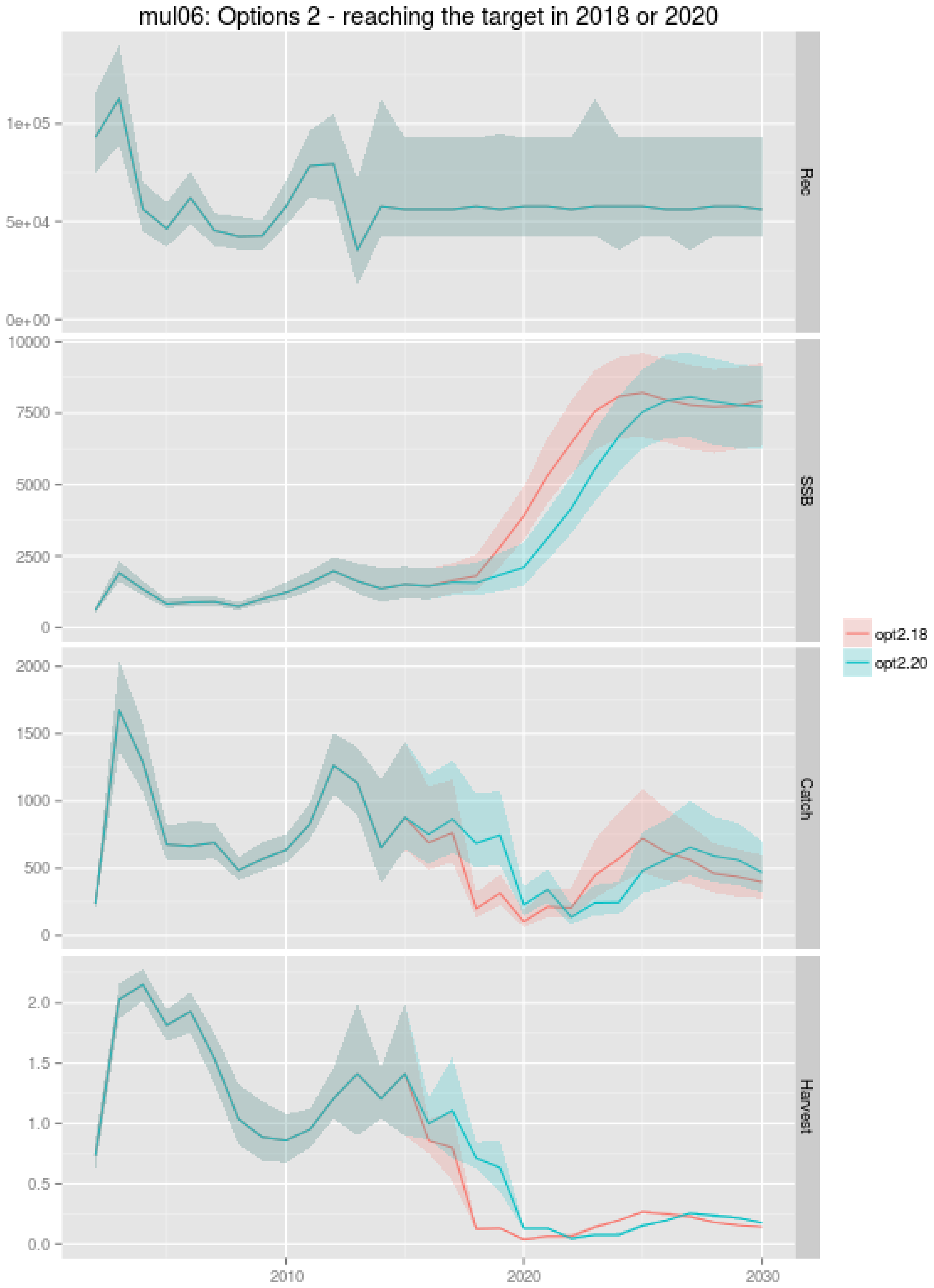


Figure 4.12 Red mullet in GSA 06: consequences of achieving the target in 2018 or 2020.

The results obtained for the two MAP scenarios, F targets set at the upper level or the lower level of the F_{msy} range, are depicted in Figure 4.13. As expected exploiting the stock at lower levels will result in larger biomasses and in neither case the biological risk is larger than 5%. Catches remain at similar levels, being slightly larger in the short term when exploiting at the upper limit of the Fmsy range.

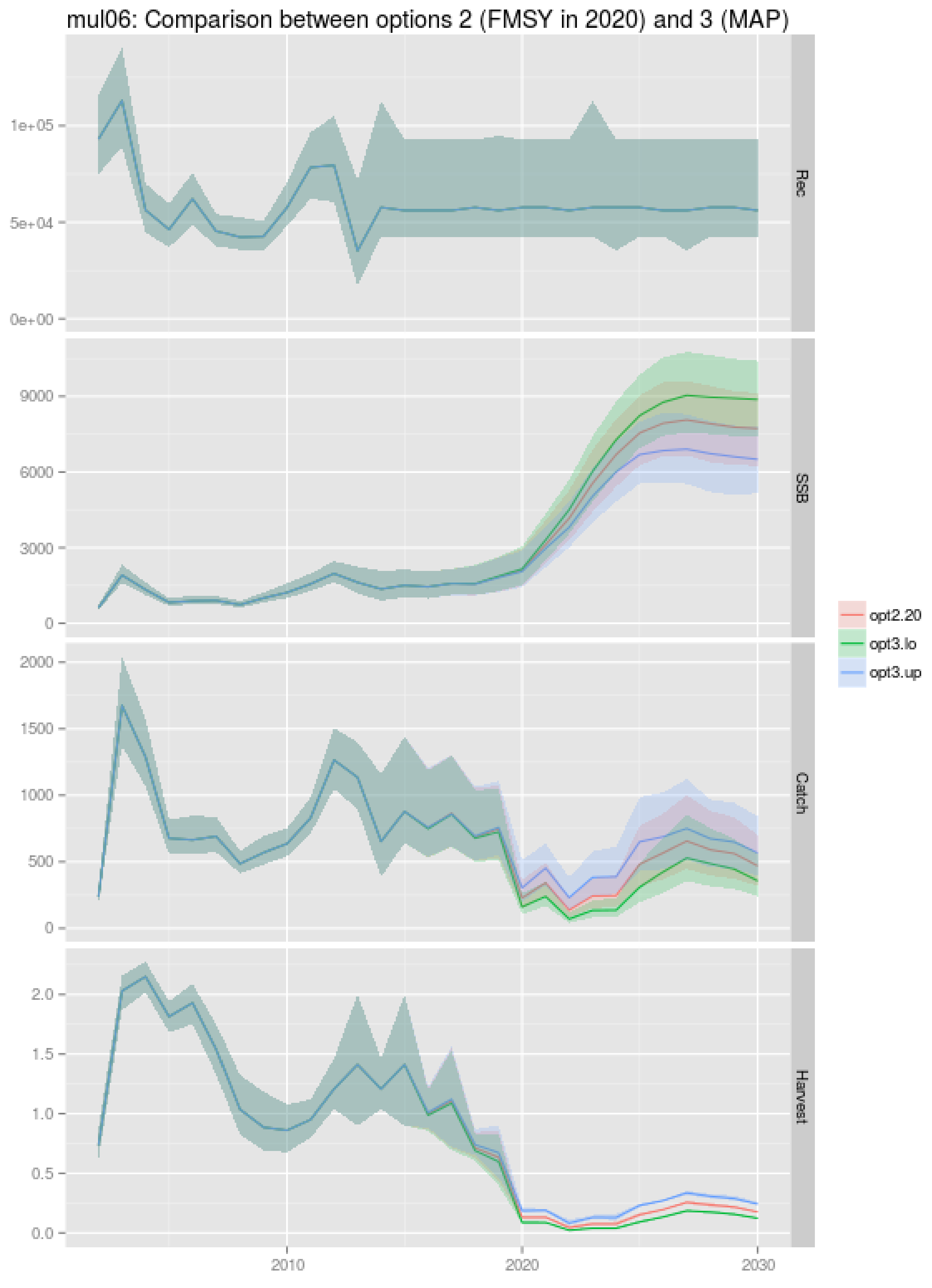


Figure 4.13 Red mullet in GSA 06: MAP scenarios, F targets set at the upper level or the lower level of the Fmsy range.

Table 4.7 Red mullet in GSA 06: results of the 5 scenarios simulated for the 3 options suggested. SSB – spawning stock biomass; F – fishing mortality rate; biorisk – risk of SSB being below the minimum historical ssb. In gray the historical assessment period.

Year	Option 01				Option 02 (2018)				Option 02 (2020)				Option 03 (MAP low)				Option 03 (MAP upp)			
	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk	ssb	catch	F	biorisk
2002	612	239	0.73	0.90	621	237	0.74	0.91	621	237	0.74	0.91	621	237	0.74	0.91	621	237	0.74	0.91
2003	1891	1664	2.02	0.00	1910	1675	2.03	0.00	1910	1675	2.03	0.00	1910	1675	2.03	0.00	1910	1675	2.03	0.00
2004	1352	1293	2.15	0.00	1338	1288	2.15	0.00	1338	1288	2.15	0.00	1338	1288	2.15	0.00	1338	1288	2.15	0.00
2005	827	681	1.82	0.22	829	677	1.81	0.24	829	677	1.81	0.24	829	677	1.81	0.24	829	677	1.81	0.24
2006	902	683	1.92	0.12	887	665	1.93	0.07	887	665	1.93	0.07	887	665	1.93	0.07	887	665	1.93	0.07
2007	905	686	1.54	0.08	906	692	1.54	0.08	906	692	1.54	0.08	906	692	1.54	0.08	906	692	1.54	0.08
2008	745	485	1.05	0.50	741	485	1.04	0.50	741	485	1.04	0.50	741	485	1.04	0.50	741	485	1.04	0.50
2009	1000	576	0.90	0.03	1002	569	0.89	0.02	1002	569	0.89	0.02	1002	569	0.89	0.02	1002	569	0.89	0.02
2010	1248	636	0.86	0.00	1224	636	0.86	0.00	1224	636	0.86	0.00	1224	636	0.86	0.00	1224	636	0.86	0.00
2011	1576	845	0.94	0.00	1562	829	0.95	0.00	1562	829	0.95	0.00	1562	829	0.95	0.00	1562	829	0.95	0.00
2012	1995	1266	1.22	0.00	1976	1264	1.21	0.00	1976	1264	1.21	0.00	1976	1264	1.21	0.00	1976	1264	1.21	0.00
2013	1626	1132	1.40	0.00	1624	1134	1.41	0.00	1624	1134	1.41	0.00	1624	1134	1.41	0.00	1624	1134	1.41	0.00
2014	1370	648	1.22	0.06	1363	653	1.21	0.04	1363	653	1.21	0.04	1363	653	1.21	0.04	1363	653	1.21	0.04
2015	1535	926	1.40	0.00	1507	878	1.41	0.00	1507	878	1.41	0.00	1507	878	1.41	0.00	1507	878	1.41	0.00
2016	1456	828	1.17	0.00	1451	691	0.86	0.00	1451	753	1.00	0.00	1451	748	0.99	0.00	1451	758	1.01	0.00
2017	1501	863	1.26	0.00	1652	764	0.80	0.00	1582	865	1.11	0.00	1586	857	1.09	0.00	1578	859	1.12	0.00
2018	1485	808	1.09	0.00	1807	199	0.13	0.00	1563	685	0.71	0.00	1572	678	0.69	0.00	1556	694	0.74	0.00
2019	1507	880	1.17	0.00	2812	316	0.13	0.00	1842	746	0.63	0.00	1869	724	0.60	0.00	1813	759	0.67	0.00
2020	1465	812	1.12	0.00	3904	103	0.04	0.00	2104	228	0.13	0.00	2157	161	0.09	0.00	2057	304	0.19	0.00
2021	1516	873	1.20	0.00	5316	214	0.06	0.00	3122	342	0.13	0.00	3305	240	0.09	0.00	2968	453	0.19	0.00
2022	1473	867	1.19	0.00	6460	207	0.06	0.00	4165	137	0.05	0.00	4506	70	0.02	0.00	3808	230	0.08	0.00
2023	1511	887	1.24	0.00	7570	449	0.14	0.00	5556	244	0.08	0.00	6030	135	0.04	0.00	5043	383	0.13	0.00
2024	1462	844	1.21	0.00	8087	572	0.20	0.00	6693	246	0.08	0.00	7279	137	0.04	0.00	6005	388	0.13	0.00
2025	1454	835	1.22	0.00	8213	722	0.27	0.00	7549	482	0.15	0.00	8236	310	0.09	0.00	6693	651	0.23	0.00
2026	1490	848	1.20	0.00	7958	617	0.25	0.00	7934	567	0.20	0.00	8769	425	0.13	0.00	6851	689	0.27	0.00
2027	1511	874	1.20	0.00	7784	562	0.23	0.00	8067	656	0.26	0.00	9041	529	0.19	0.00	6909	750	0.34	0.00
2028	1517	863	1.19	0.00	7714	462	0.18	0.00	7916	591	0.24	0.00	8969	486	0.17	0.00	6732	674	0.31	0.00
2029	1475	869	1.19	0.00	7754	437	0.16	0.00	7781	562	0.22	0.00	8927	446	0.16	0.00	6608	649	0.29	0.00
2030	1427	835	1.19	0.00	7944	398	0.14	0.00	7729	470	0.18	0.00	8876	357	0.12	0.00	6502	567	0.24	0.00
2031	1471	840	1.19	0.00	8133	415	0.14	0.00	7803	437	0.16	0.00	8974	325	0.11	0.00	6578	548	0.22	0.00
2032	1478	853	1.20	0.00	8398	451	0.15	0.00	8001	419	0.14	0.00	9154	300	0.09	0.00	6739	529	0.21	0.00

2033	1469	860	1.20	0.00	8510	470	0.17	0.00	8165	415	0.15	0.00	9379	304	0.10	0.00	6868	547	0.21	0.00
2034	1494	871	1.20	0.00	8539	507	0.18	0.00	8377	456	0.16	0.00	9631	331	0.10	0.00	6988	578	0.22	0.00
2035	1503	893	1.20	0.00	8510	531	0.19	0.00	8469	491	0.17	0.00	9714	365	0.11	0.00	7105	623	0.24	0.00

4.3 Employment and dependency

A dependency index of the French and Spanish fleets in the Mediterranean (FAO area 37) in 2012 is calculated to estimate the dependency of these fleets to the main demersal stocks (

Table 4.8). The index is estimated by country and fleet segment (main fishing technique + vessel length) for the species blue and red shrimp (*Aristeus antennatus*), Deep-water rose shrimp (*Parapenaeus longirostris*), European hake (*Merluccius merluccius*), red mullet and striped red mullet (*Mullus barbatus* and *Mullus surmuletus*), and blue whiting (*Micromesistius poutassou*), which were previously identified as main demersal target species for the French and Spanish fleets in GFCM GSAs 6 (Northern Spain) and 7 (Gulf of Lion) in 2012.

Landings in weight and value for these target species and totals by fleet segment, were extracted from the 2014 Annual Economic Report (STECF, 2014). Due to the methodology used to aggregate economic fleet segments there's some level of uncertainty to which GSA these fleets are operating. Nevertheless, it constitutes the best source of information for this analysis.

The dependency index identifies the importance of a species from an economic point of view for a fleet. The index is built by dividing a species value of landings from a fleet segment by the fleet segment's total value of landings. Thus, it measures the dependency in terms of the revenue obtained from key demersal species compared to total revenue of the fleet.

The highest employment can be found in the passive gears polyvalent vessels (PGP) 06-12m, demersal trawlers (DTS), purse seiners (PS). However, the purse seine fleets do not fish the demersal species analysed, while demersal trawlers are significantly dependent on them.

Table 4.8. Top 10 higher employment fleet segments in the area with the number of employed people and dependency degree.

Fleet segment	Employment	Dependency
Spain Area 37 PGP VL0612	1888	8.6
Spain Area 37 DTS VL1824	1499	44.2
Spain Area 37 PS VL1824	930	0.0
Spain Area 37 PS VL1218	767	0.0
Spain Area 37 DTS VL2440	736	61.7
France Area 37 DFN VL0612	444	6.0
Spain Area 37 DTS VL1218	383	26.3
Spain Area 37 HOK VL1218	360	1.6
Spain Area 37 PS VL2440	303	0.2
Spain Area 37 HOK VL0612	223	5.2

In addition, it was also identified the main fleets fishing the target species, which was done by estimating the share of a fleet segment's value of landings for a certain species (or group of species) by the total value of landings of that species in the area.

The following 10 fleet segments were found to be the most dependent on these demersal stocks:

- French demersal trawlers: DTS from 12 to 18 meters, from 18 to 24 meters and from 24 to 40 meters.
- French gillnetters: DFN from 6 to 12 meters and from 12 to 18 meters.
- Spanish demersal trawlers: DTS from 12 to 18 meters, from 18 to 24 meters and from 24 to 40 meters.
- Spanish long-liners: HOK from 6 to 12 meters and from 12 to 18 meters.

Dependency indicators for all fleet segments are presented in the Annex III. For these most dependent fleet segments, socio-economic data from the

2014 Annual Economic Report (STECF, 2014) were extracted and presented in the Annex III.

Table 4.9 presents the dependency degree for the most dependent fleets.

Table 4.9. Dependency degree for the most dependent fleets.

Country	Main gear	Vessel length	Vessels (N)	Total fishers employed	Dependency degree	Target species landing share
Spain	DTS	VL2440	155	736	**61.7%**	**34.0%**
Spain	DTS	VL1824	346	1499	**44.2%**	**45.9%**
Spain	DTS	VL1218	164	383	**26.3%**	9.0%
France	DTS	VL2440	32	149	**23.5%**	3.3%
France	DTS	VL1824	28	84	**21.5%**	2.0%
France	DTS	VL1218			**14.0%**	0.1%
France	DFN	VL0612	404	444	6.0%	0.4%
Spain	HOK	VL0612	80	223	5.2%	0.2%
France	DFN	VL1218	9	26	3.6%	0.0%
Spain	HOK	VL1218	90	360	1.6%	0.1%

Table 4.9 reports that these 10 fleet segments contain a bit more than 1300 vessels, with about 3900 fishers. The Spanish demersal trawlers (DTS) from 18 to 24 meters are the ones employing more fishers, with almost 1500.

The 10 selected fleet segments account for the 53% of all French and Spanish landings in the Mediterranean. However, these fleets are responsible of capturing 95% of all demersal target species analysed. In particular, Spanish demersal trawlers between 18 and 24 m, and 24 and 40 m, are responsible for the 46% and 34%, respectively, of all target species landings. This makes these demersal species to account for the 44% and 62% of all their revenues, making these fleet segments very dependent on the analysed species.

In general, the demersal trawl fleet segments (6) are the ones more dependent on the demersal species. Moreover, between the most dependent segments, these demersal trawlers segments are those that employ the largest number of fishers. For the French gillnetters and Spanish long-liners the importance of these target species in their landings income is lower, between 1.6% and 6%.

Data issues:

- No data is available for the French demersal trawlers (DTS) from 12 to 18 meters.
- Data missing on the implicit value of unpaid labour and annual depreciation costs for France.
- France reports all mullets data under striped red mullet (*Mullus surmuletus*), and so red mullet (*Mullus barbatus*) are reported under striped red mullet. Spain differentiates between red mullet and striped red mullet, but also reports a significant amount of landings under grey mullets (*Mugilidae*). Therefore, all red mullets are analysed together in this section.

5 ToR 2

The experts are also requested to evaluate whether other stocks such as cephalopods and species of family Sparidae will be sufficiently protected through the management measures proposed to achieve FMSY for the stocks mentioned in the scope. Identify those stocks that would need specific conservation measures.

To evaluate if the stocks of Sparidae and cephalopods would be managed by the management measures applied to the target stocks, the EWG looked at the spatial distribution of the stocks and evaluated if there were areas without overlapping between the target stocks and the stocks identified by DGMARE. In such cases it can be argued that the fleet can decouple their fishing effort and directly target these species, which means that the management measures applied to the major stocks will not affect the fleet's activity.

In the areas of study, GSA 6 and GSA 7, there are several commercially important populations of demersal species of fishes, crustaceans and molluscs. A number of these species are clearly coastal, i.e. grey mullets (*Mugilidae*), sea breams (*Sparus aurata* and other sparidae), sea bass (*Dicentrarchus labrax*), some shrimps and many molluscs. The upper zones of the continental shelf are inhabited by species like red mullets (*Mullus barbatus, Mullus surmuletus*), sole (*Solea solea*), gurnards (*Trigla sp.*), poor cod (*Trisopterus minutus capelanus*) and some shrimps.

On the continental slope there are many fish species of great economic interest. Thus in the upper part of the slope (200 and 400m) there are hake (*Merluccius merlucci*us), Norway lobsters (*Nephrops norvegicus*) and various shrimps (e.g. *Parapeneus longirostris*). In deeper waters, from 400 to 600m, the dominant species are the greater forkbread (*Phycis blennoides*), the blue whiting (*Micromesistius poutassou*) and the red shrimps (*Aristeus* *antennatus*). In the Gulf of Lions the area where now is implemented the Fisheries Restricted Area (FRA), was recognized as an important zone where aggregations of spawners of many exploited species (hake, monk fish, lobsters) occur (Figure 5.1). The fishing effort in this area has been frozen to the level of 2008.

Figure 5.1 Fisheries Restricted Area (FRA) zoning in the Gulf of Lions

M. merluccius in the GSA 6 is distributed along the entire coast, shelf and slope (Figure 5.2). The areas showing higher values of biomass, according to the yields obtained, are located in Cabo de Palos, Gulf of Valencia, Columbretes Islands, Badalona, Blanes and Cap de Creus. In GSA 7, hake is a species very widely distributed in the Gulf of Lions since the very coastal sector, near 30m depth, until 800 m. The species is mainly present between 80 and 150 m. A strong spatial persistence of hake appears in the Gulf of Lions FRA.

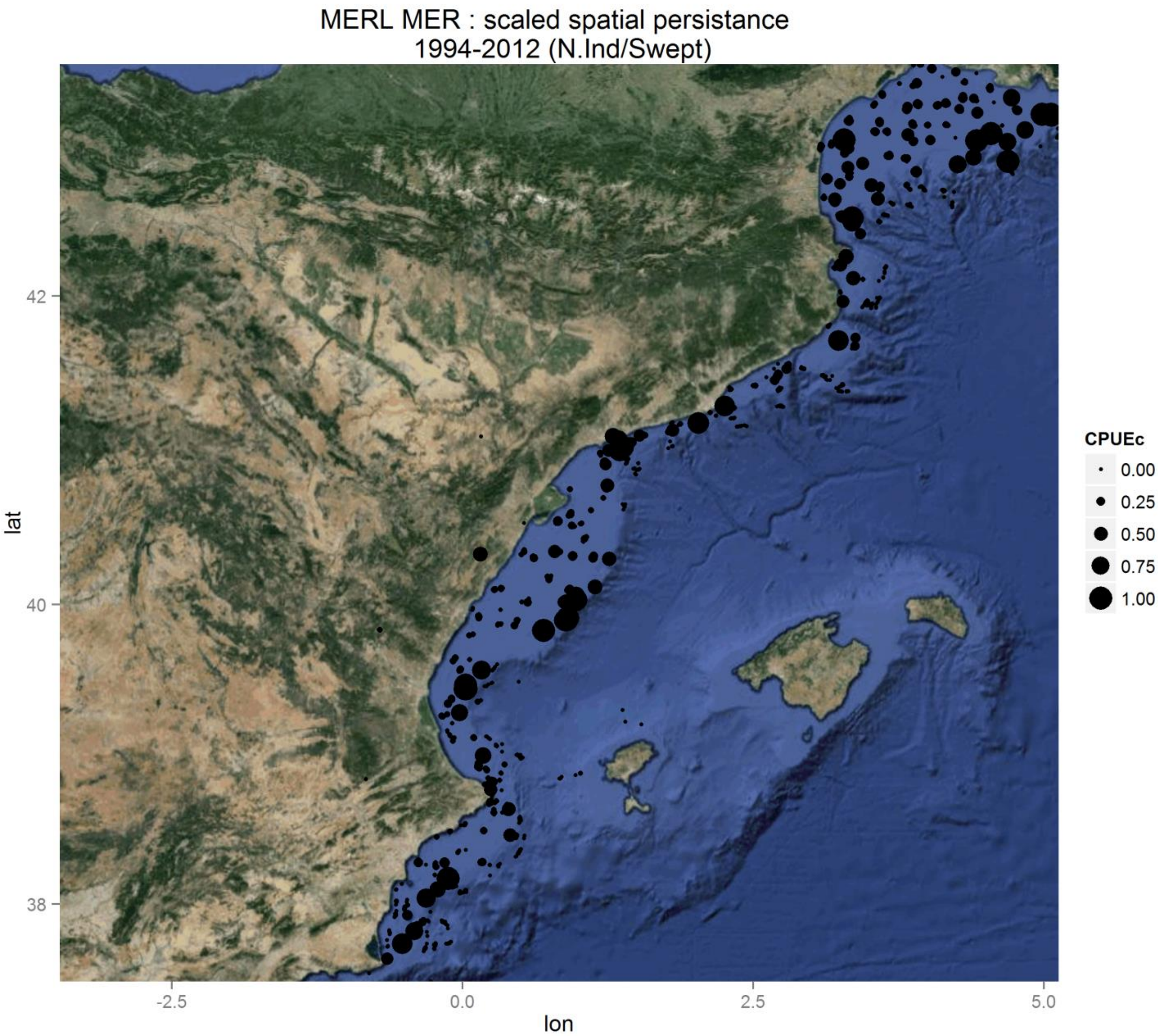


Figure 5.2 Spatial persistence of *Merluccius merluccius* in GSA 6-7 according to MEDITS survey 1994-2012

M. barbatus (Figure 5.3) occurs on sandy and muddy bottoms between 50 and 200m depth in areas with wider continental shelf, whereas *M. surmuletus* has a wider bathymetric range (occurring to a depth of 400 m) but its maximum abundance is concentrated near the coast, on gravel and rocky bottoms between 10 and 100 m depth, especially in areas where the shelf is steepest and with a higher influence of seagrass beds, especially *Posidonia oceanica*. In the GSA 6, red mullet (*M. barbatus*) is distributed along the entire coast, shelf and slope. The areas showing higher values of biomass, according to the yields obtained, are located in Cape de Palos, South of the Gulf of Valencia, Columbretes Islands and Blanes-Cap de Creus.

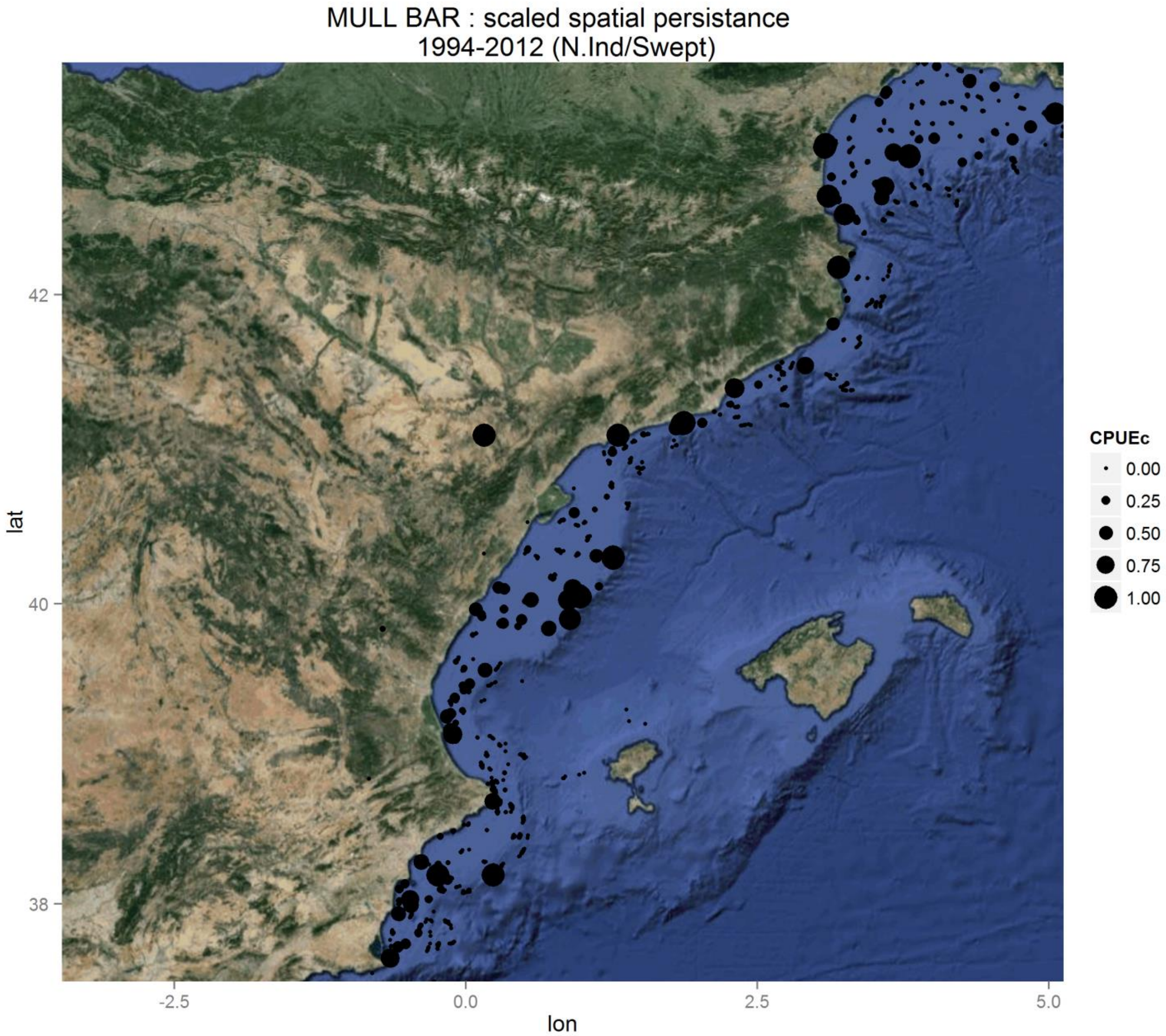


Figure 5.3 Spatial persistence of *Mullus barbatus* in GSA 6-7 according to MEDITS survey 1994-2012

In the GSA 6, striped red mullet (*M. surmuletus)* (Figure 5.4) is distributed along the entire coast, shelf and slope. The areas showing higher values of biomass, according to the yields obtained, are located in Santa Pola-Alicante, South of the Gulf of Valencia, in front of Valencia-Sagunto, Columbretes Islands, Barcelona and Blanes.

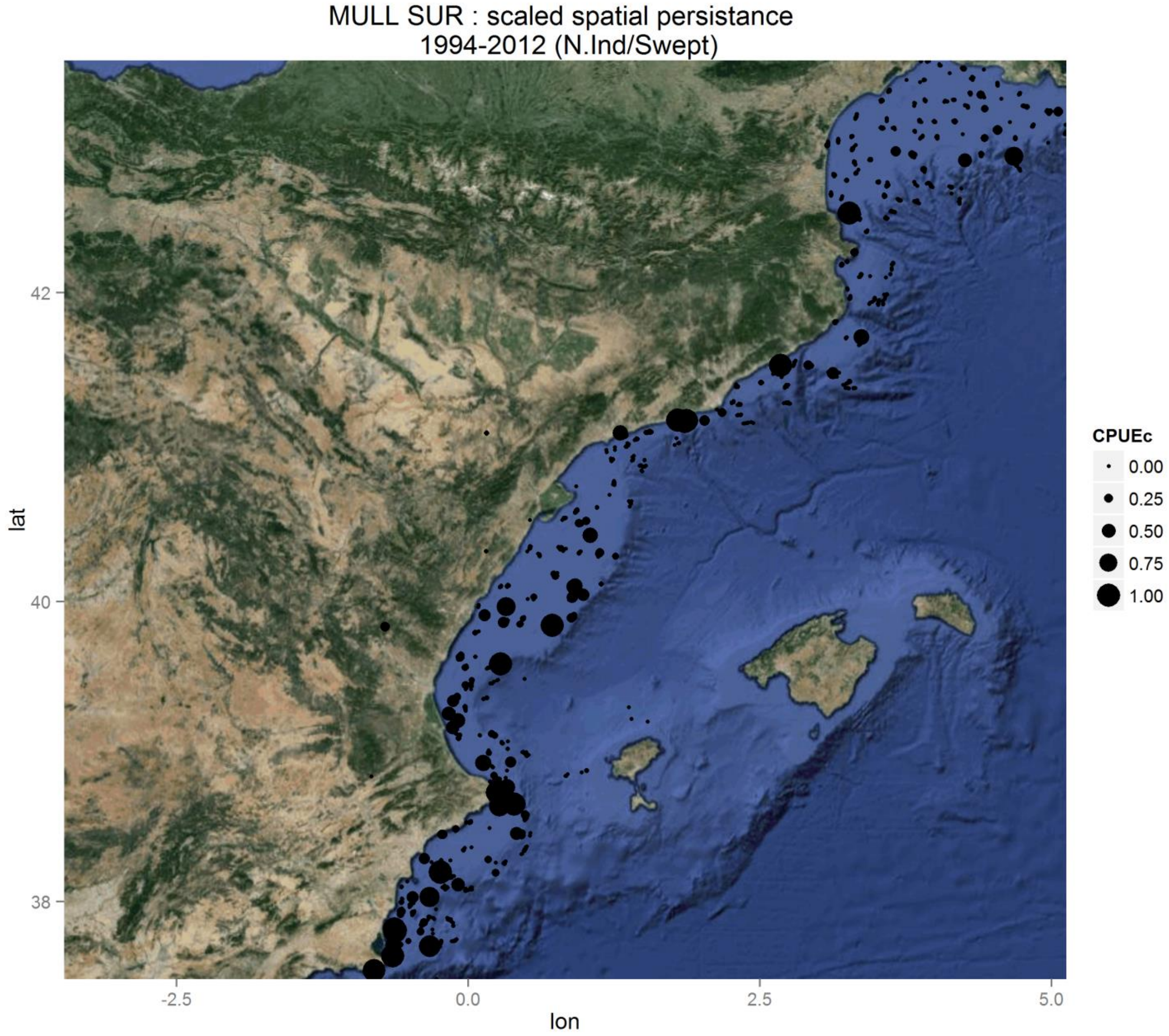


Figure 5.4 Spatial persistence of *Mullus surmuletus* in GSA 6-7 according to MEDITS survey 1994-2012

Deepwater pink shrimp is distributed from 150 to 400 m depth in GSA 06, with higher densities on soft muddy bottoms in the southern part of GSA and, in years of high abundance of the population also in the north of GSA 06. The areas showing higher values of biomass, according to the yields obtained, are located in Santa Pola-Alicante and from Tarragona to the North (Cap de Creus).

The Norway lobster (*Nephrops norvegicus*) (Figure 5.5) is a demersal species found on muddy bottoms along the coasts of the Iberian Peninsula. It is a sedentary lobster that inhabits borrows built in the mud and is found at depths ranging from 20 to 800 m. In GSA 6, Norway lobster it is distributed along the entire coast, shelf and mainly in the slope. The areas showing higher values of biomass, according to the yields obtained, are located in front of Mar Menor, North and South of Cape San Antonio and Cap de Creus. A strong spatial persistence of Norway lobster appears in the Gulf of Lions FRA.

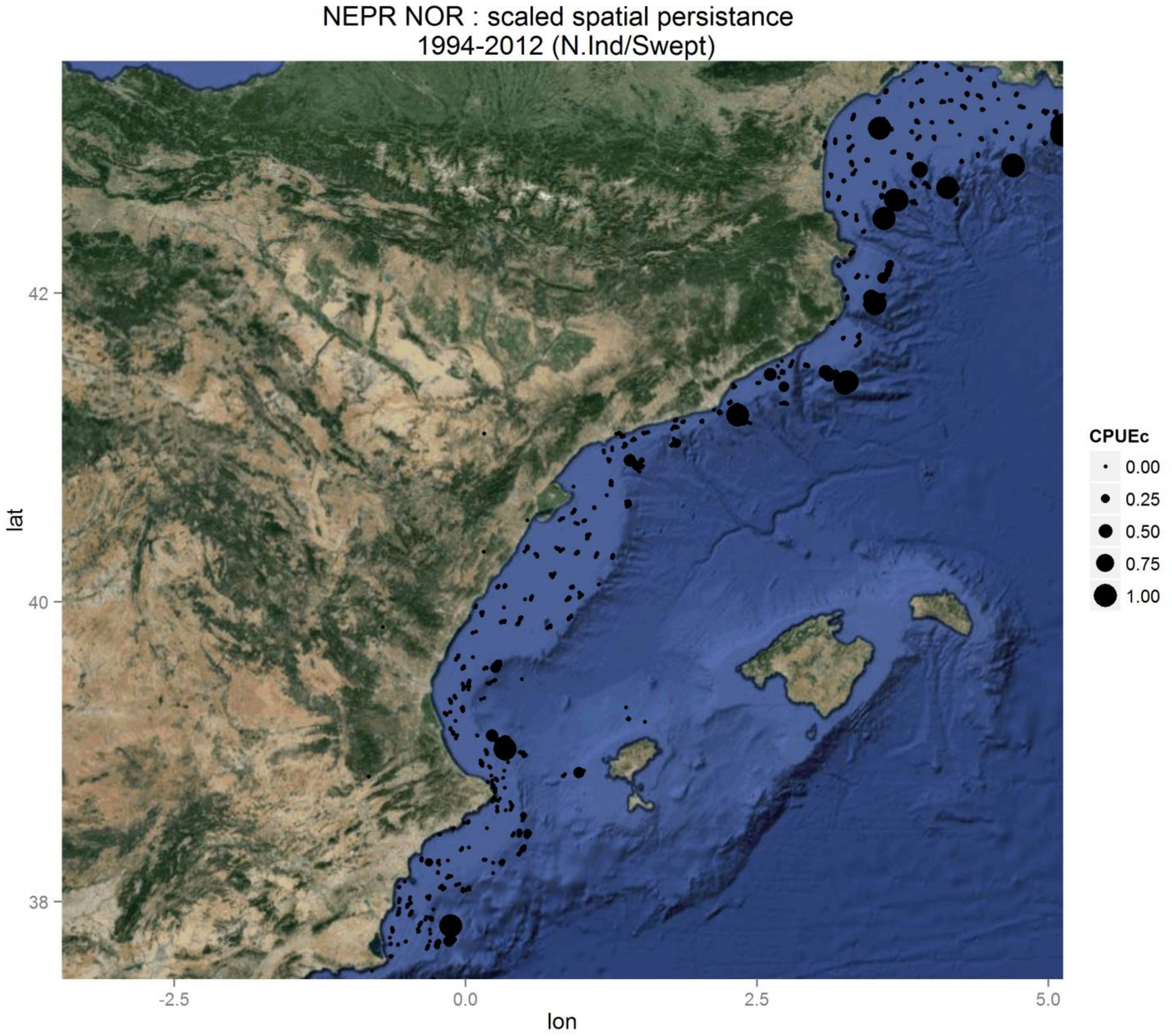


Figure 5.5 Spatial persistence of *Nephrops norvegicus* in GSA 6-7 according to MEDITS survey 1994-2012

The Red shrimp (*Aristeus antennatus*) (Figure 5.6) is a demersal species that is found on the muddy bottoms of the slope of the continental shelf, more specifically in zones close to the submarine canyons. Its distribution area is very wide, since it is found in the Mediterranean and Atlantic south of the Iberian peninsula. In the Western Mediterranean (GSA 6 and 7), its bathymetric distribution is wide, being found between depths of 350 and 800 m. In the GSA 6, red shrimp it is distributed along the entire coast slope, appearing in areas associated to the presence of submarine canyons. The areas showing higher values of biomass, according to the yields obtained, are located in Mar Menor- Torrevieja, Barcelona-Blanes and Cap de Creus. A strong spatial persistence of red shrimp appears in the Gulf of Lions FRA.

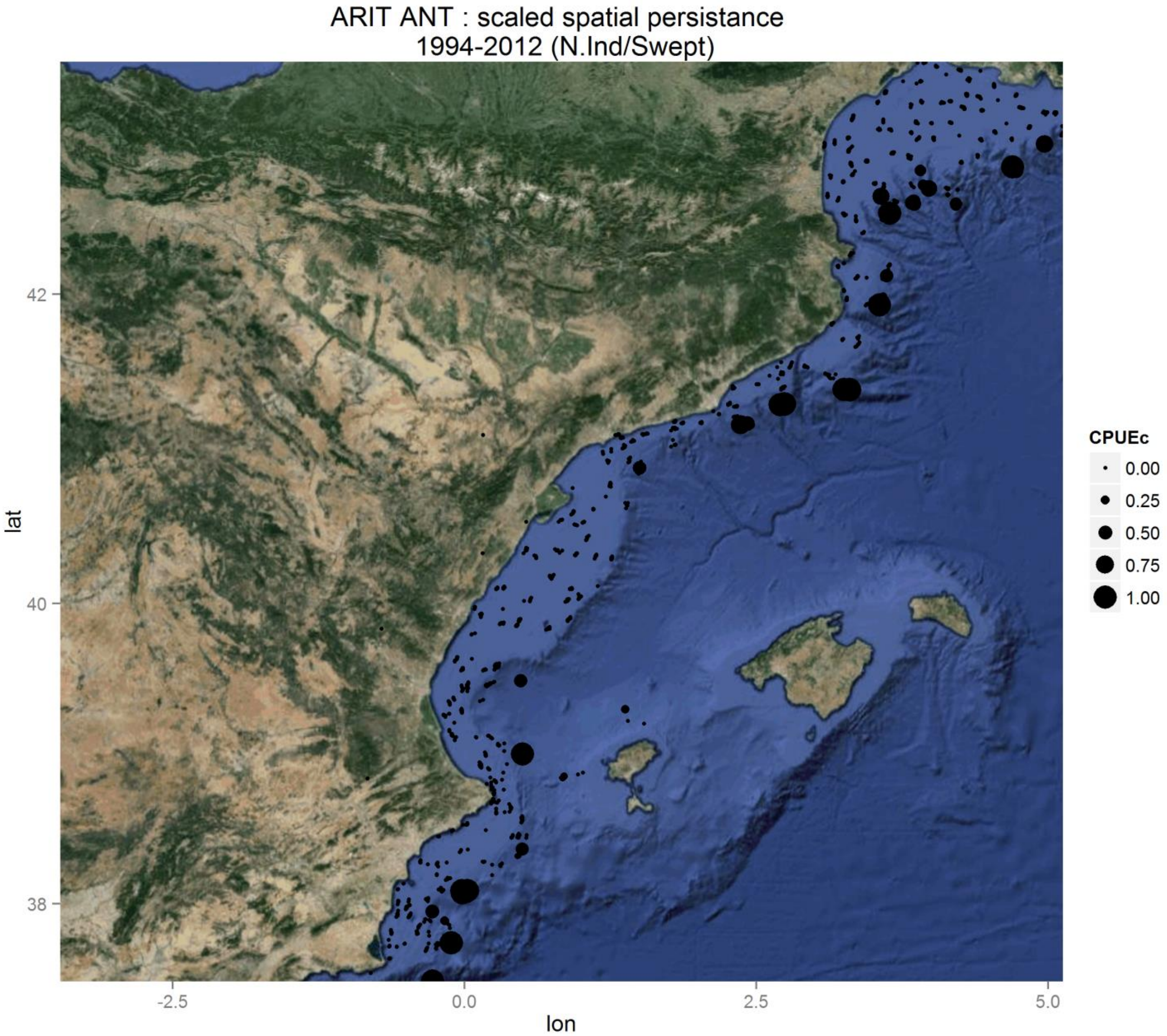


Figure 5.6 Spatial persistence of *Aristeus antennatus* in GSA 6-7 according to MEDITS survey 1994-2012

Lophius has its two species distributed throughout the Mediterranean. The monkfish *Lophius piscatorius* L. and the black bellied monkfish, *Lophius* *budegassa*, with both species being considered as purely benthic, since they are distributed from shallow waters down to depths of more than 500 m. In the GSA 6, the black bellied monkfish (*L. budegassa) (*Figure 5.7) is distributed along the entire coast, shelf and slope. The areas showing higher values of biomass, according to the yields obtained, are located in Santa Pola-Alicante, South of the Gulf of Valencia, South of Ebro River, Blanes and Cap de Creus. In GSA 7 blackbellied angler is widely distributed on the shelf and upper slope part, the standardized CPUE is higher than in GSA 6. A strong spatial persistence of blackbellied angler appears in the Gulf of Lions FRA.

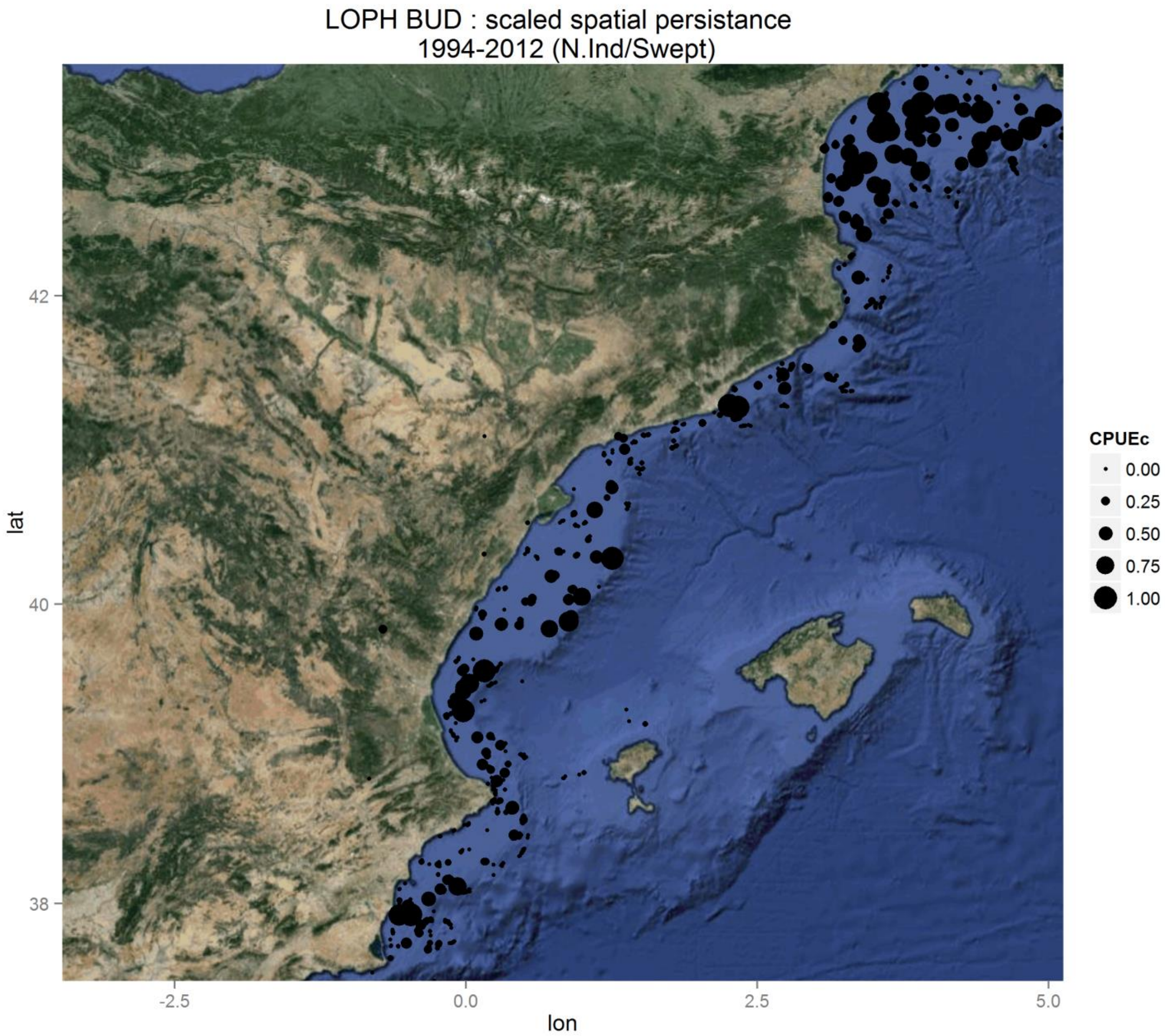


Figure 5.7 Spatial persistence of *Lophius budegassa* in GSA 6-7 according to MEDITS survey 1994-2012

Lophius piscatorius has a wide distribution in GSA 6 and 7 (Figure 5.8), however in the Gulf of Lions is more present on the shelf than *L. budegassa*. A strong spatial persistence of monk-fish appears in the Gulf of Lions FRA.

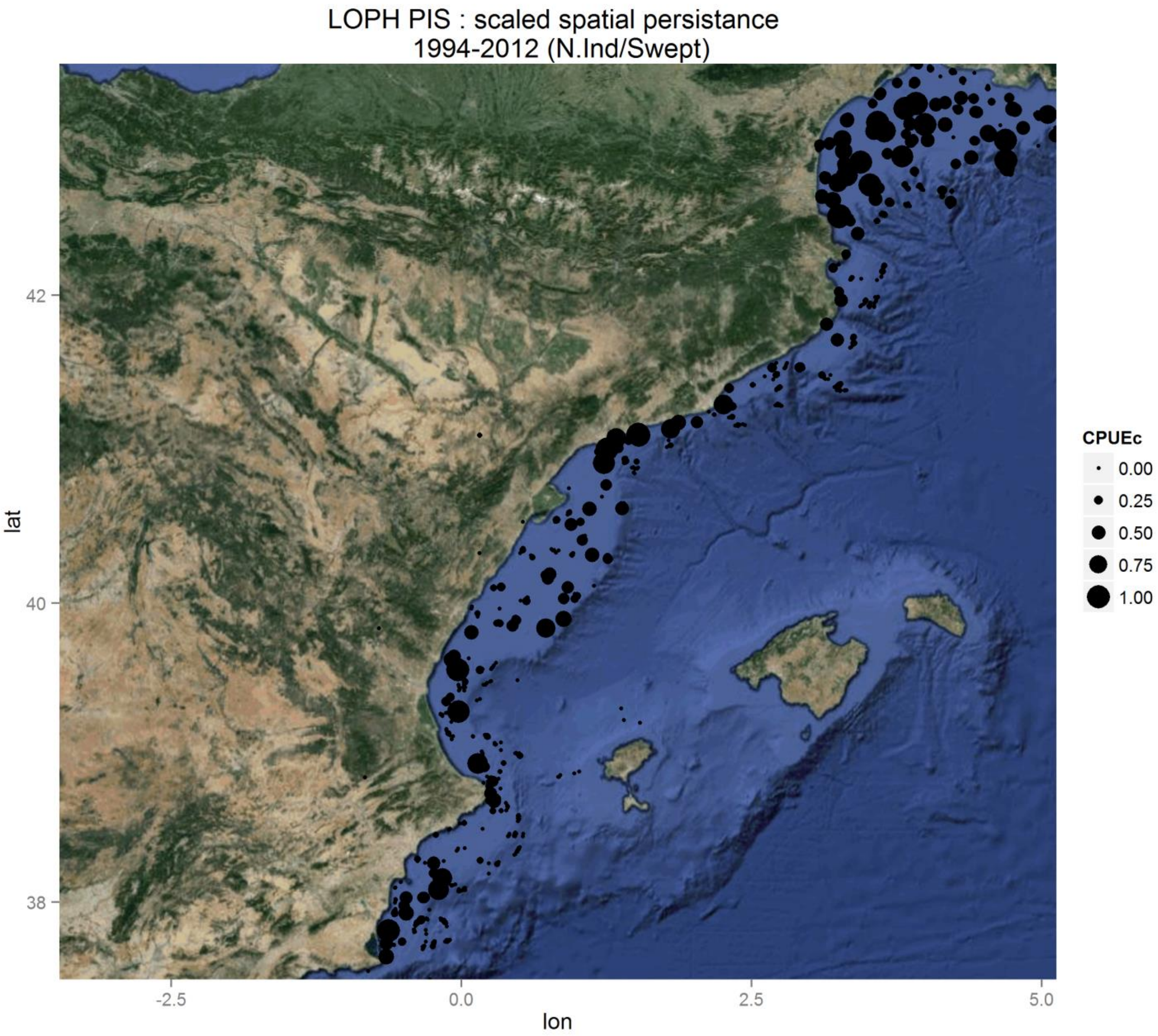


Figure 5.8 Spatial persistence of *Lophius piscatorius* in GSA 6-7 according to MEDITS survey 1994-2012

The spatial persistence of Blue whiting (*Micromestius poutassou)* (Figure 5.9) is predominantly associated to the upper slope in both GSA 6 and 7 while on the shelf there are low CPUEs. A strong spatial persistence of blue whiting appears in the Gulf of Lions FRA.

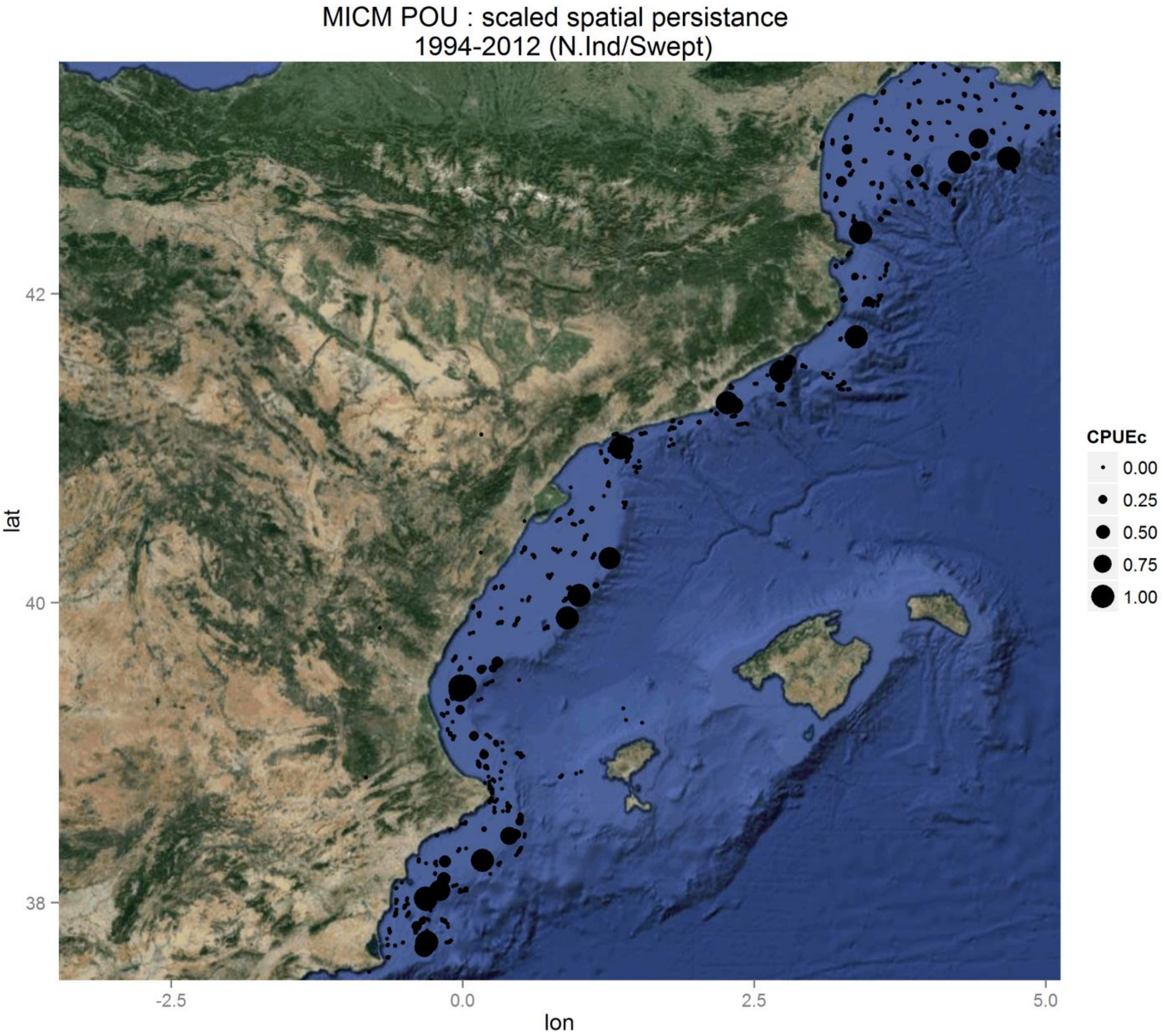


Figure 5.9 Spatial persistence of *Micromestius poutassou* in GSA 6-7 according to MEDITS survey 1994-2012

The spatial persistence of Cephalopods and Sparidae were computed by aggregating all classified as “C” in the MEDITS faunistic cathegory and the genus 'DIPL' 'SPAR' 'DENT' 'SPIC' 'BOOP' 'PAGE' 'SARP' 'LITH', respectively.

The spatial persistence for Cephalopods (Figure 5.10) shows a distribution predominantly on the shelf and in coastal areas, particularly in GSA 6.

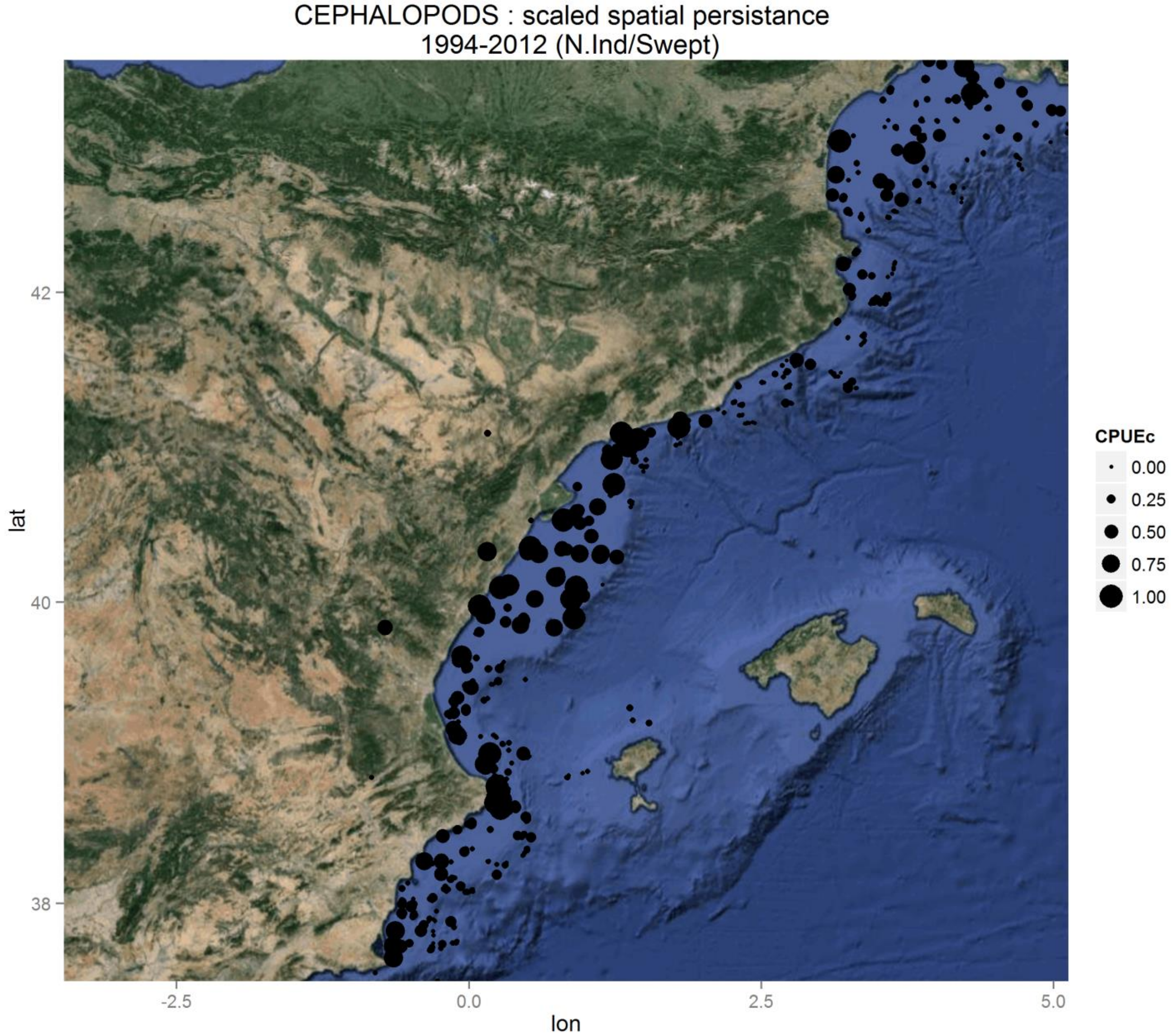


Figure 5.10 Spatial persistence of all Cephalopods in GSA 6-7 according to MEDITS survey 1994-2012

The spatial persistence for Sparidae (Figure 5.11) shows a distribution predominantly in coastal areas, particularly in GSA 6. However there are some large abundances at the shelf break in GSA 6, likely due to captures of *Pagellus bogaraveo*.

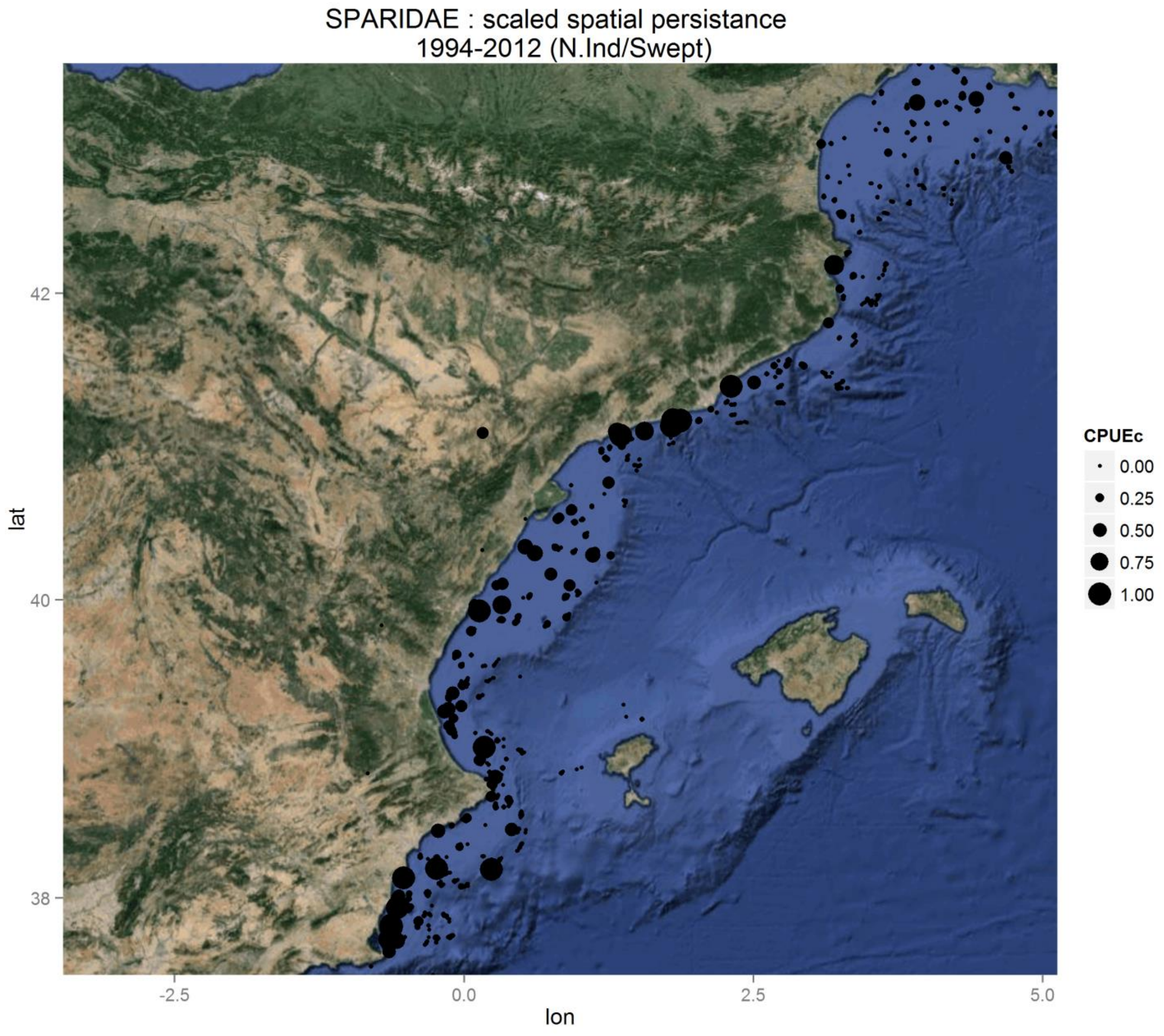


Figure 5.11 Spatial persistence of Sparidae in GSA 6-7 according to MEDITS survey 1994-2012

Cephalopods spatial persistence is not overlapping with the main species under management since these are predominantly at the shelf break, with some minor exceptions in GSA 7 for *Lophius*.

In the case of Sparides, given the predominantly coastal distribution of the stock no strong overlap can be identified with the distribution of hake and other stocks under management. As such, controlling the fishing effort targeting hake and red mullets is unlikely to reduce fishing mortality on the

Sparides. A possible exception could be *Pagellus bogaraveo*, but it was not possible to further explore this stock in detail.

Overall there are large areas of no-overlapping between the target stocks of the management plans (HKE, MUT, etc) and Cephalopods and Sparidae, which suggests that managing the target species will have only a limited constraint on the exploitation of these groups. It is also impossible predicting fishermen behaviour in response to management plans for target stocks, e.g. fishermen with a strong limitation of hake might switch to a more coastal targeting to avoid hake, thus increasing exploitation on Sparidae.

The analysis spatial persistence of abundance suggests that the FRA overlaps with an area of high abundance of hake, blue whiting, red shrimp and Norway lobster, although the models used by the EWG 15-09 were not suited to estimate the precise impact of this area.

6 CONCLUSIONS

- In all stocks tested the exploitation rate is largely above the targets and would benefit from a reduction of fishing mortality that aligns the exploitation with the CFP objectives. The MAPs may be the best tool to achieve these reductions.
- The difference between reaching Fmsy in 2020 or 2018 is most likely an overestimation due to the lack of mixed fisheries interactions, which would constrain the intended decrease.
- In the cases tested the distinction between the CFP 2020 scenario (option 2) and the MAPs was not very evident. The large decrease in F required to align the exploitation with MSY, blurs the effects of exploiting the stocks at relatively small differences in F that the Fmsy ranges provide.

- The Spanish economic fleet segments of demersal trawls and seiners (DTS) with length overall 12-18m, 18-24m and 24-40, are among the largest employers and are very dependent on the species likely to be under the MAP.

- There are areas of non-overlapping between the target stocks (HKE, MUT, etc) and cephalopods and sparidae, which suggests that managing the target species will only have a limited constraint on the exploitation of these groups.

- Hake in GSA 6 shows a clear pattern of decreasing recruitment and a high exploitation rate, focused on recruits and individuals of age 1. This situation requires immediate attention.

- Most fleets concentrate their exploitation on young ages: age-classes 0, 1, although in the case of crustaceans, age classes 2 and 3 are also important if not dominant (e.g. *Parapenaeus, Nephrops*).

- For the stocks hake in GSAs 6 and 7, red mullet in GSA 6, deep water shrimp in GSA 6 and rose shrimp in GSA 6, the EWG computed proxies for fmsy ranges using a meta-analysis, and tested the robustness of the upper levels to mis-specifications of M and S/R. In the case of deep water shrimp the upper range was not robust.

- The safeguards don’t operate in the cases studied, due to the large increase in biomass that the simulations show. As such, the impact of having safeguards could not be evaluated.

- Mixed fisheries methods dealing with all the relevant species in the areas of the MAP were not available. The EWG developed single species, single fleet MSEs in FLR/a4a to deal with the request.

- For the stocks studied there aren't biological management references set, like Bpa or Blim. The approach applied was to compute Bpa using a multiplier (1.4) of the minimum biomass observed.

- In most cases explored, the distance between current f and the targets is very high. The decrease in F simulated drive the stocks to a dynamics unseen in the recent past, which raises concerns about the assumptions made for population dynamics. In particular for the hake stocks.

- Rebuilding the time series of landings and surveys would be helpful in understanding the historical dynamics of the stocks and fisheries. However, in most stocks, abundance is suspected to be at historical lows in the last 10-15 years. Rebuilding historical catches and employing methods that can deal with time-varying catchability, would be a starting point to have a better understanding of the dynamics of fish stocks in the Mediterranean at decadal scales.

- Building a time series of catch at age by fleet will provide the basis for fleet based forecasts and management testing. This task would require considerable effort of digitizing and exploiting existing length frequency data in specific fisheries research centers.

- The analysis was limited by availability of data, assessments and time.

- The economic analysis was limited due to inconsistencies in the data.

- The analysis spatial persistence of abundance suggests that the FRA overlaps with an area of high abundance of hake, blue whiting, red shrimp and nephrops, although the models used by the EWG were not suited to estimate the precise impact of this area.

7 REFERENCES

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JOE.- 2013. 2 mars 2013 Texte 25 sur 112. Arrêté du 28 février 2013 portant adoption d'un plan de gestion pour la pêche professionnelle au chalut en mer Méditerranée par les navires battant pavillon français. NOR : TRAM1304962A.

Scientific, Technical and Economic Committee for Fisheries (STECF) – Assessment of Mediterranean Sea stocks - part 1(STECF-14-17). 2014. Publications Office of the European Union, Luxembourg, EUR 26955 EN, JRC 93120, 393 pp.

8 CONTACT DETAILS OF STECF MEMBERS AND EWG-15-09 LIST OF PARTICIPANTS

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9 LIST OF ANNEXES

Electronic annexes are published on the meeting's web site on:
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List of electronic annexes documents:

1. Annex I Description of the fisheries in GSA 06 and 07.
2. Annex II Spatial distribution of stocks under MAP in GSA 06 and 07.
3. Annex III Fisheries employment and dependencies.
4. Annex IV R code to reproduce analysis in the report.
5. Annex V Fmys ranges proxies calculation and documentation.

10 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:

http://stecf.jrc.ec.europa.eu/web/stecf/ewg1509

List of background documents:

1. EWG-15-09 – Doc 1 - Declarations of invited and JRC experts (see also section 8 of this report – List of participants)

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EUR 27405 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: Scientific, Technical and Economic Committee for Fisheries. Western Mediterranean Multi-annual Plan (STECF 15-09).

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