

Stock Assessment Form version 1.0 (January 2014)

Uploader: [T. Rouyer](#)

Stock assessment form

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1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
<i>Mullus barbatus</i>	Red mullet	33 MUT
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
GSA 07		
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
1st Country	2nd Country	3rd Country
France	Spain	
4th Country	5th Country	6th Country
Stock assessment method: (direct, indirect, combined, none)		
Indirect (XSA and Yield per Recruit)		
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2 Stock identification and biological information

The Gulf of Lions (GSA07) is used as an individualized area for the assessment and management of red mullet in the western Mediterranean. However no study currently allows to state that the red mullet stock is isolated from concomitant areas, for instance from the GSAs 05 and 06.

2.1 Stock unit

2.2 Growth and maturity

Table 2.2.1: Maximum size, size at first maturity and size at recruitment.

Somatic magnitude measured	LT	Units	cm		
Sex	Fem	Mal	Combined	Reproduction season	
Maximum size observed			29	Recruitment season	
Size at first maturity			8.6	Spawning area	
Recruitment size to the fishery			5	Nursery area	

Table 2.2.2: M vector and proportion of matures by size or age (combined)

Age	Natural mortality	Proportion of matures
0	0.83	0.37
1	0.35	0.85
2	0.26	0.95
3	0.18	0.97
4	0.15	0.98
5+	0.14	1

Natural mortality was obtained from PRODBIOM (Abella et al., 1997) and the maturity was obtained from DCF data collected in the GSA 7 over the period 2003-2012 by IFREMER.

Table 2-3: Growth and length weight model parameters

Growth model	L _∞	Units	Sex			Years
			female	male	Combined	
	K					29
	t ₀					0.25
						-1.28
	Data source	Inbio, based on DCF data collected by IFREMER (2006-2010) in GSA 07				
Length weight relationship	a					0.0077
	b					3.1315
	sex ratio (% females/total)	(*)				

(*) Sex-ratio at length from data collected in the GSA 7 (2003-2012) by IFREMER for the DCF was used to compute the number of females and males at length. The following proportions of females at length were used:

Size (cm)	1-17	18	19	20	21	22	23	24-33	34	35
Prop. Of Fem	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.46	0.47	0.47

From 2004 to 2011 the growth curve derived from age-length keys has been used to slice the data and for 2012 an age-length key was produced based on 2012 DCF data collected in GSA 07 and processed using COST tools:

Size (mm)	0	1	2	3	4	5
80	10	0	0	0	0	0
90	10	1	0	0	0	0
100	11	5	0	0	0	0
110	10	28	0	0	0	0
120	10	42	2	0	0	0
130	2	53	2	0	0	0
140	0	41	5	0	0	0
150	2	39	22	0	0	0
160	2	27	29	1	0	0
170	0	25	30	1	1	0
180	0	13	42	3	0	0
190	0	4	32	4	0	0
200	0	1	24	4	0	0
210	0	0	20	3	0	0
220	0	1	9	2	1	0
230	0	0	5	1	1	0
240	0	0	0	0	2	0
250	0	0	0	3	1	0
260	0	0	0	0	2	1
270	0	0	0	0	1	0
280	0	0	0	0	1	0
290	0	0	0	0	7	3
300	0	0	0	0	6	4
310	0	0	0	0	5	5
320	0	0	0	0	4	6
330	0	0	0	0	3	7
340	0	0	0	0	2	8
350	-	-	-	-	-	-
360	-	-	-	-	-	-
370	0	0	0	0	1	9
380	-	-	-	-	-	-
390	0	0	0	0	0	10
400	-	-	-	-	-	-
410	0	0	0	0	0	10

3 Fisheries information

3.1 Description of the fleet

In the Gulf of Lions (GFCM-GSA 07), red mullet (*Mullus barbatus*) is exploited by both french and spanish trawlers. Information on french gillnetters is only available for 2011, but although it is

suspected that they have been fishing red mullet in the past, no data is available to quantify their catches. Between 2004 and 2012, around 100 boats have been involved in the fishery. According to official statistics, during this period the total annual landings have oscillated around an average value of 190 tons and the french trawlers have been dominating the fishery, as they represented 76% of the boats (103 boats) and 83% of the landings (158 tons). Between 2010 and 2012 the number of trawlers decreased by 20% and it decreased by 40% over the 2004-2012 period. This follows management measures to reduce the number of boats. A temporary closure of 1 month by year for the trawlers has been enforced since 2011. The mean modal lengths in the catches of the french and spanish trawlers were 13 and 15cm, respectively and the length at first capture is about 7 cm. Catch is mainly composed by individuals of age 0, 1 and 2, while the oldest age class (5+ group) is poorly represented. In GSA 07, the trawl fishery is a multi-specific fishery. In addition to *M. barbatus*, the following species can be considered important by-catches: *Merluccius merluccius*, *Lophius sp.*, *Pagellus sp.*, *Trachurus sp.*, *Mullus surmuletus*, *Octopus vulgaris*, *Eledone sp.*, *Scyliorhinus canicula*, *Trachinus sp.*, *Triglidae*, *Scorpaena sp.*

Table 3-1-1.: Description of operational units exploiting the stock

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	France	GSA 07	E – trawl (12-24m)	03 - Trawls	33 – Demersal shelf species	MUT
Operational Unit 2	Spain	GSA 07	E – trawl (12-24m)	03 - Trawls	33 – Demersal shelf species	MUT

Table 3-1-2.: Catch, bycatch, discards and effort by operational unit in the reference year

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
FRA 07 I 03 33 - MUT	69	150 tons	M. merluccius, M. surmuletus, Solea spp., Lophius spp., S. aurata, D. labrax, Pagellus spp., M. poutassou, T. m. capelanus, O. vulgaris and Eledone spp.	No		
ESP 07 I 03 33 - MUT	25	29 tons	M. merluccius, M. surmuletus, Solea spp., Lophius spp., Pagellus spp., M. poutassou, T. m. capelanus, O.	No		

			vulgaris and E. cirrhosa			
Total	94	179				

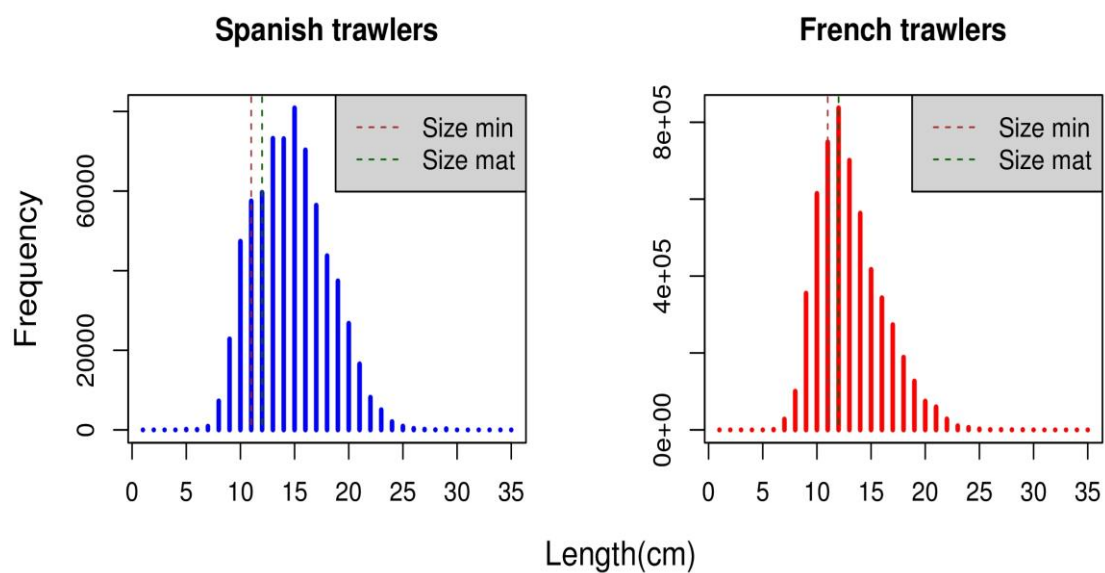


Figure 3.1.1: Length-frequency distributions of red mullet caught by spanish (left) and french (right) trawlers in the GSA 07. The red dotted line represents the minimum legal size and the green dotted line the size at maturity.

3.2 Historical trends

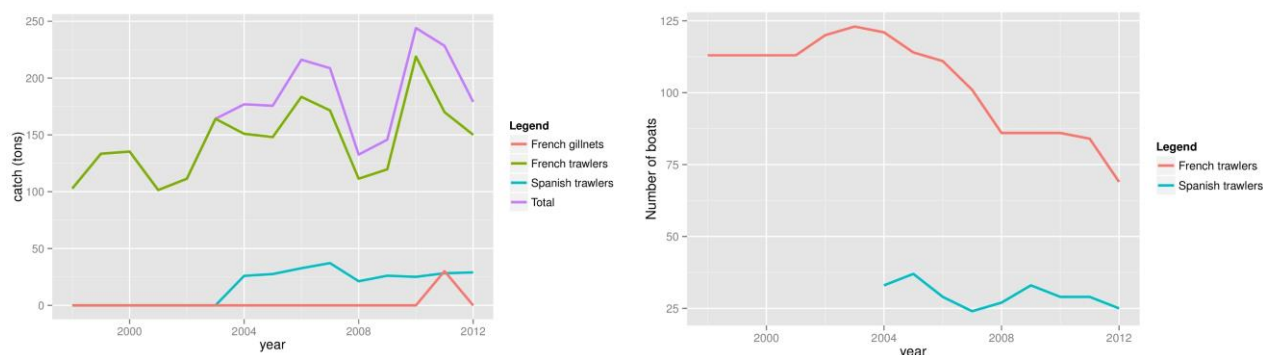


Figure 3.2.1: On the left panel, time series of catch of red mullet in the GSA 07 for the french gillnets and the french and spanish trawlers. On the right panel, time series of the number of french and spanish trawlers operating in GSA 07.

The total catch of red mullet in GSA 07 has been increasing from 103 tons in 1998 to 179 tons in 2012. The total catch has been driven by the french trawlers, whose catch accounted for 83% over the period 2004-2012. Data on french gillnets was only available for 2011 even though it is likely that this fleet was catching red mullet in the past. Between 2010 and 2012 the number of trawlers decreased by 20% and it decreased by 40% over the 2004-2012 period. This follows french management measures to reduce the number of boats in the fleet. From a maximum number of 123 trawlers in 2003, the french fleet is nowadays composed by 69 units.

3.3 Management regulations

French trawlers

- Fishing license: fully observed
- Engine power limited to 316 KW or 500 CV: not observed
- Cod-end mesh size (bottom trawl: square 40 mm or 50 mm diamond with derogation): not fully observed
- Fishing forbidden within 3 miles (France): not fully observed

Spanish trawlers

- Fishing license: fully observed
- Engine power limited to 316 KW or 500 CV: not observed
- Mesh size in the codend (square 40 mm or 50 mm diamond with derogation): fully observed
- Fishing forbidden <50 m depth: fully observed
- Time at sea: fully observed

In 2009, the GFCM proposed to create a High Sea Fishery Restricted Area (FRA, GFCM/33/2009/1) in which the fishing effort for demersal stocks of vessels using towed nets, bottom and mid-water longlines, bottom-set nets shall not exceed the level of fishing effort applied

in 2008 in the fisheries restricted area of the eastern Gulf of Lions. The FRA area is bounded by lines joining the following geographic coordinates: 42°40'N, 4°20' E; 42°40'N, 5°00' E; 43°00'N, 4°20' E; 43°00'N, 5°00' E. This fisheries restricted area was established in article 4 from the EU Regulation No. 1343/2011 of the European Parliament and of the Council of 13 December 2011. In 2012 both french (Arrêté du 28 décembre 2012, NOR: TRAM1240493A) and spanish (Orden AAA/1857/2012 de 22 de agosto) governments published their own laws regulating the FRA. A temporary closure of 1 month by year for the french trawlers has been enforced since 2011.

3.4 Reference points

Table 3.-1: List of reference points and empirical reference values previously agreed (if any)

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F					
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 MEDITS

4.1.1 Brief description of the direct method used

Fishery independent information regarding the state of the red mullet in GSA 07 was derived from the international survey MEDITS. MEDITS surveys have been carried out from late spring to middle summer, between 1994 and 2012, following random depth-stratified sampling design. Five depth strata were considered: 10-49m, 50-99m, 100-199m, 200-499m and 500-800m. The gear used was a GOC 73, an experimental bottom trawl gear, with a cod-end mesh size of 20 mm. Sampling duration depended on the depth of the sampling station: 30 minutes for the samples on the shelf (10-199m) and 60 minutes for those in the slope (200-800m). Further details are given in Bertrand et al. (2002).

The data was assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Catches by haul were standardized to 60 minutes hauling duration. The abundance and biomass indices were calculated through stratified means (Cochran, 1953; Saville, 1977). This involves weighting the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas:

$$Y_{st} = \sum (Y_i * A_i) / A$$

$$V(Y_{st}) = \sum (A_i^2 * s_i^2 / n_i) / A^2$$

Where:

A=total survey area

A_i=area of the i-th stratum

s_i=standard deviation of the i-th stratum

n_i=number of valid hauls of the i-th stratum

n=number of hauls in the GSA

Y_i=mean of the i-th stratum

Y_{st}=stratified mean abundance

V(Y_{st})=variance of the stratified mean

Length distributions were obtained by the sum of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata.

4.1.2 Spatial distribution of the resources

No maps are currently available to describe the spatial distribution of the resource.

4.1.3 Historical trends

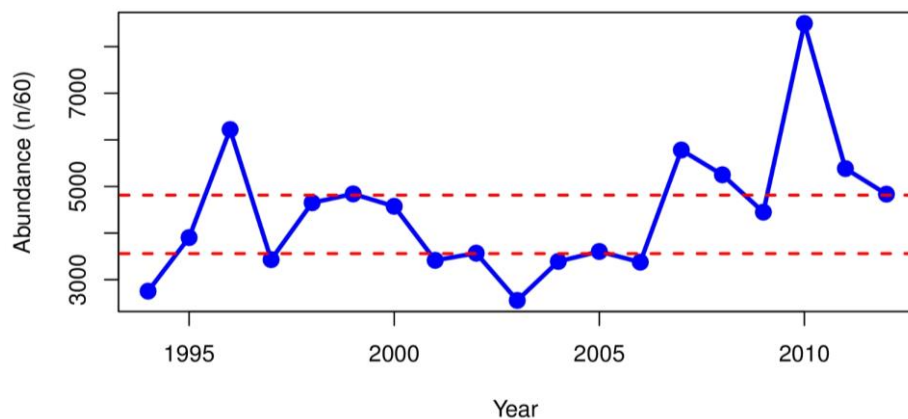


Figure 4.1.3.1: Total MEDITS abundance time series for red mullet in GSA 07. The two red dotted lines indicate the 33rd and 66th percentiles of the time series.

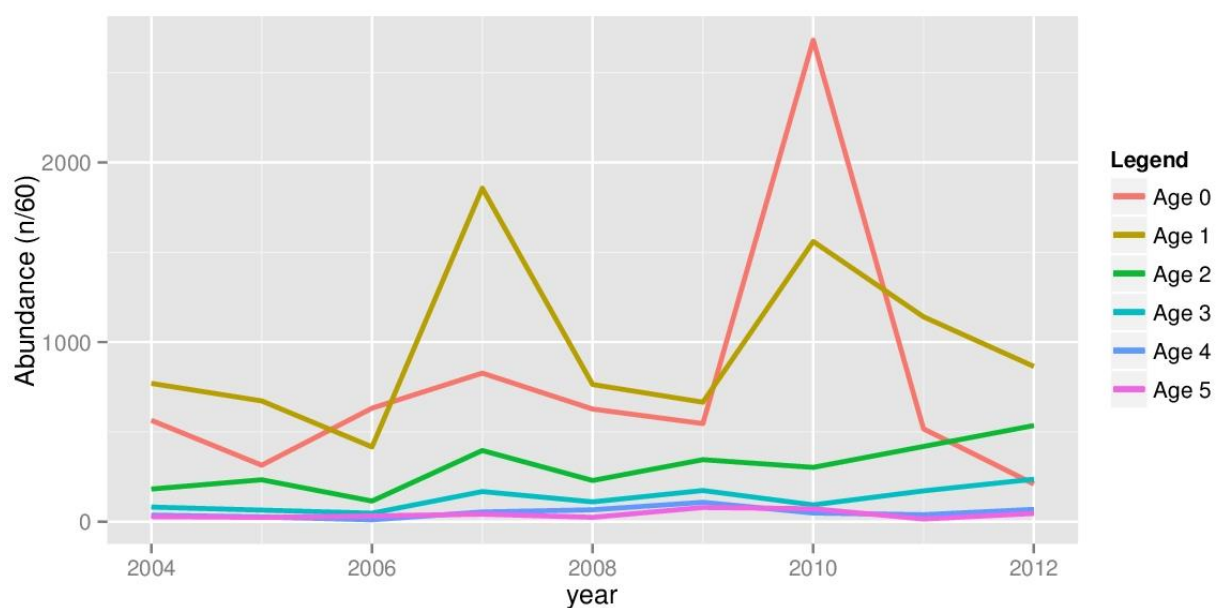


Figure 4.1.3.2: MEDITS abundance time series for each red mullet age class in GSA 07, as used to tune the XSA analysis.

5 Ecological information

5.1 Protected species potentially affected by the fisheries

No list of protected species that can be potentially affected by the fishery is currently available.

5.2 Environmental indexes

There is currently no evidence for any environmental index to be relevant for the fishery.

6 Stock Assessment

6.1 Extended Survivor Analysis (XSA)

6.1.1 Model assumptions

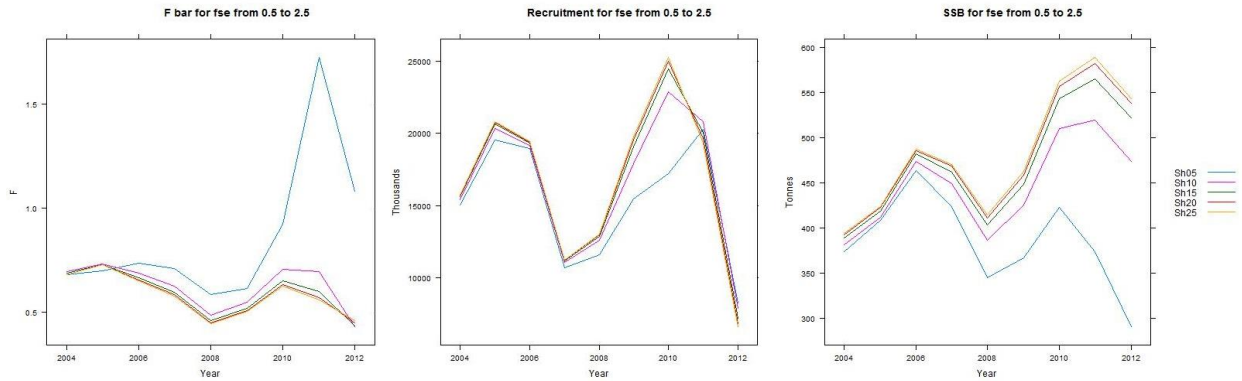


Figure 6.1.1.1: Sensitivity analysis to investigate shrinkage strength

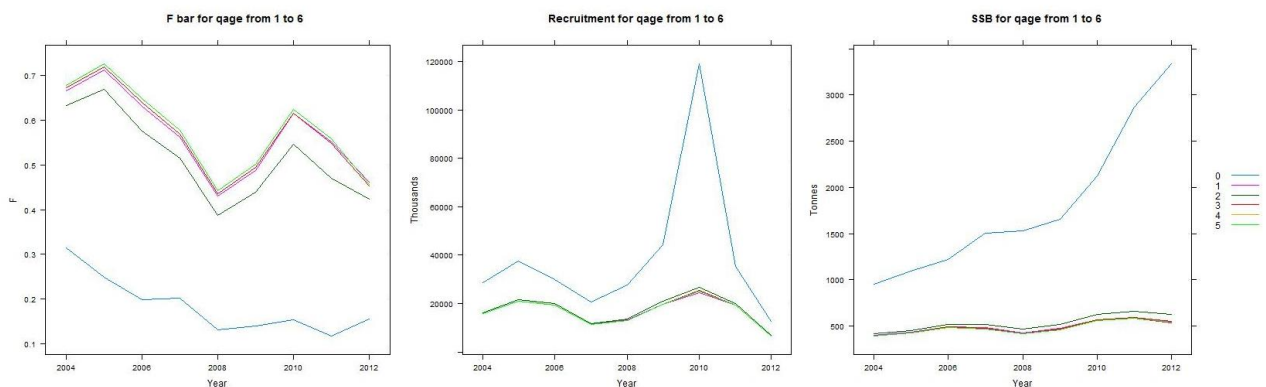


Figure 6.1.1.2: Sensitivity analysis to investigate the age shrunk

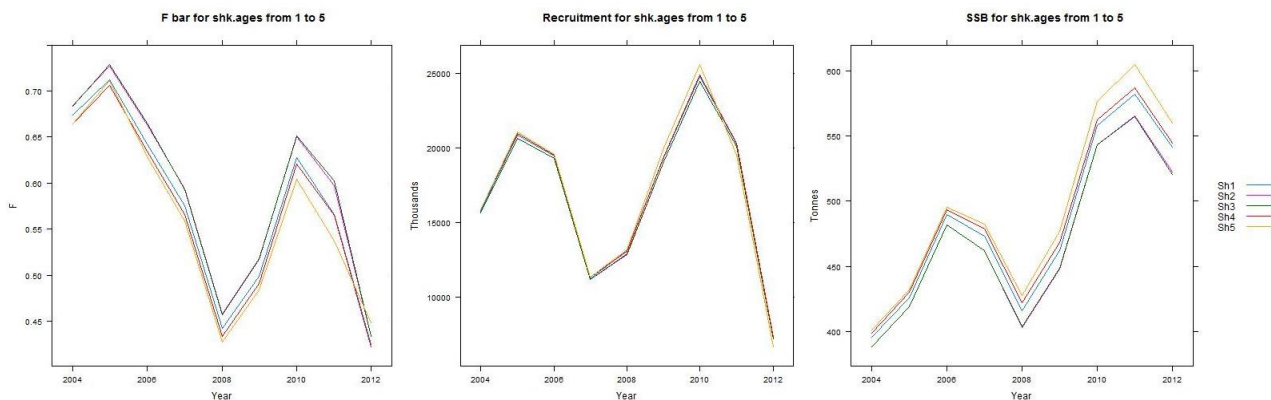


Figure 6.1.1.3: Sensitivity analysis to investigate the age above which catchability is assumed constant

The selection of the suitable parameters for the final XSA run was performed by running sensitivity and retrospective analyses, to ensure the robustness of the final estimates. For instance a value of 0.5 for the shrinkage weight was found inappropriate as it induced large departures from the general pattern (figure 6.1.1.1). The parameters selected the previous year are generally kept unless strong changes were observed. The full detail of the parameters is provided in the script (see next section).

6.1.2 Scripts

The R script and the data used to perform the final XSA run have been provided to the GFCM.

6.1.3 Input data and Parameters

Table 6.1.3.1: Catch-at-age (thousands). Discards are not included.

Age class	Catch-at-age (thousands). Discards are not included.								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	2728.6	1891.2	2264.4	1736.8	750.6	1844.1	4781.5	3166.4	1774.4
1	2699	2110.5	3943.3	3538.1	1134.7	1381.6	2765.3	2225.8	3282.1
2	904.3	958.1	859.3	904.6	870.1	787.4	1252.8	1290.5	810.8
3	147.2	278.4	287.9	221.7	337.6	344	291	425.4	58.1
4	48	91.4	82.2	127.9	103.1	110.1	131.2	122.9	15.2
5+	26.8	50	33.1	39.4	25.6	29.1	53	56.6	3

Table 6.1.3.2: Weight-at-age in the catch and in the stock (kg).

Age class	Weight-at-age in the catch and in the stock (kg).								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0.015	0.014	0.017	0.017	0.015	0.013	0.013	0.013	0.013
1	0.03	0.031	0.029	0.031	0.033	0.031	0.031	0.032	0.03
2	0.058	0.059	0.058	0.056	0.058	0.059	0.058	0.059	0.06
3	0.089	0.088	0.088	0.092	0.09	0.09	0.091	0.089	0.089
4	0.121	0.12	0.12	0.119	0.118	0.12	0.119	0.121	0.119
5+	0.162	0.202	0.162	0.152	0.158	0.156	0.165	0.171	0.188

The maturity at age and the natural mortality at age were assumed constant over time and are given as a vector in section 2.2.

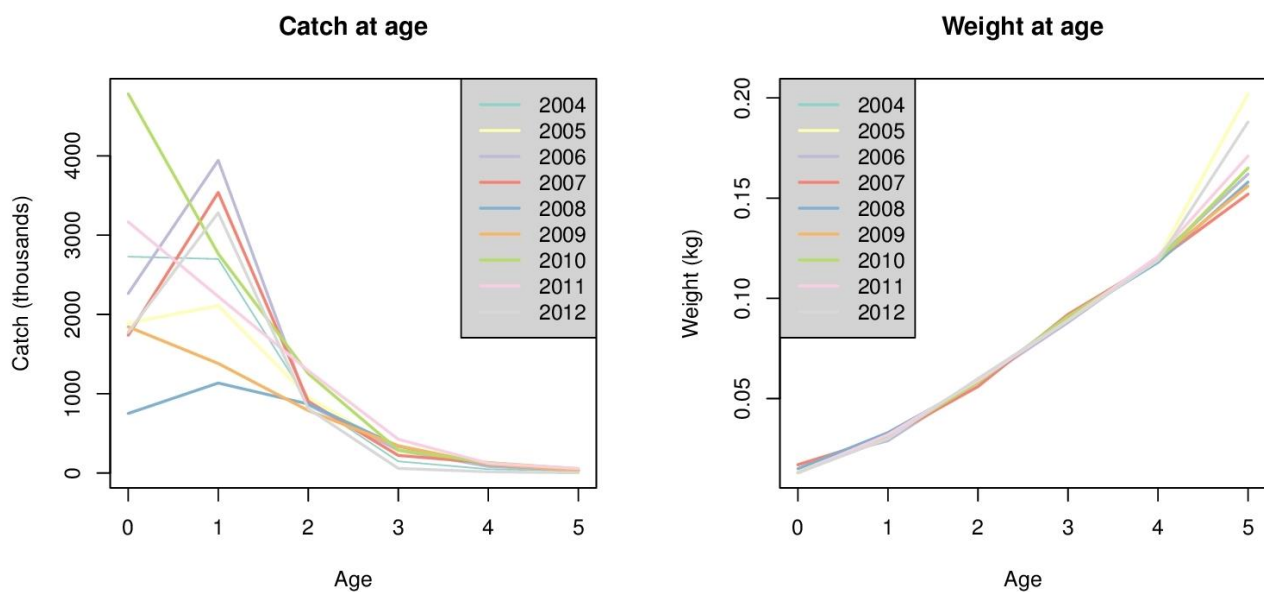


Figure 6.1.3.1: Catch (left panel) and weight (right panel) at age for the years covered by the stock assessment.

6.1.4 Tuning data

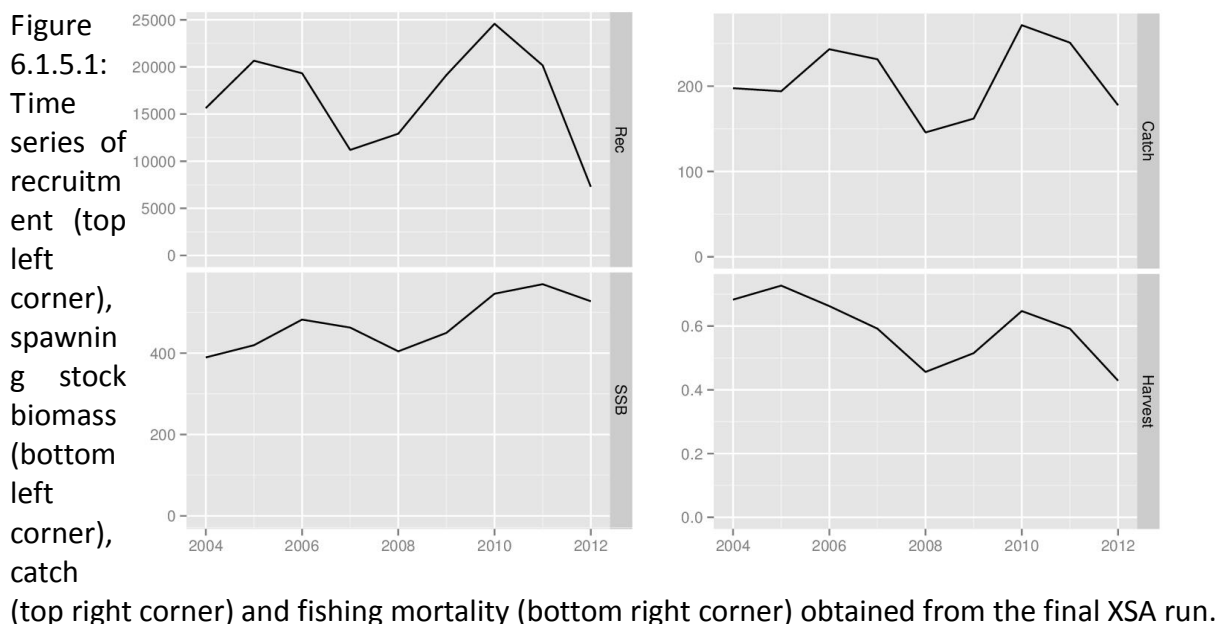
Table 6.1.4.1: Tuning data (MEDITS).

Age class	Tunig data. MEDITS index at age.								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	564.3	314.3	631.9	827.2	627.1	546.2	2681.5	517	209.7
1	769.9	672.4	416.1	1857.4	763.7	665.2	1560.2	1140.9	864.6
2	181.7	233.3	114.8	396.3	229.3	345.1	302.3	418.8	535.2
3	81.3	64.3	47.2	167.6	110.2	173.4	93.3	171.5	236.3
4	36.2	26.5	10.5	53.9	66.2	107.8	48.3	38.6	68.6
5+	28	23.8	32	41.8	24.1	79	72	14.8	45.6

6.1.5 Results

It has to be noted that the growth parameters used this year induced changes in the overall level of the outputs from XSA compared to last year. However analyses comparing different growth

parameters scenario showed that this change in growth parameters neither affected the trends nor the diagnostics of the assessment.



The 2012 estimated recruitment is the lowest of the time series. However, the last point is usually not very well estimated by XSA. The recruitment series displayed long term fluctuations, 5 years period, with no clear trend. This 5-years cyclicality was discernable in recruitment, spawning stock biomass, catch and fishing mortality series. The spawning stock biomass an increasing trend over time, whereas the catch time series had no clear trend and the fishing mortality displayed a decreasing trend, the 2012 value being the lowest of the series.

Table 6.1.5.1: Estimated fishing mortality at age

Age class	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0.3070	0.1493	0.1953	0.2679	0.0921	0.1577	0.3491	0.2716	0.4601
1	0.7876	0.6960	0.9302	0.9367	0.4496	0.3863	0.6203	0.4320	0.8759
2	1.0380	0.8603	0.8107	0.6495	0.7290	0.7643	0.8678	0.7856	0.3107
3	0.5998	1.2024	0.7147	0.5137	0.5540	0.7522	0.7517	0.8785	0.0693
4	0.3892	0.9206	1.6646	0.7915	0.4593	0.3350	0.7022	0.8169	0.0611
5+	0.3892	0.9206	1.6646	0.7915	0.4593	0.3350	0.7022	0.8169	0.0611

Table 6.1.5.2: Estimated abundance at age (thousands)

Age class	2004	2005	2006	2007	2008	2009	2010	2011	2012
-----------	------	------	------	------	------	------	------	------	------

0	15631.273	20654.786	19324.713	11191.353	12914.847	19136.944	24574.375	20161.314	7286.89
1	5898.798	5014.201	7757.669	6931.253	3733.102	5135.858	7126.917	7558.222	6700.425
2	1594.602	1891.118	1761.774	2156.506	1914.288	1678.141	2459.384	2700.903	3457.725
3	357.082	435.459	616.847	603.871	868.453	711.984	602.521	796.234	949.353
4	160.479	163.729	109.287	252.113	301.777	416.849	280.307	237.314	276.285
5+	89.085	88.478	43.105	76.838	74.436	109.614	112.15	108.096	54.437

Table 6.1.5.3: Summary table

Year	Biomass (t)	SSB (t)	Recruitment (thousands)	Abundance (thousands)	Fbar (0-3)	Catch (t)
2004	569.55	389.32	15631.3	23731	0.68308	197.6
2005	632.02	419.41	20654.8	28248	0.72699	194
2006	730.06	482.34	19324.7	29613	0.66275	243.25
2007	623.12	462.73	11191.4	21212	0.59195	231.47
2008	553.48	404.34	12914.8	19807	0.45618	145.76
2009	638.2	449.72	19136.9	27189	0.51514	161.97
2010	789.74	545.89	24574.4	35156	0.64722	271.38
2011	781.38	569.31	20161.3	31562	0.59191	250.94
2012	630.81	527.41	7286.9	18725	0.42899	177.72
Av. 2010-2012	733.98	547.54	17340.87	28481.00	0.56	233.35
Av. 2004-2012	660.93	472.27	16764.06	26138.11	0.59	208.23

6.1.6 Robustness analysis

6.1.7 Retrospective analysis, comparison between model runs, sensitivity analysis, etc.

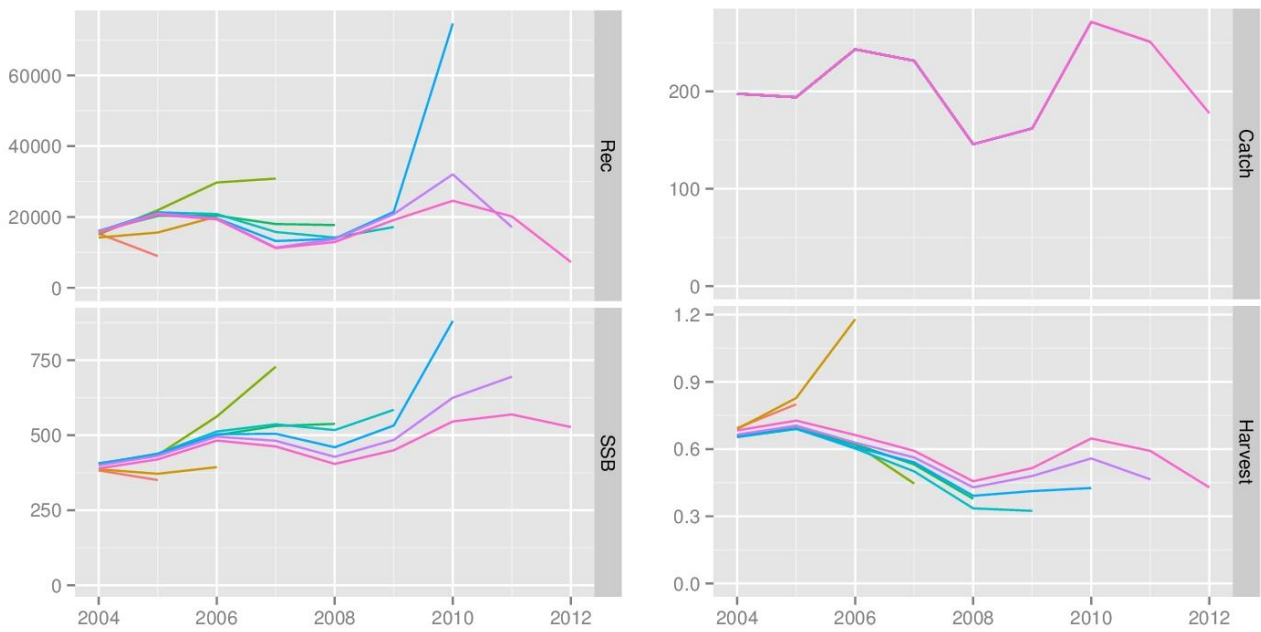


Figure 6.1.7.1: Retrospective analysis of the final XSA runs for recruitment (top left corner), spawning stock biomass (bottom left corner), catch (top right corner) and fishing mortality (bottom right corner).

Besides a large departure to the general pattern of the recruitment time series in 2010, no serious problem could be detected on the retrospective analysis.

6.1.8 Assessment quality

Log residuals for MEDITS survey for red mullet in GSA 7

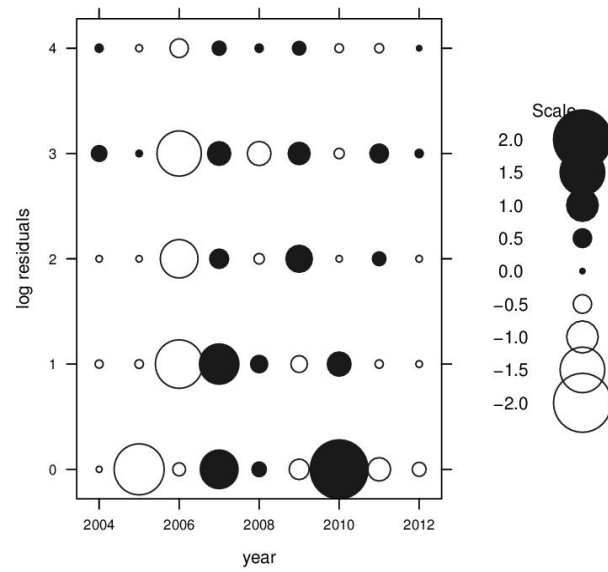


Figure 6.1.8.1: Log residuals for the MEDITS survey.

No clear pattern could be detected in the residuals while their absolute value was not too large.

7 Stock predictions

No stock predictions were attempted this year.

7.1 Short term predictions

7.2 Medium term predictions

7.3 Long term predictions

Yield per recruit analysis was used to compute $F_{0.1}$. Yield per recruit analysis was performed using the average of the 3 last years of the fishing mortality ($F_{\text{current}}=0.56$) estimated by XSA. $F_{0.1}$ was estimated equal to 0.14. It has to be noted that the growth parameters used this year induced changes in $F_{0.1}$ compared to last year. However analyses comparing different growth parameters scenario showed that this change in growth parameters neither affected the trends nor the diagnostics of the assessment.

8 Draft scientific advice

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	$F_{0.1} = 0.14$	$F_{c(2010-2012)}=0.56$	$F_c/F_{0.1}=4$	D	IO _H
Stock abundance	Biomass		$B_{2010-2012}=734$ tons	$B_{33} = 628$ tons $B_{66} = 664$ tons	N	
Final Diagnosis		In high overfishing status with a relative high biomass.				

This diagnostic is based upon analytical results based on fishing mortality. However, time series displayed cyclical behaviours and the current estimated Biomass is above the 33rd and 66th percentiles. However computed over a relatively short time-period (2004-2012), the increase in spawning stock biomass and the decrease in fishing mortality have to be noticed.

Investigate potential changes in catchability.

Management advice and recommendations:

- Improve the fishing pattern of trawlers so that the minimum length of catches is consistent with the minimum legal landing size
- Reduce the effort of trawlers
- Freezing of the effort in the Fishery Restricted Area

It has to be noticed that management measures are currently enforced since 2011 to reduce the number of trawlers.

8.1 Explanation of codes

Trend categories

- 1) N - No trend
- 2) I - Increasing
- 3) D – Decreasing
- 4) C - Cyclic

Stock Status

Based on Fishing mortality related indicators

- 1) **N - Not known or uncertain** – Not much information is available to make a judgment;
- 2) **U - undeveloped or new fishery** - Believed to have a significant potential for expansion in total production;
- 3) **S - Sustainable exploitation**- fishing mortality or effort below an agreed fishing mortality or effort based Reference Point;
- 4) **IO –In Overfishing status**– fishing mortality or effort above the value of the agreed fishing mortality or effort based Reference Point. An agreed range of overfishing levels is provided;

Range of Overfishing levels based on fishery reference points

In order to assess the level of overfishing status when $F_{0.1}$ from a Y/R model is used as LRP, the following operational approach is proposed:

- If $F_c/F_{0.1}$ is below or equal to 1.33 the stock is in (**O_L**): **Low overfishing**
- If the $F_c/F_{0.1}$ is between 1.33 and 1.66 the stock is in (**O_I**): **Intermediate overfishing**
- If the $F_c/F_{0.1}$ is equal or above to 1.66 the stock is in (**O_H**): **High overfishing**

* F_c is current level of F

- 5) **C- Collapsed**- no or very few catches;

Based on Stock related indicators

- 1) **N - Not known or uncertain**: Not much information is available to make a judgment
- 2) **S - Sustainably exploited**: Standing stock above an agreed biomass based Reference Point;
- 3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

- **Relative low biomass**: Values lower than or equal to 33rd percentile of biomass index in the time series (**O_L**)
- **Relative intermediate biomass**: Values falling within this limit and 66th percentile (**O_I**)
- **Relative high biomass**: Values higher than the 66th percentile (**O_H**)

- 4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
- 5) **R –Recovering**: Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

Overfished (or overexploited) - A stock is considered to be overfished when its abundance is below an agreed biomass based reference target point, like $B_{0.1}$ or B_{MSY} . To apply this denomination, it should be assumed that the current state of the stock (in biomass) arises from the application of excessive fishing pressure in previous years. This classification is independent of the current level of fishing mortality.

Stock subjected to overfishing (or overexploitation) - A stock is subjected to overfishing if the fishing mortality applied to it exceeds the one it can sustainably stand, for a longer period. In other words, the current fishing mortality exceeds the fishing mortality that, if applied during a long period, under stable conditions, would lead the stock abundance to the reference point of the target abundance (either in terms of biomass or numbers)