Stock Assessment Form

Demersal species

Reference year: 2019

Reporting year: 2021

Trawl fishery data for the period 2004-2018 have been used to assess the *Mullus barbatus* stock in the GSA06. The assessment has been carried out applying statistical catch at age model (a4a), Y/R analysis and short term projections. To this aim, FLR libraries under R language were used. Results indicate that average fishing mortality for ages 1-2 and recruitment shows a decreasing trend, while a slight increasing trend on SSB and catches was identified over the studied period. Fcurr (1.37) is higher than F0.1 (0.30), chosen as proxy of FMSY, which indicates that red mullet stock in GSA 06 is in high overfishing with relative high biomass and spawning stock biomass.

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Encarnación García Rodríguez*

Stock assessment form

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Mullus barbatus	Red mullet	33 MUT[
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_6]		
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
1st Country	**2nd Country**	**3rd Country**
Spain		
4th Country	**5th Country**	**6th Country**
Stock assessment method: (direct, indirect, combined, none)		
SCAA (a4a)		
Authors:		
García-Rodríguez, E. (1); Vivas, M. (1); Esteban, A. (1); Pérez-Gil, J. L. (2); García-Ruíz, C. (2)		
Affiliation:		
(1)Instituto Español de Oceanografía (IEO). Murcia. Spain. (2) Instituto Español de Oceanografía (IEO). Málaga. Spain.		

The ISSCAAP code is assigned according to the FAO 'International Standard Statistical Classification for Aquatic Animals and Plants' (ISSCAAP) which divides commercial species into 50 groups on the basis of their taxonomic, ecological and economic characteristics. This can be provided by the GFCM secretariat if needed. A list of groups can be found here:

http://www.fao.org/fishery/collection/asfis/en

Direct methods (you can choose more than one):

- Acoustics survey
- Egg production survey
- Trawl survey
- SURBA
- Other (please specify)

Indirect method (you can choose more than one):

- ICA
- VPA
- LCA
- AMCI
- XSA
- Biomass models
- Length based models
- Other (please specify)

Combined method: you can choose both a direct and an indirect method and the name of the combined method (please specify)

2 Stock identification and biological information

Specify whether the assessment is considered to cover a complete stock unit. If the stock unit limits are more or less known, but for technical reasons the assessment only covers part of the stock (e.g. a GSA area but stock spreads to other GSAs), explain the state of the art of the stock unit knowledge. If there are doubts about the stock unit, state them here. If there is knowledge on migration rates between different stock units that affect the stock state them here.

2.1 Stock unit

Due to the lack of information about the structure of the population in the Western Mediterranean, it is considered that the stock limits of the assessed *Mullus barbatus* are in agreement with the limits of GSA 06.

2.2 Growth and maturity

Incorporate different tables if there are different maturity ogives (e.g. catch and survey). Also incorporate figures with the ogives if appropriate. Modify the table caption to identify the origin of the data (catches, survey). Incorporate names of spawning and nursery areas and maps if available.

Table 2.2-1: Maximum size, size at first maturity and size at recruitment.

Somatic magnitude measured (LT, LC, etc)				**Units**	
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	May-July
Maximum size observed			30 (1)	**Recruitment season**	October-December
Size at first maturity			13.7 (2)	**Spawning area**	Continental shelf (4)
Recruitment size to the fishery			7.8 for the period 2004-2010 13.7 for the period 2011-2016 (3)	**Nursery area**	Coastal areas

(1) Size composition of trawl catches in GSA06.

(2) From the Spanish DCF National Programme (2019)

(3) García-Rodriguez, M. and Fernández, A. M. 2005.

(4) Lombarte, A.; L. Recasens; M. González and L. Gil de Sola (2000)

Table 2-2.2: M vector and proportion of matures by size or age (both sex)

Size/Age	Natural mortality	Proportion of matures
Age 0	*1.23*	*0.127*
Age 1	*0.41*	*0.929*
Age 2	*0.28*	*0.999*
Age 3+	*0.22*	*1.000*

Table 2-2.3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**	cm			34.5	cm
	K				0.34	
	t_0				-0.143	
	Data source	Demestre *et al*., 1997 (adopted by SGMED-08-03)				
Length weight relationship	**a**				0.007555	
	b				3.127831	
	M (scalar)	0.42				
	sex ratio (% females/total)	0.69				

3 Fisheries information

3.1 Description of the fleet

Both species of red mullet, *Mullus surmuletus* and *M. barbatus*, are exploited by trawl and artisanal fleets in GSA 06, although small gears (trammel nets and gillnets) account only for 5% of the total landings of these species (Demestre et al., 1997). Trawl fisheries developed along the continental shelf and upper slope are multi-specific. Small vessels (12-16m length) operate mainly on the shallow shelf targeting on red mullets, octopus, cuttlefish and sea breams. Medium and large vessels usually operates on deep continental shelf and slope areas targeting on hake and decapod crustaceans, but some of these units can also operate on the shallow shelf depending on weather conditions or market prices. Red mullet is more intensively exploited from September to November coinciding with the recruitment period of this species (Martín et al., 1999). The total trawl fleet in the GSA 06 has declined from 810 boats in 1998 to 424 boats in 2016.

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*	ESP	06	E – Trawl (12-24 m)	03 - Trawl	33-Demersal shelf species	Pagellus acarne Pagellus erythrinus Merluccius Octopus vulgaris Sepia officinalis Eledone cirrhosa

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)
[Operational Unit1]	405	1388 tons				50177 Fishing days *1000
Total	405	1388 tons				50177

3.2 Historical trends

The fishery developed in the early seventies and landings increased quickly. Since then landings widely fluctuates but a general decreasing trend is observed. In the period assessed landings fluctuate but without any clear trend.

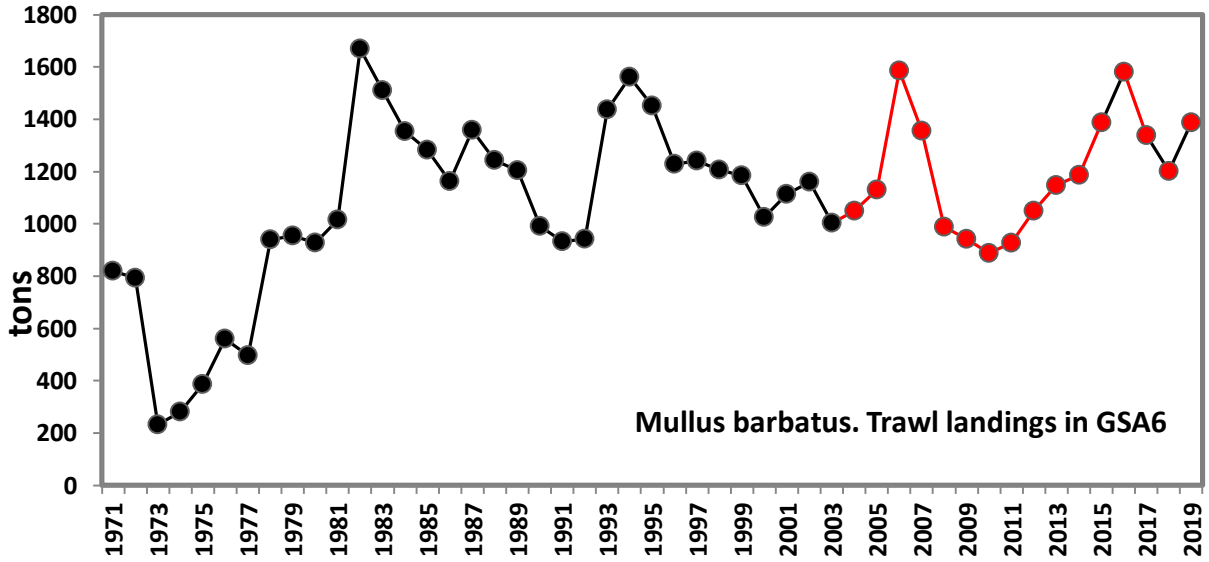


Figure 3.2-1: Landings along the time series studied.

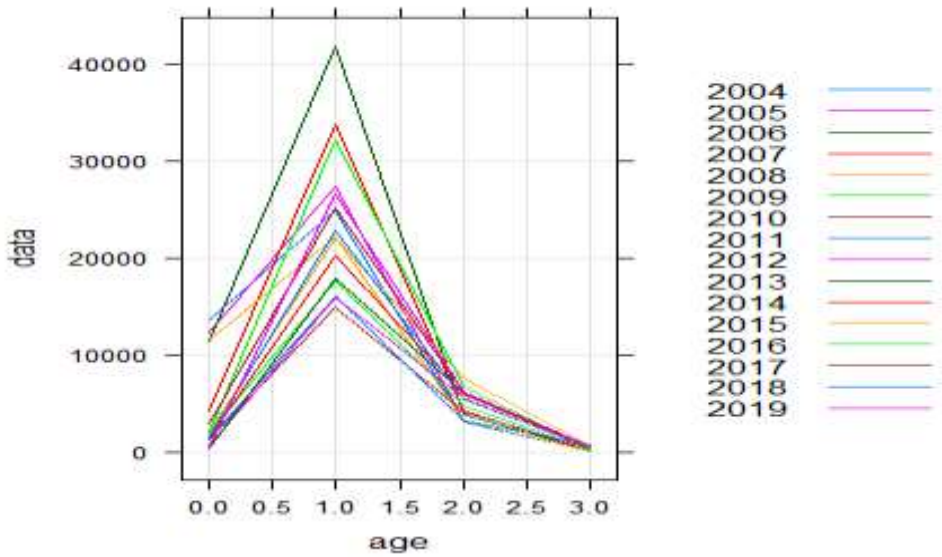


Figure3.2-2: Length frequency distribution of trawl catches in the geographical subarea GSA6 (Northern Spain) for the period 2004-2019. Size composition has been obtained from monthly onboard and port sampling (stratified random method).

3.3 Management regulations

- Engine power limited to 316 KW or 500 CV.

- Mesh size in the cod-end (50 mm diamond or 40 mm square).
- Fishing ban of trawl fishing in areas less than 50 m depth.
- Time at sea (12 hours per day and 5 days per week).
- Spatial and temporal closures of trawl fishing.
- Minimum legal size: 11 cm TL.

3.4 Reference points

Table 3.4-1: 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		3060		3013	B mean as a referent point (B low = 2081)
SSB		1070		715	SSB mean as a referent point (SSB low = 451)
F		1.37		0.30	F0.1 as a referent point
Y		1388		1196	Y mean as a referent point (Y low = 889)
CPUE		27.66		22.08	CPUE mean as a referent point (CPUE low = 16.89)

4 Fisheries independent information

4.1 MEDITS Survey (2004-2019)

The Mediterranean International Bottom Trawl Survey MEDITS has been carried in the GSA 6 since 1994.

4.1.1 Brief description of the direct method used

The Spanish MEDITS survey carries out about 170 – 180 hauls in spring. It samples 4 GSAs, including Balearic Islands, and the sampling procedure is based on the common methodology included in the MEDITS instruction manual. The GSAs sampled are: GSA1, GSA2, GSA5 and GSA6.

Direct methods: trawl based abundance indices

Table 4.1-1: Trawl survey basic information

Survey	Mediterranean International Bottom Trawl Survey (MEDITS)	**Trawler/RV**	Miguel Oliver
Sampling season	SPRING		
Sampling design	random stratified with number of haul by stratum proportional to stratum surface		
Sampler (gear used)	GOC-73		
Cod –end mesh size as opening in mm	20		
Investigated depth range (m)	40-800		

Table 4.1-2: Trawl survey sampling area and number of hauls

Stratum	**Total surface (km^2)**	**Trawlable surface (km^2)**	**Swept area (km^2)**	**Number of hauls**
A (-50m)	3026	3026	0.4689	8
B (50-100m)	11314	11314	1.7507	39
C (100-200m)	6889	6889	1.3371	25
D (200-500 m)	6719	6719	2.3469	21
E (+500m)	4558	4558	1.2012	9
Total (km^2)	32506	32506	7.1047	102

Figure 4.1-1: Map of the position of MEDITS survey hauls and CTD stations in GSA 06.

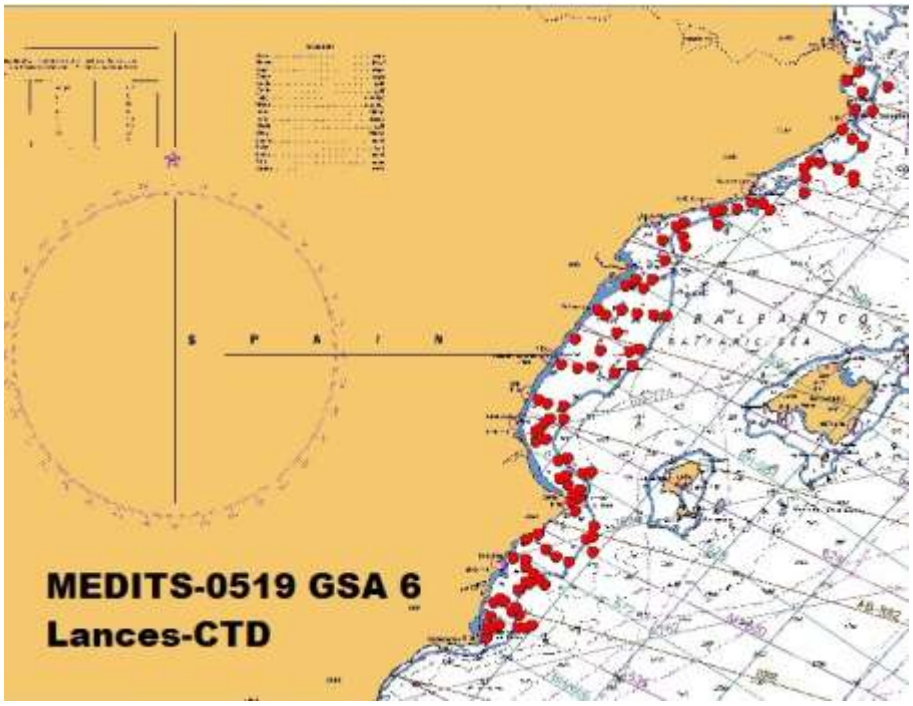


Table 4.1-3: Trawl survey abundance and biomass results

Depth Stratum	Years	kg per km^2	N per km^2
40-800 m	2004	7.60	262
40-800 m	2005	7.08	223
40-800 m	2006	14.20	266
40-800 m	2007	22.19	562
40-800 m	2008	6.76	104
40-800 m	2009	8.14	184
40-800 m	2010	9.88	207
40-800 m	2011	6.03	98
40-800 m	2012	13.26	208
40-800 m	2013	9.90	426
40-800 m	2014	12.23	527

40-800 m	2015	14.71	583
40-800 m	2016	17.75	901
40-800 m	2017	12.47	529
40-800 m	2018	14.47	653
40-800 m	2019	15.47	826

- Specify CV or other index of variability of mean
- Specify sampling design (for example random stratified with number of haul by stratum proportional to stratum surface; or systematic on transect;…)
- Specify if catchability coefficient is assumed =1 or other

Direct methods: trawl based length/age structure of population at sea

Slicing method

Report the maturity scale and age slicing method used

Table 4.1-4: Trawl survey results by length or age class

N (Total or sex combined) by Length or Age class	**Year**		
	….	**….**	**…..**
Total			

Sex ratio by Length or Age class	Year		
	….	….	…..
Total			

- Specify if numbers are per km^2 or raised to the area, assuming the same catchability .
- In case maturity ogive has not been estimated by year, report information for groups of years.
- Possibility to insert graphs and trends

Direct methods: trawl based Recruitment analysis

Table 4.1-5: Trawl surveys; recruitment analysis summary

Survey		**Trawler/RV**	
Survey season			
Cod –end mesh size as opening in mm			
Investigated depth range (m)			
Recruitment season and peak (months)			
Age at fishing-grounds recruitment			
Length at fishing-grounds recruitment			

Table 4.1-6: Trawl surveys; recruitment analysis results

Years	**Area in km^2**	**N of recruit per km^2**	**CV or other**

- Specify type of recruitment:
  - continuous and diffuse
  - discrete and diffuse
  - discrete and localised
  - continuous and localised.
- Specify the method used to estimate recruit indices
- Specify if the area is the total or the swept one
- Possibility to insert graphs and trends

Direct methods: trawl based Spawner analysis

Table 4.1-7: Trawl surveys; spawners analysis summary

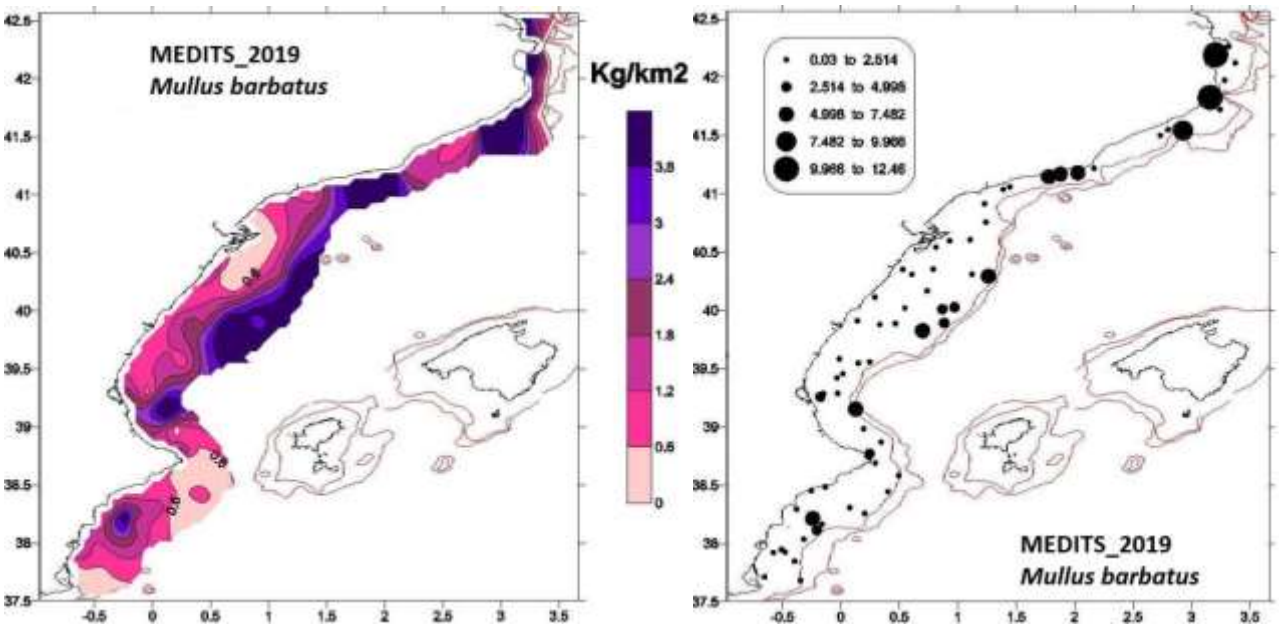
Survey		**Trawler/RV**	
Survey season			
Investigated depth range (m)			
Spawning season and peak (months)			

Table 4.1-8: Trawl surveys; spawners analysis results

Surveys	**Area in km²**	**N (N of individuals) of spawners per km²**	**CV or other**	**SSB per km²**	**CV or other**

- Specify type of spawner:
  - total spawner
  - sequential spawner
  - presence of spawner aggregations
- Specify if the area is the total or the swept one
- Possibility to insert graphs e trends

4.1.2 Spatial distribution of the resources



Figures 4.1.2-1 and 2: Mullus barbatus spatial distribution of estimated abundances indices for the 2019 MEDITS_ES trawl survey (GSA6, Northern Spain)

4.1.3 Historical trends

MEDITS surveys data show a slight increasing trend in abundance along the period.

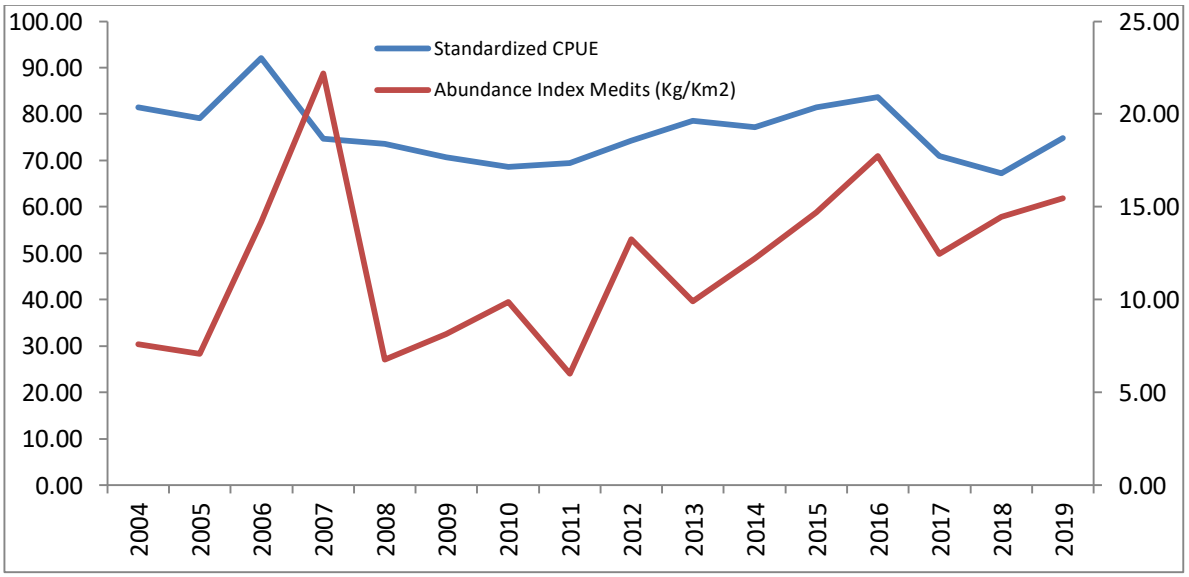


Figure 4.1.3-1: Historical Medits abundance index along the time series assessed

5 Ecological information

5.1 Protected species potentially affected by the fisheries

A list of protected species that can be potentially affected by the fishery should be incorporated

here. This should also be completed with the potential effect and if available an associated value (e.g. bycatch of these species in T)

5.2 Environmental indexes

If any environmental index is used as i) a proxy for recruitment strength, ii) a proxy for carrying capacity, or any other index that is incorporated in the assessment, then it should be included here.

Other environmental indexes that are considered important for the fishery (e.g. Chl a or other that may affect catchability, etc.) can be reported here.

6 Stock Assessment

6.1 Statistical catch at age model a4a (Jardim et al., 2013) implemented with FLR libraries.

The statistical catch at age model a4a, (non-linear model implemented in R/FLR/ADMB, (flr-project.com), was used to model the stock (2004-2019 period).

6.1.1 Model assumptions

6.1.2 Scripts

FLR (Fisheries Libraries in R)
FLR Project -http://flr-project.org/

Fitted model:

Fishing mortality sub-model: **fmod <- ~s(age, k=4, by = breakpts(year, 2009)) + s(year, k=9)**

Catchability sub-model: **qmod <- list(~factor(replace(age,age>1,1)))**

Stock-recruitment sub-model: **srmodel <- ~factor(year)**

6.1.3 Input data and Parameters

The assessment by means of a4a was carried out using as input data the period 2004-2019 for the catch data and 2004-2019 for the tuning file (MEDITS indices).
A natural mortality vector computed using ProdBiom software was used (after the benchmark performed at WGSAD 2016, ProdBiom was accepted as most appropriate method to estimate M vector for this stock). Length-frequency distributions of commercial catches and surveys were split by sex and then transformed in age classes (plus group was set at age 3) using length-to-age slicing.

Table 6.1.3-1: Catch at age matrix (No discards, as considered negligible)

	0	1	2	3+
2004	137967.08	29743.11	3313.54	132.32
2005	185616.18	36106.41	3446.5	229.28
2006	145724.15	48142.41	3630.95	239.47
2007	130699.13	37624.68	4506.62	233.3
2008	95191.98	34022.29	4007.45	304.29
2009	73336.19	25253.14	4886.36	431.96
2010	96201.29	19782.21	4719.05	749.61
2011	98972.12	27661.33	4035.22	557.8
2012	99638.99	28480.62	5971.38	504.42
2013	118995.65	28700.39	6592.89	759.09
2014	125818.33	34300.52	6996.45	970.31
2015	147749.81	36236.65	7871.29	969.55
2016	125342.78	42445.71	6932.48	780.95
2017	123754.82	35932.58	6976.67	521.75
2018	160955.89	35501.92	6207.04	522.95
2019	57737.48	46298.14	7439.46	663.63

Table 6.1.3-2: Tuning data (MEDITS survey).

	0	1	2	3+
2004	2.6	136.8	28.5	2
2005	0.2	105.1	29.3	3.3
2006	15.6	255.6	49.4	5
2007	7.7	481.8	59.1	8.6
2008	0.2	68.9	31.7	4.4
2009	11.1	143.1	29.1	4.9
2010	2.3	180.6	26.7	7
2011	2.4	72.4	26.8	4.1
2012	8.2	298.8	37.9	3.3
2013	2.2	180.7	31.4	3.9
2014	4.8	215.1	46.2	4.3
2015	2.9	232.9	55.5	6.3
2016	10.4	418.7	48	4.3
2017	0.6	214.8	58.6	5.6
2018	6.1	257.3	56.3	6.9
2019	1.1	200.7	49.4	4.7

Table 6.1.3-3: Input parameters and model settings

Age group	M (Prodbiom)	Maturity (DCF)
0	1.23	0.127
1	0.41	0.929
2	0.28	0.999
+gp	0.22	1.000

6.1.4 Results

The results of the assessment run using a4a show an increasing trend in Catches and SSB. A decreasing trend is observed in recruitment. Fishing mortality (F) has been decreasing slightly since 2016.

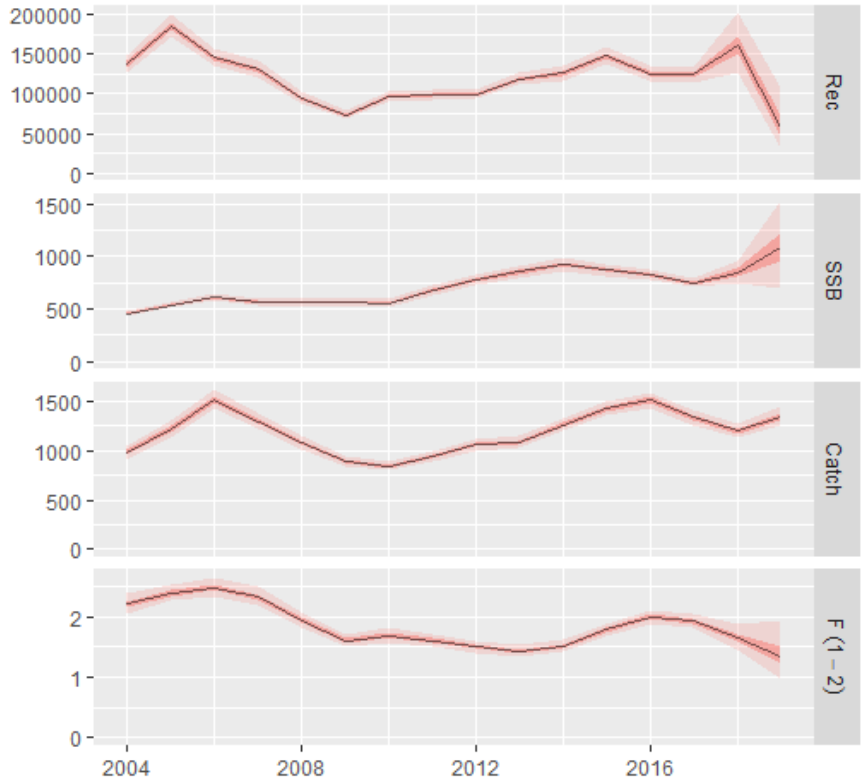


Figure 6.1.4-1: Red mullet in GSA 06; a4a results: fishing mortality (Harvest), recruitment, SSB, and yield.

Figure 6.1.4-2: Red mullet in GSA 06; a4a results: comparative between 2018 and 2019 results.

Table 6.1.4-1: Fishing mortality at age

	0	1	2	3+
2004	0.110543	1.74524	2.68531	0.586451
2005	0.11952	1.88698	2.90339	0.634079
2006	0.124057	1.95861	3.01361	0.65815
2007	0.115879	1.8295	2.81495	0.614764
2008	0.096945	1.53057	2.35501	0.514316
2009	0.080272	1.26734	1.94999	0.425863
2010	0.016405	1.17972	2.19921	1.30013
2011	0.015617	1.12306	2.09358	1.23768
2012	0.014646	1.05323	1.96341	1.16073
2013	0.013927	1.0015	1.86698	1.10372
2014	0.014767	1.06194	1.97963	1.17032
2015	0.017297	1.24385	2.31876	1.37081
2016	0.019408	1.39565	2.60174	1.5381
2017	0.018717	1.34596	2.5091	1.48333
2018	0.016031	1.15279	2.149	1.27045
2019	0.013266	0.953978	1.77838	1.05134

Table 6.1.4-2: Recruitment, Spawning stock biomass and Fbar1-2 in 2019

	RECRUITMENT	SSB	FBAR
2004	137814	451	2.2153
2005	185835	537	2.3952
2006	145347	610	2.4861
2007	130935	565	2.3222
2008	95314	558	1.9428
2009	73330	571	1.6087
2010	95983	555	1.6895
2011	98921	677	1.6083
2012	99634	779	1.5083
2013	118993	853	1.4342
2014	125918	927	1.5208
2015	147779	870	1.7813
2016	125330	820	1.9987
2017	124005	750	1.9275
2018	160748	848	1.6509
2019	57792	1070	1.3662

6.1.5 *Robustness analysis*:

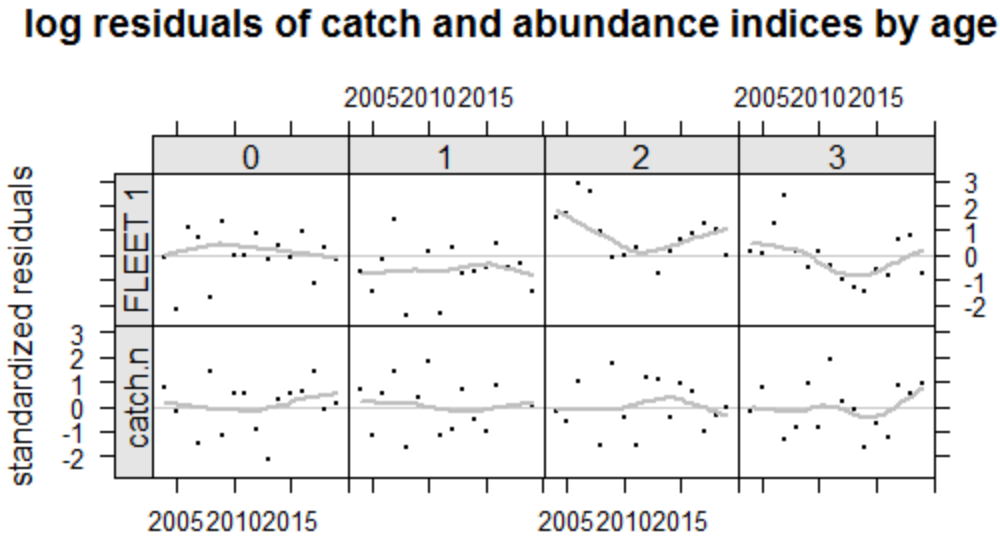


Figure 6.1.5-1: Red mullet in GSA 06. Log residuals of catch and survey indices by age.

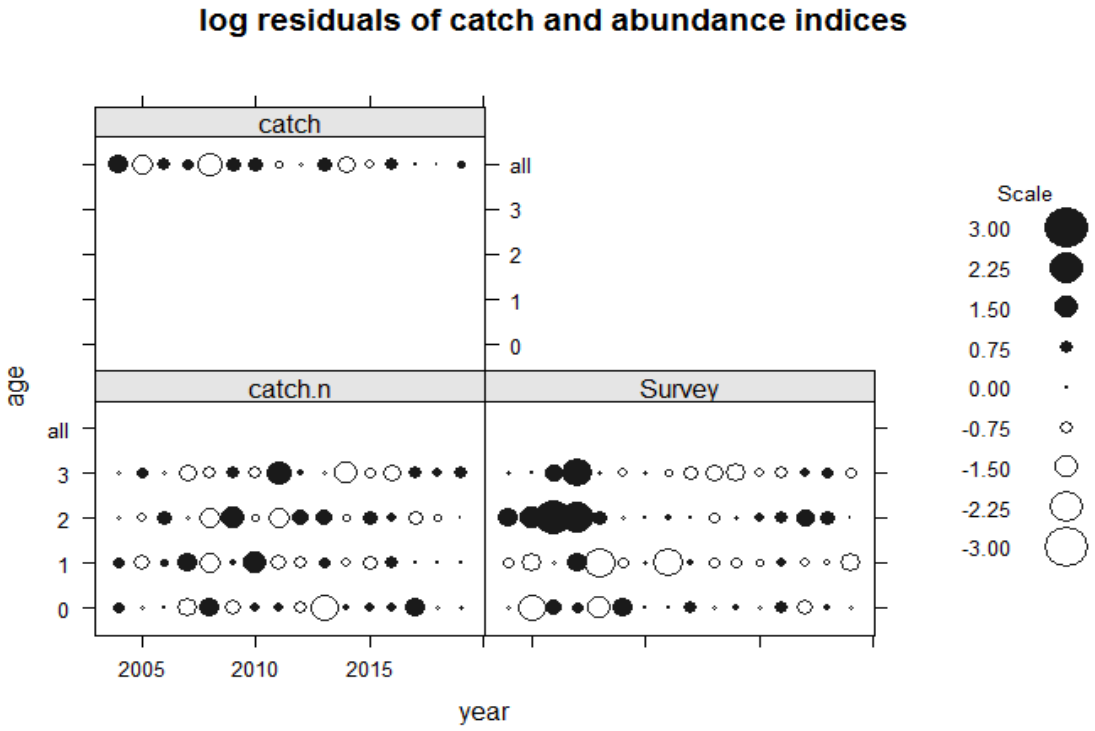


Figure 6.1.5-2: Red mullet in GSA 06. Bubble plot of log residuals of catch and survey indices by age.

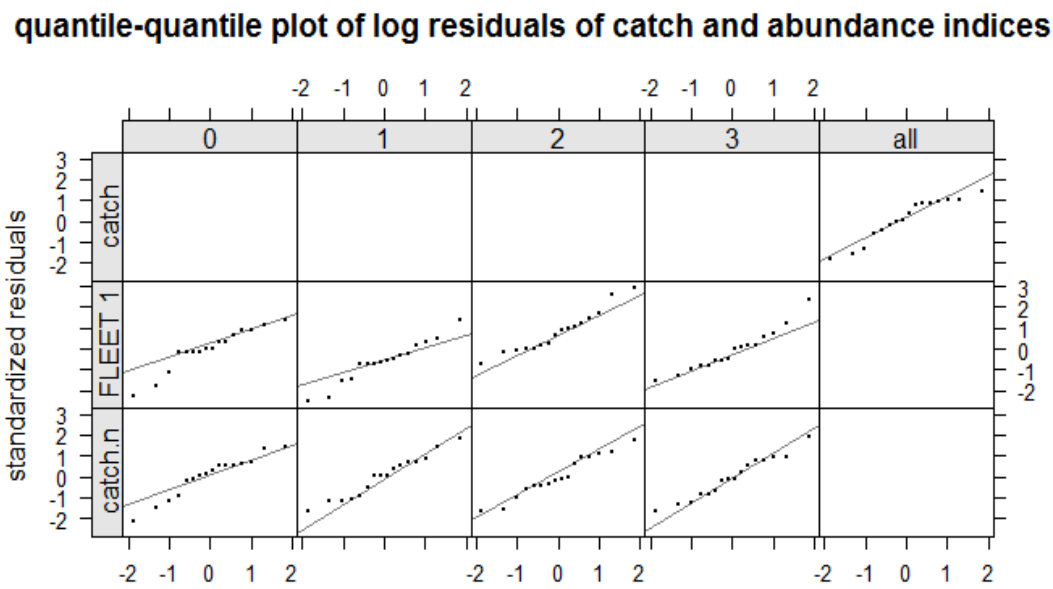


Figure 6.1.5-3: Red mullet in GSA 06. QQ plot of log residuals of catch and survey indices.

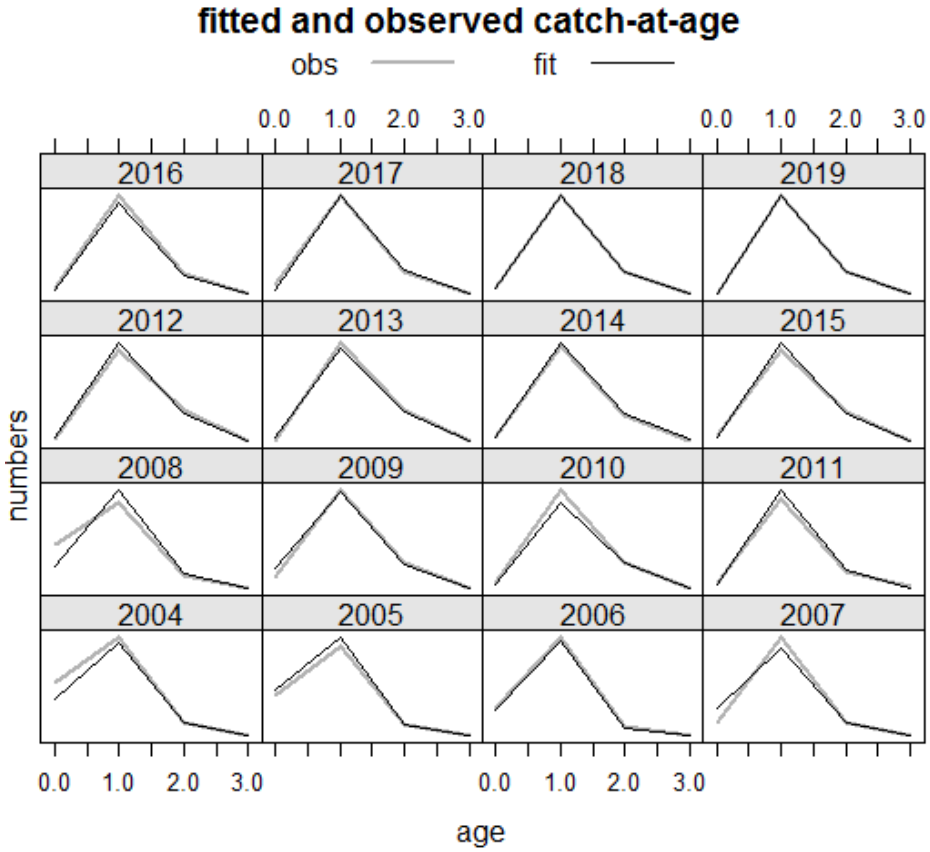


Figure 6.1.5-4: Red mullet in GSA 06. Fitted vs observed catch-at-age.

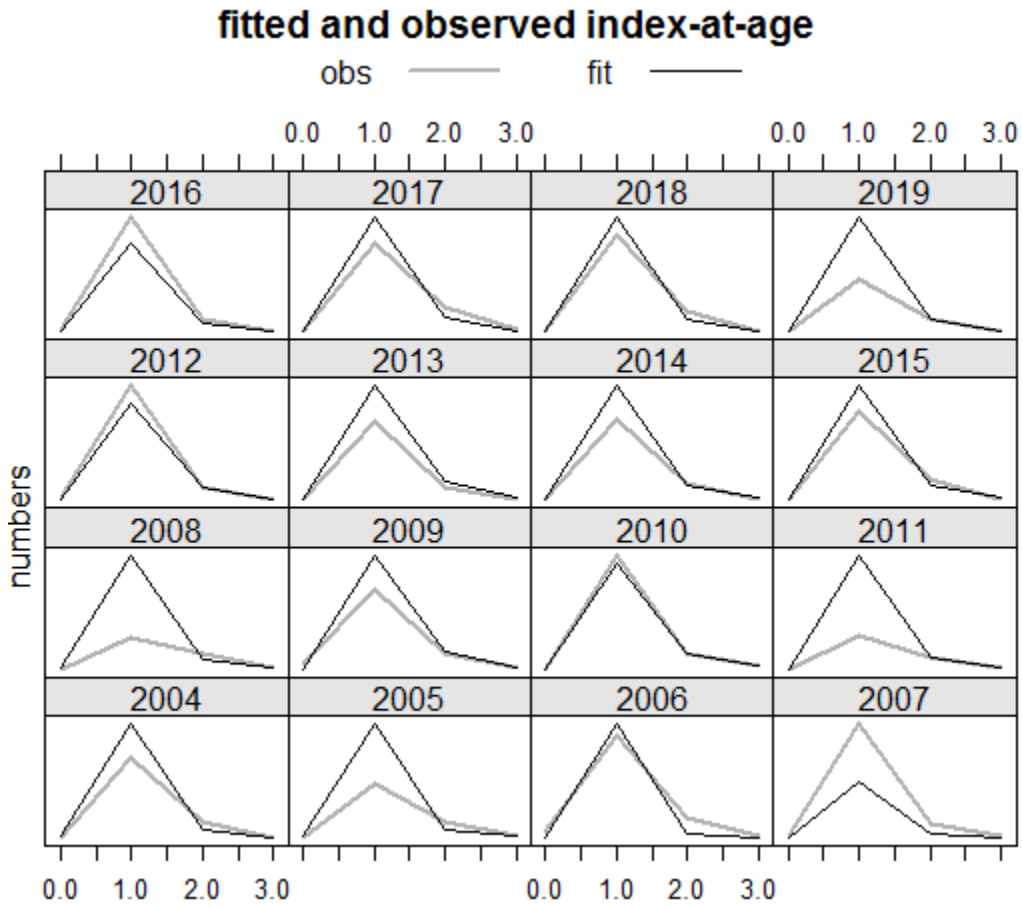


Figure 6.1.5-5: Red mullet in GSA 06. Fitted vs observed survey indices-at-age.

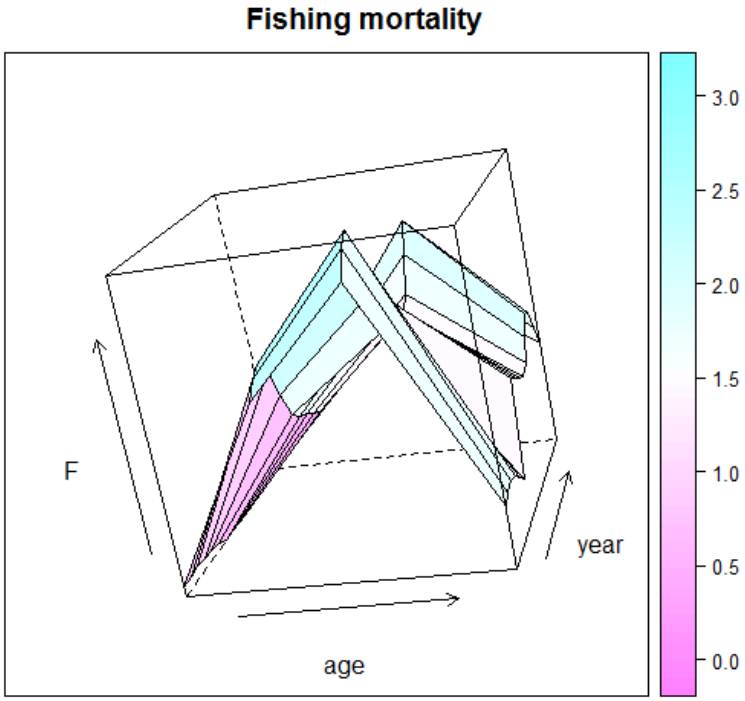


Figure 6.1.5-6: Red mullet in GSA 06. Fishing mortality by age and year.

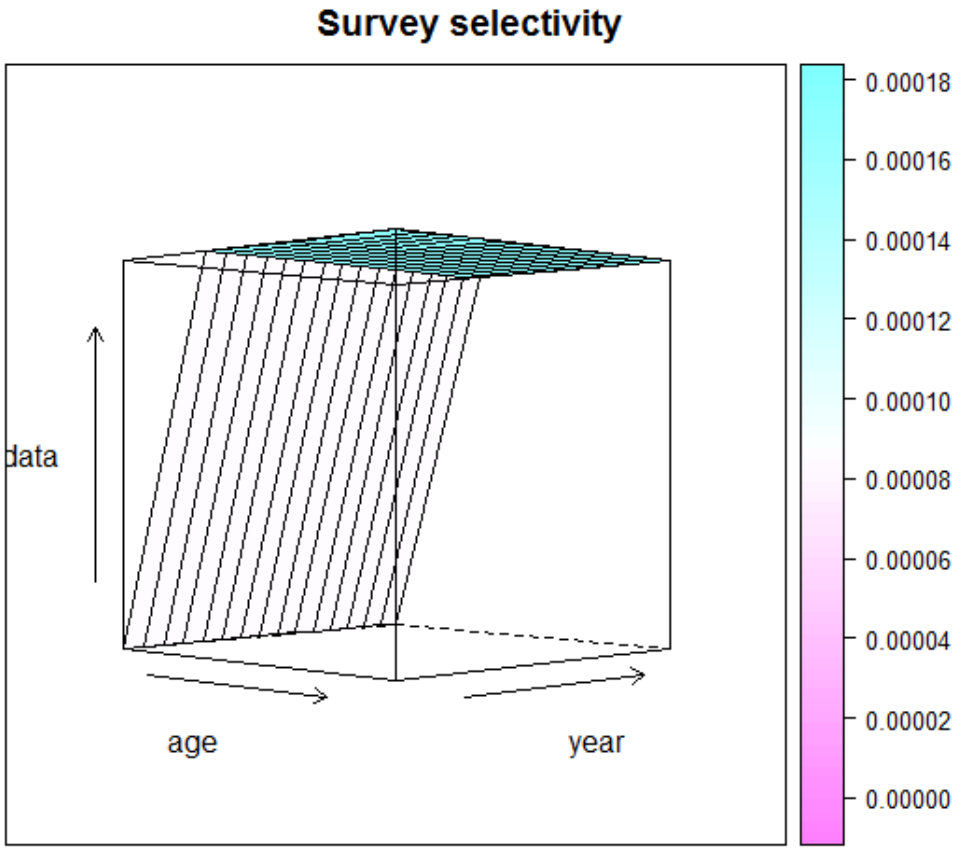


Figure 6.1.5-7: Red mullet in GSA 06. Survey selectivity by age and year.

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

In addition, a retrospective analysis was conducted to ensure the robustness of the final estimates. The retrospective series indicate good agreement between years except in the case of recruitment and SSB.

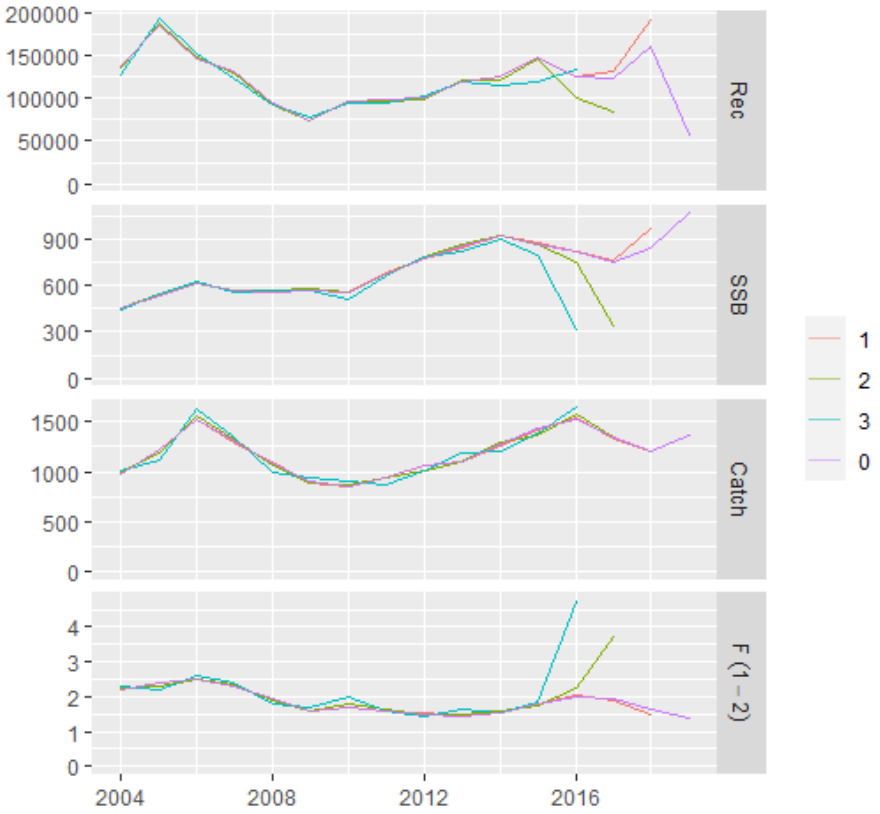


Figure 6.1.6-1: Red mullet in GSA 06. Retrospective analysis on the a4a model.

6.1.7 Assessment quality

Discards were not used in the assessment as they are considered negligible for this species. Figure 6.1.7-1 shows the internal consistency of the Medits survey used as tuning fleet in the a4a model, while Figure 6.1.7-2 shows the internal consistency of catch-at-age matrix.

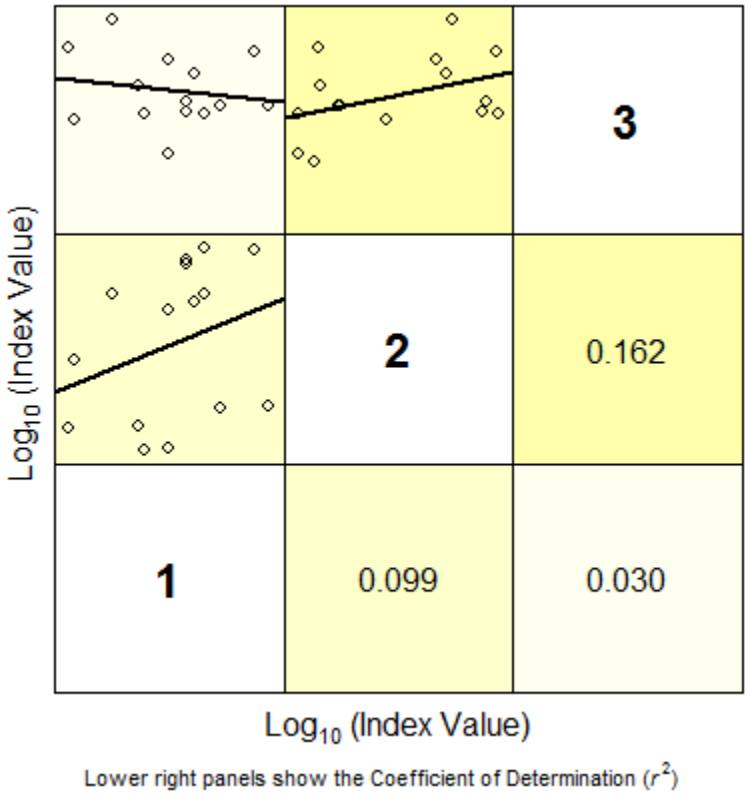


Figure 6.1.7-1: Red mullet in GSA 06. Internal consistency of the tuning fleet (Medits Survey).

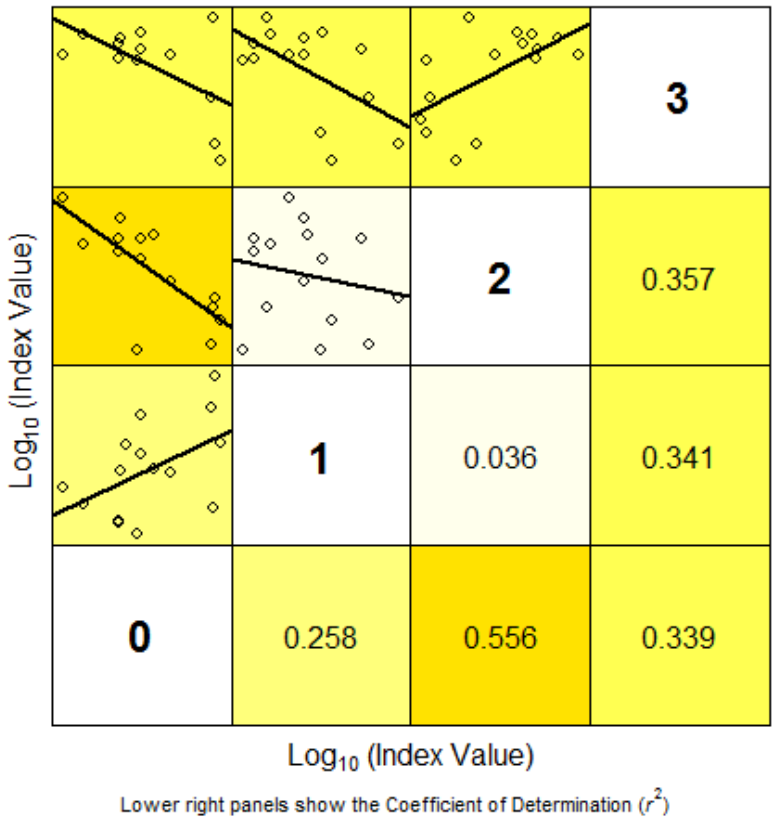


Figure 6.1.7-2: Red mullet in GSA 06. Internal consistency of the catch at age matrix.

6.2 STOCK / RECRUITMENT RELATIONSHIP

7 Stock predictions

7.1 Short term predictions

Deterministic projections for three years (2020-2022) were produced. These projections are based on the arithmetic mean of recruitment, catches and weights at age of the last three years (2017-2019). F Status Quo is the geometric mean of $Fbar_{1-2}$ during the last three years (2017-2019).

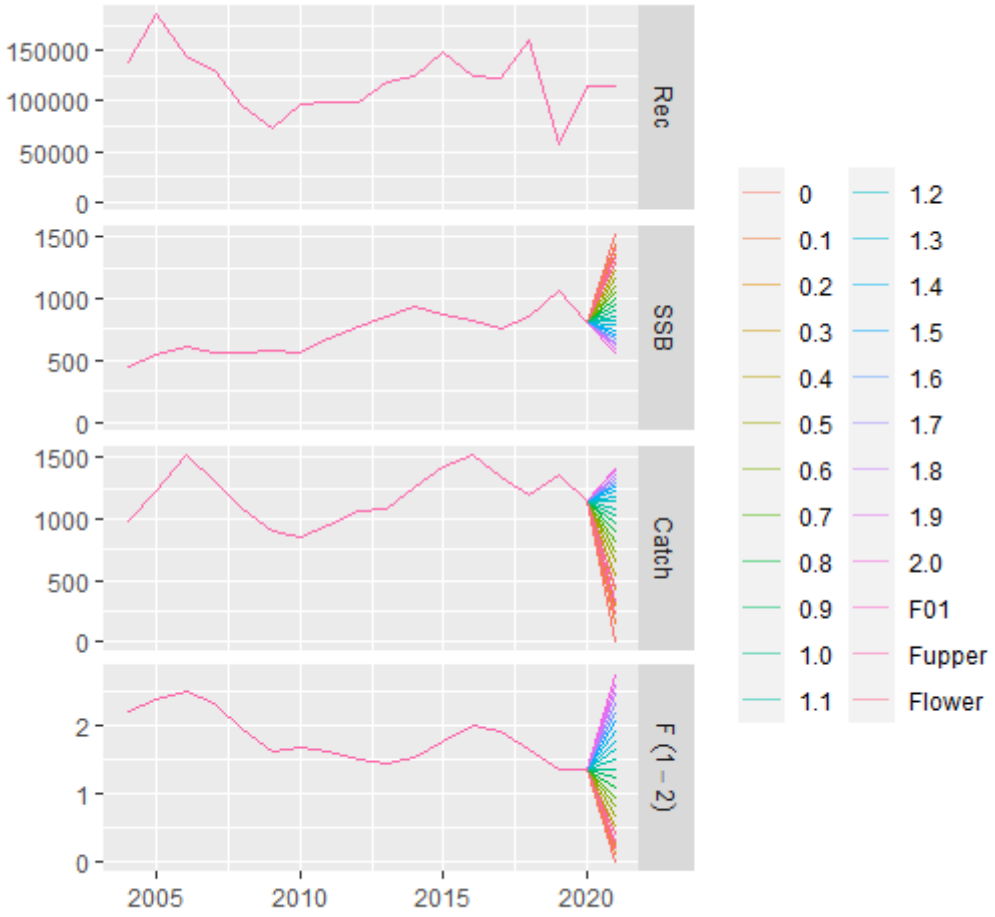


Figure 7-1: Short term projection, summary results

7.2 Medium term predictions

No medium term prediction was carried out due to the lack of a reliable model fit for the spawning stock biomass-recruitment relationship.

7.3 Long term predictions

Yield per recruit analyses was conducted based on the exploitation pattern resulting from the a4a model and population parameters. Minimum and maximum ages for the analysis were considered to be age group 0 and 3+. Reference F was considered to be mean F for ages 1 to 2 during the last 3 years (2016-2018). The assessment results with a4a were used as input data for the Y/R analysis performed in FLR (FLBRP library) in order to calculate the reference point $F_{0.1}$ (as a proxy of F_{MSY}).

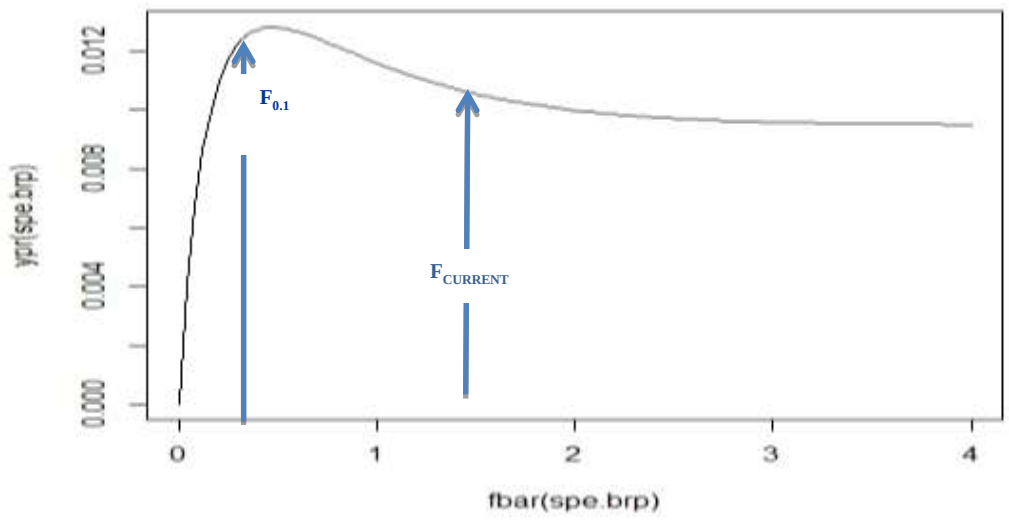


Figure 7.3-1: Equilibrium Yeld (g) per Recruit and SSB (g) per Recruit vs Fishing mortality (F) including yield and spawner reference point proxy MSY (F0.1 =0.30, Fcurrent=1.37).

8 Draft scientific advice

Based on	Indicator	Analytical 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	$F_{0.1}$=0.30 (2019)	Fcurrent (ages 1-2 for2019) = 1.37		D	IO_O_H
	Catch		1388 (2019)	Mean catch (2004-2019) = 1196 tons	I	
Stock abundance	Total Biomass		3395(2017-2019)		D	
	SSB		889 (2017-2019)	33^{th} percentile = 571 66^{th} percentile =816	I	O_H
Recruitment			58×10^6 (in 2019)		D	
Final Diagnosis	In High overfishing (Fcurrent > F0.1). Relative high total SSB					

State the rationale behind that diagnoses, explaining if it is based on analytical or on empirical references

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

*Fc 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 B0.1 or BMSY. 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)*