Stock Assessment Form
Demersal species

Reference year: 2014

Reporting year: 2016

The red Mullet *Mullus barbatus* is an important demersal species for commercial fisheries in the GSAs13 - 14. It is exploited by trawl and artisanal fleet. Small gears (trammel nets and Gillnets) account for 4% of the total landings of *M. barbatus* (average 2008-2016 period). Trawl fleet a ccount 2402 tones (average 2008-2016 period).

Trawlers fishery exploits a highly diversified species assemblages, the main commercial species being the caramote prawn (Penaeus kerathurus), Striped mullet (Mullus surmuletus), Hake (Merluccius merluccius), sparid fish (Pagellus erythrinus, Diplodus annularis, Sparus auratus, ….) Length catches ofred mullet range between 8 and 26 cm total length (TL), with an average size of 14 cm TL.

Stock assessment of Mullusbarbatus was carried out using the official Tunisian catch data of bottom trawling in the two GSAs 13-14. Number-at-age data from experimental trawl surveys carried out in the considered GSAs, were used as tuning data. The vector of natural mortality by a ge was calculated using the Gislason model. Maturity by age data was estimated using the maturity ogive parameters of M. barbatus female determined by Cherif (2015). Considering results of the XSA analysis carried out, the stock of M. barbatus in GSAs 13-14 is subject to overfishing, being the current F higher than the proposed reference point F0.1. A reduction of fishing mortality is advised.

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Olfa BEN ABDALLAH-BEN HADJ HAMIDA*

Stock assessment form

Contents

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Mullus barbatus	Red Mullet	34
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_13]	[GSA_14]	
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
1st Country	**2nd Country**	**3rd Country**
Tunisia		
4th Country	**5th Country**	**6th Country**
Stock assessment method: (direct, indirect, combined, none)		
INDIRECT		
Authors:		
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Affiliation:		
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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):

- **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

According to the stock assessments carried out on the national level in Tunisia, the choice of a unit stock for both eastern and southern areas (GSAs 13 and 14) was carried out since 1996. This choice was based, mainly, on similar biological characteristics of the two populations of red mullet as well as similar changes in CPUE levels in the two GSAs.

2.2 Growth and maturity

The red mullet, *Mullus barbatus* L. 1758 is one of the main target species of the trawl fishing industry along the continental shelf off the Tunisian coasts.

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

Somatic magnitude measured (LT, LC, etc)			**LT**	**Units**	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	**May-July**
Maximum size observed	26	25	26	**Recruitment season**	
Size at first maturity	14.07	13.43	14.5	**Spawning area**	
Recruitment size to the fishery				**Nursery area**	

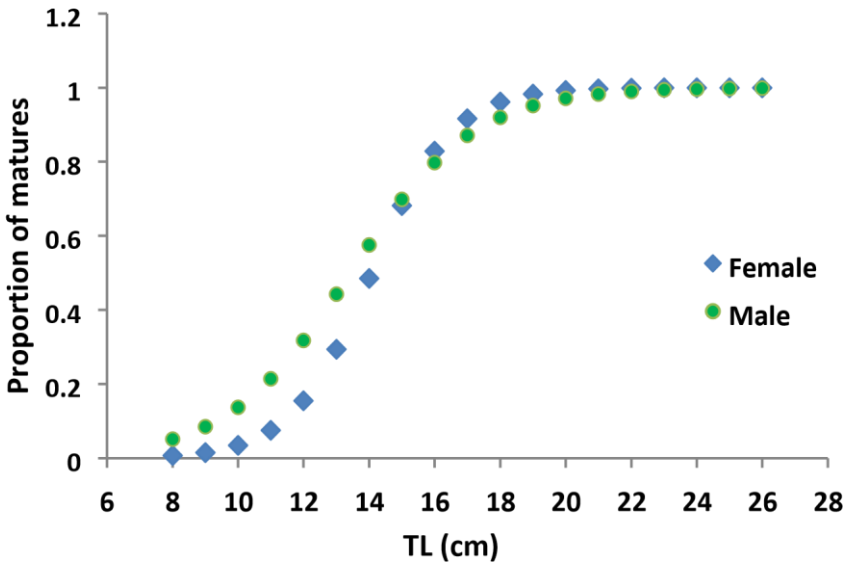


Table 2-2.2: M vector and proportion of matures by size or age (Males)

Size	Natural mortality	Proportion of matures
8	1.843	0.0519
9	1.525	0.0855
10	1.287	0.1376
11	1.104	0.2142
12	0.959	0.3176
13	0.843	0.4427
14	0.749	0.5757
15	0.670	0.6985
16	0.604	0.7982
17	0.548	0.8710
18	0.499	0.9202
19	0.458	0.9517
20	0.422	0.9711
21	0.390	0.9829
22	0.362	0.9899
23	0.337	0.9941
24	0.314	0.9965
25	0.294	0.9980
26	0.276	0.9988

Table 2-2.3: M vector and proportion of matures by size or age (Females)

Size/Age	Natural mortality	Proportion of matures
8	2.258	0.0069
9	1.868	0.0156
10	1.576	0.0346
11	1.352	0.0751
12	1.175	0.1553
13	1.033	0.2942
14	0.917	0.4857
15	0.821	0.6815
16	0.740	0.8290
17	0.671	0.9166
18	0.612	0.9614
19	0.561	0.9826
20	0.516	0.9922
21	0.477	0.9966
22	0.443	0.9985
23	0.412	0.9993
24	0.385	0.9997
25	0.361	0.9999
26	0.338	0.9999

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**	cm	27.65	24.23	25.96	2005-2006
	K	$Year^{-1}$	0.311	0.307	0.309	2005-2006
	t_0	year	-0.687	-0.983	-0.824	2005-2006
	Data source	Biological study in Northern Tunisian waters				
Length weight relationship	**a**		0.0069	0.0053	0.0044	2005-2006

	b		3.13	3.23	3.29	2005-2006
	M (scalar)	$Year^{-1}$	0.567	0.552	0.566	
	sex ratio (% females/total)	66.4%				

3 Fisheries information

3.1 Description of the fleet

Identification of Operational Units exploiting this stock. Use as many rows as needed.

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

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	TUNISIA	13-14	F - Trawl (>24 metres))	03 - Trawls	34 - Miscellaneous demersal fishes	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)	Effort (units)
[Operational Unit1]	334	**1923.41**	Pagellus erythrinus = 1833 tons Mullus surmuletus = 820 tons Sparus aurata = 221 tons Diplodus annularis = 416 tons Solea sp. = 384 tons Merluccius merluccius = 586 tons Penaeus kerathurus = 2749 tons Metapenaeus monoceros = 872 tons Parapenaeus longirostris = 838 tons Sepia officinalis = 1370 tons Octopus vulgaris = 251 tons Eledone moschata = 410 tons Loligo vulgaris = 162 tons	334
Total	334	**1923.41**		334

3.2 Historical trends

Time series analysis with tables and figures showing the observed trends in catches, landings, fishing capacity or effort.

Table 3.2.1 - Total Trawler's landings of Mullus barbatus in GSAs 13 & 14

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Landings (Tons)	2373.240	2965.009	2985.380	2281.040	2062.717	1887.912	2256.887	2480.34	1923.41

Table 3.2.2 - Total Trawler's number in GSAs 13 & 14

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
number	333	333	339	337	339	323	323	327	334

3.3 Management regulations

In Tunisia, no regulations targeting specifically for Red mullet fishery are currently in place. However, trawling is not permitted within 3 nautical miles of the coast and at less than 50m depth in GSAs 13-14. Moreover, in GSA 14, a three-month closed season for trawling (from July to September) is in place. The objective of the measure is to protect recruits of a large number of species. Also, minimum landing size of 12 cm standard length in Tunisia has been established.

3.4 Reference points

Table 3.3-1: List of reference points and empirical reference values in 2016

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F			F0.1	0.44	
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 {TYPE OF SURVEY}

Fill in one section for each of the direct methods used. The name of the section should be the name of the TYPE OF SURVEY.

4.1.1 Brief description of the direct method used

Description of the survey and method applied. One of several tables would have to be chosen: Egg Production Method, Acoustic survey, Trawl.

Direct methods: trawl based abundance indices

Table 4.1-1: Trawl survey basic information

Survey		**Trawler/RV**	
Sampling season			
Sampling design			
Sampler (gear used)			
Cod –end mesh size as opening in mm			
Investigated depth range (m)			

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**
Total (… – … m)				

Map of hauls positions

Table 4.1-3: Trawl survey abundance and biomass results

Depth Stratum	Years	kg per km^2	CV or other	N per km^2	CV or other
	……				
	……				
	……				
	……				
	……				
Total (… – … m)	……				

*Comments

- 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			

Comments

- 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**

*Comments

- Specify type of recruitment:
  - Continuous and diffuse
  - Discrete and diffuse
  - Discrete and localized
  - Continuous and localized
- 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**

*Comments

- 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 and trends

4.1.2 Spatial distribution of the resources

Include maps with distribution of total abundance, spawners and recruits (if available) .

4.1.3 Historical trends

Time series analysis (if available) and graph of the observed trends in abundance, abundance by age class, etc. for each of the directed methods used.

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

An Extended Survivors Analysis (XSA) as implemented in the FLR (fisheries libraries in R) was run using official catch data from Tunisia (GSA 13 and 14). Number at age data from experimental trawl surveys carried out in the GSAs 13-14 were used as tuning data. The vector of natural mortality M was estimated using Gislason model. The annual size of the landings as well as surveys data (used as tuning data) were converted into the number at age by knife edge slicing.

6.1 XSA

6.1.1 Model assumptions

Darby and Flatman (1994) outline the XSA algorithm as performing the following steps: (1) a cohort analysis of the total catch-at-age data to produce estimates of population abundance-at-age, and total fishing mortalities; (2) adjustment of the CPUE values for the period of fishing defined using the alpha and beta parameters in the fleet tuning file, into CPUE values that would have been recorded if the fleet had fished only at the beginning of the year. The adjusted values are directly comparable with the population abundances at the beginning of the year; (3) calculation of fleet-based estimates of population abundanceat-age from the adjusted CPUE values and fleet catchabilities; (4) calculation of a least squares estimate (weighted mean) of the terminal population (survivors at the end of the final assessment year) for each cohort in the tuning range using the fleet-derived estimates of population abundance-at-age. These terminal populations are used to initiate the Cohort analysis in the next iteration. The process iterates until the convergence criteria described for ad hoc tuning are achieved. Various options are available for catchability analysis, time series weighting and shrinkage of the weighted estimates.

6.1.2 Scripts

If a script is available which incorporates the stock assessment run (e.g. if using FLR in R) it should be provided here in order to create a library of scripts.

6.1.3 Input data and Parameters

For analytical models: **catch matrix** in lengths or ages (see the example below for age). Specify if catch includes discards

Catch-at-age (thousands) (No discards)									
Age class	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	36079.9	59288.7	55469. 5	33396.9	31608.4	29270. 1	45079.6	38044.2	28852.0
2	39122.7	57546.9	59596. 1	43069.9	34377	35416	38557.6	43145.7	34416.5
3	7708.9	3044.7	3948.6	6221	6330	5401.5	4975.2	7462.3	6056.8
4	736.1	139.0	180.3	74.8	473	58. 4	271.1	407.0	193.9
5+	262.9	59.6	77.3	37.4	507.8	20.9	175.4	244.2	59.7

6.1.4 Tuning data

Catch-at-age (thousands) (No discards)									
Age class	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	5301.9	1348.9	854.95	2275	1506	3178	9742.1	7466.324	4557.202
2	1366.8	260.63	158.33	233.33	551.9	1067.2	6958.6	2311.336	2712.189
3	1258.3	138.6	82.021	108.33	73.39	728.6	1140	1425.035	1284.935
4	0	0	0	0	0	98.765	533	131.3494	98.92913
5+	0	0	0	0	0	29.611	59.222	56.07113	63.18983

Table 6.1.3.1. Natural mortality by age estimated by Gislason's method and Maturity data

Age class	1	2	3	4	5+
Natural mortality (M)	1.2711	0.7492	0.5576	0.4685	0.3771

Table 6.1.3.1. Maturity data by age

Age class	1	2	3	4	5+
Maturity	0.1149	0.6654	0.9535	0.9922	0.9988

6.1.5 Results

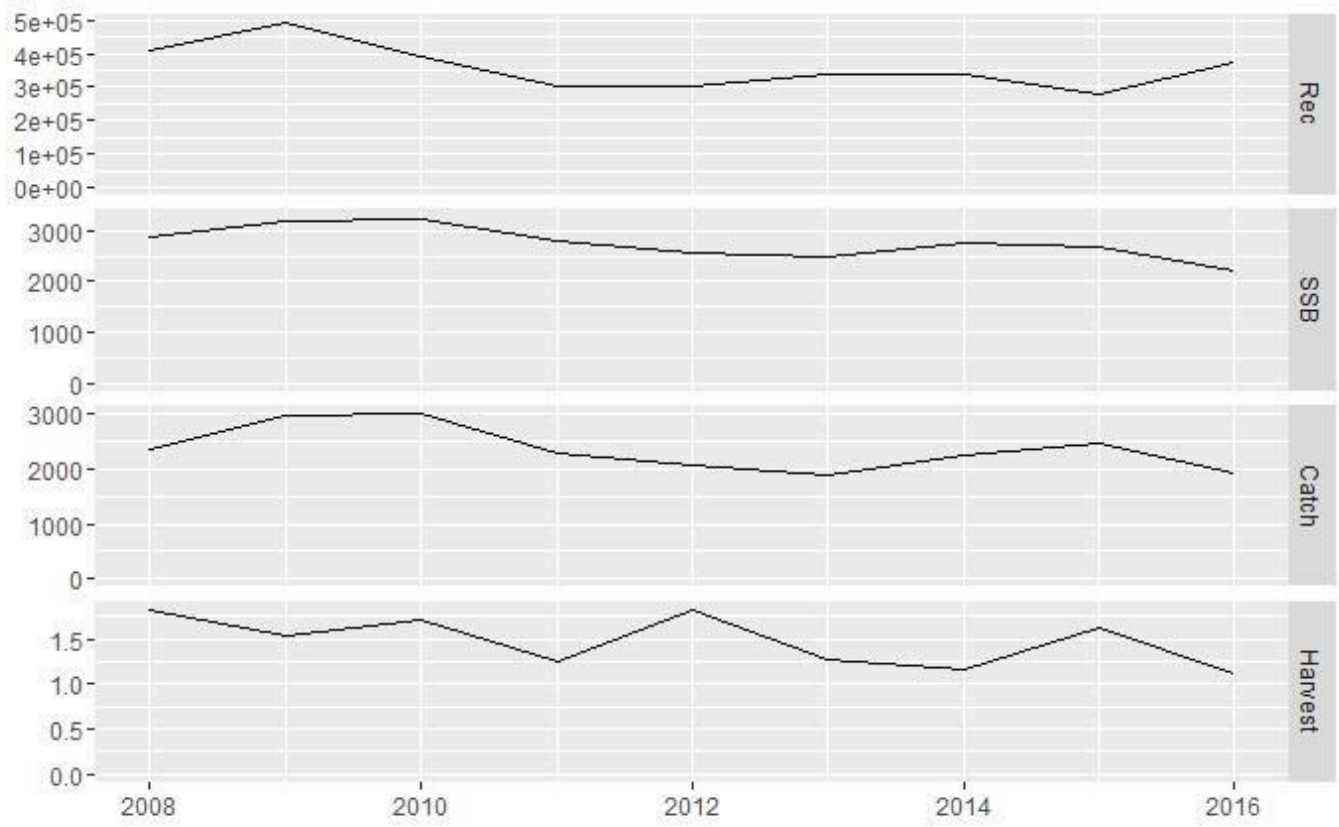
The results obtained with XSA method showed an increase of fishing mortality in 2009, 2012 and 2014. Recruitment showed an increase in 2009 followed by a decrease in 2010-2012; then it increases in the last 2 years. SSB presented an increase in 2009-2010 and in 2014; and a decrease from 2011 to 2013.

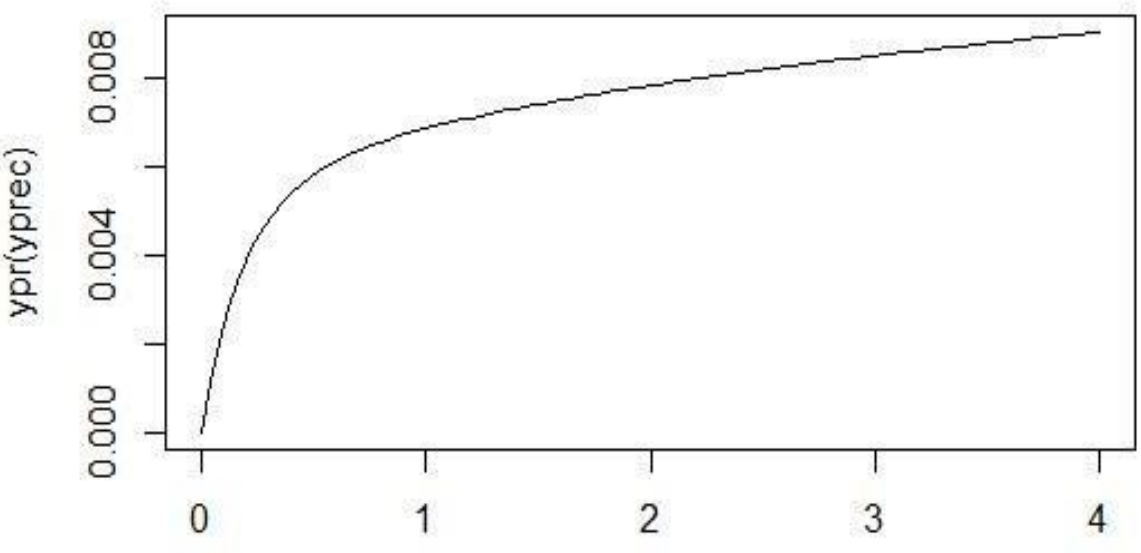
XSA was run setting shrinkage at 0.5, 1.0, 1.5 and 2.0. Results with different settings produced quite similar estimates of recruitment and SSB. The model with shrinkage of 2.0 setting and with catchability equal to 2 years was adopted as final model on both residual and retrospective analysis.

Considering the results of the analyses carried out, the red Mullet stock in GSAs 13-14 is subject to overfishing, being the current F (2012-2014) estimated with XSA method equal to 1.68 and higher than the proposed reference point F0.1 = 0.52.

Table 6.2.5.1- Main results of XSA analyses

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fbar	1.81	1.54	1.72	1.26	1.82	1.24	1.11	1.45	1.38
Total Biomass	10189.2	12041.4	10414.5	8270.3	7962.3	8181.6	9145.4	8655.5	8359
SSB	2897.8	3182.2	3247	2795.6	2572.6	2481.6	2821.5	2960.3	2529.3
Recruitment	407530	491949	392446	302337	302311	335460	374339	308181	328312

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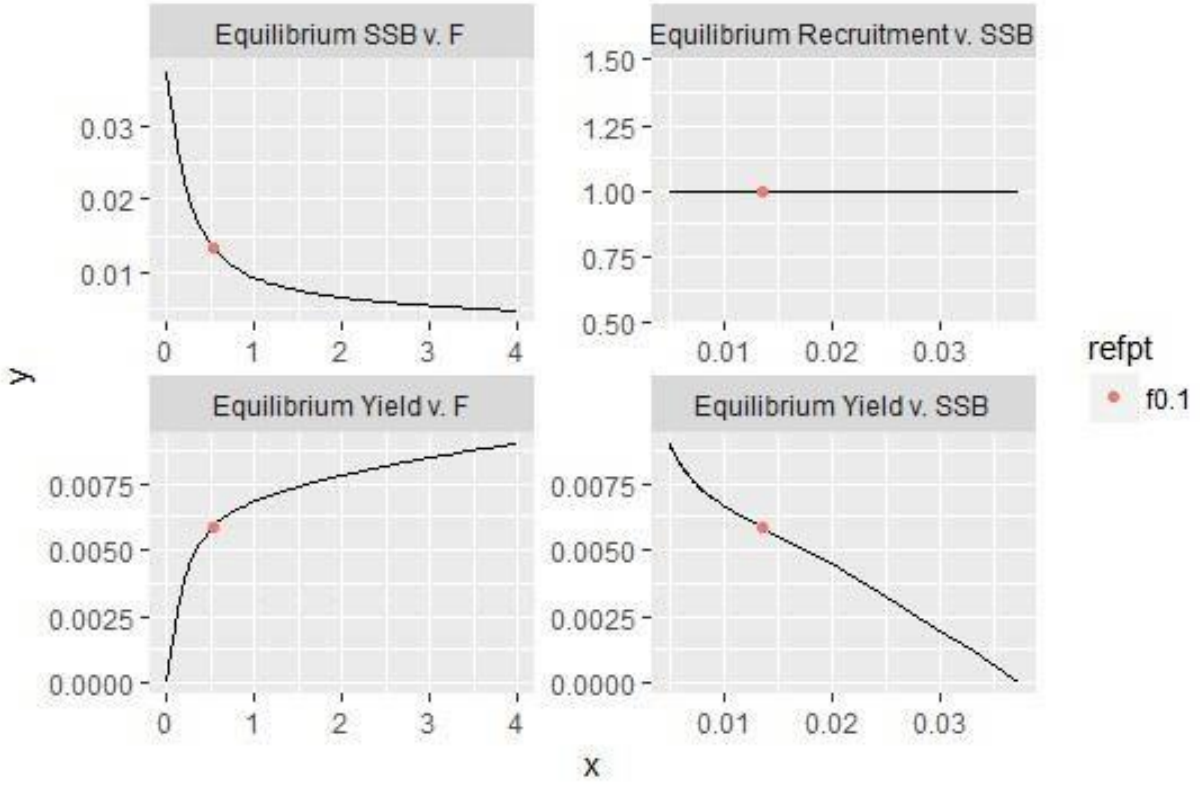
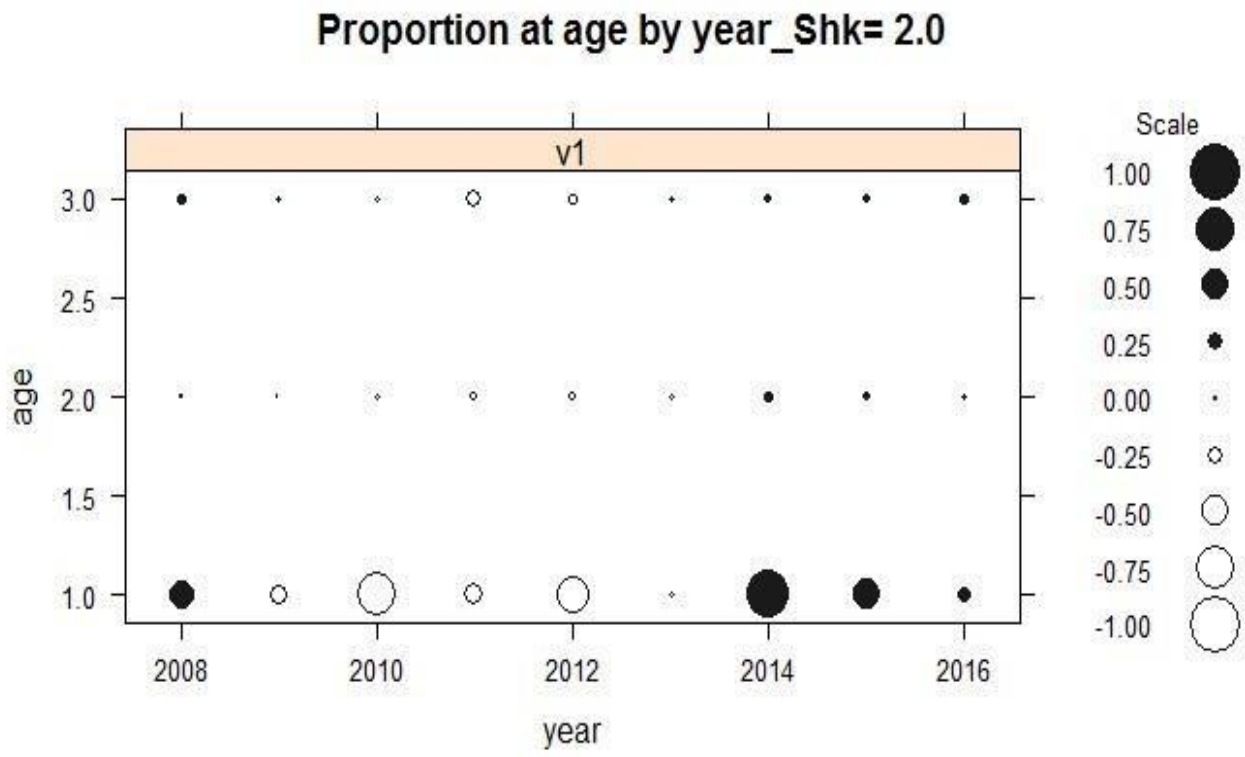
0.004
0.008
0
1
2
3
4
fbar(yprec)


Equilibrium SSB v. F
Equilibrium Recruitment v. SSB
Equilibrium Yield v. F
Equilibrium Yield v. SSB
y
x
refpt
f0.1

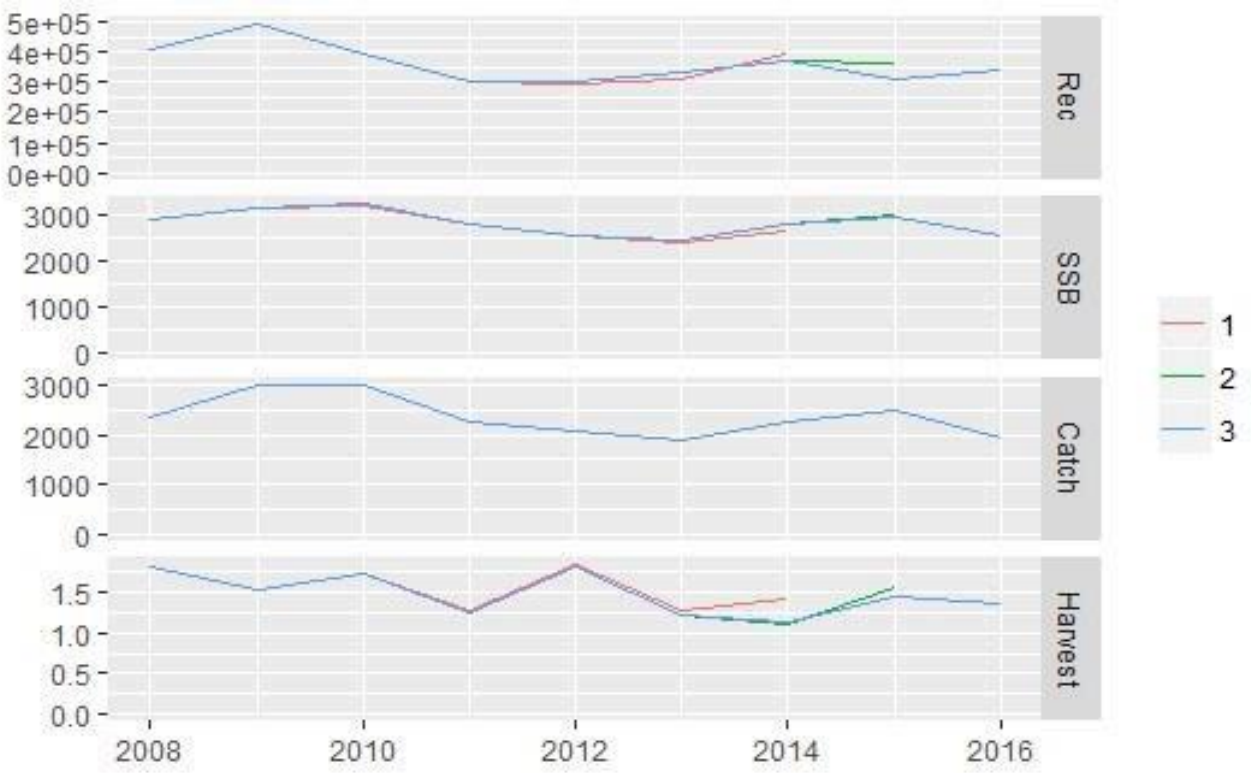
6.1.6 Robustness analysis

Residuals at age analysis obtained with XSA models at different shrinkage allowed to considerate the setting shrinkage at 2.0.



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

Sensitivity analysis with shrinkage values of 0.5, 1.0, 1.5 and 2.0 was performed on the results, and on the basis of the residuals and retrospective analyses. The shrinkage 2 provided the best results. In fact, the residuals do not show any particular trend and the results of the retrospective analysis are consistent.



6.1.8 Assessment quality

Stability of the assessment, evaluation of quality of the data and reliability of model assumptions.

7 Stock predictions

7.1 Short term predictions

The default assumptions about what happens to weights, maturity and selection pattern in the future were used:

- Weights are the means of the last 3 years)
- Future recruitment to be as geometric mean of the last 3 years
- to run several F scenarios for the STF which are based on 'F_status_quo', which we calculated as the mean F of the last 3 years, with the following F pattern:

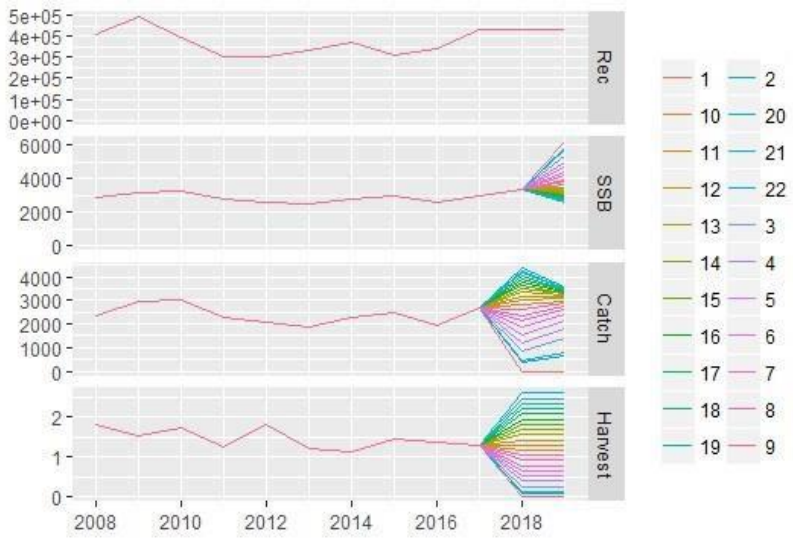
• year 1: fbar_status_quo
• year 2: fbar_status_quo * fbar_multiplier
• year 3: fbar_status_quo * fbar_multiplier
• The fbar_multiplier is the same for years 2 and 3 (The fbar_multiplier ranges from
0.1 to 2 by 0.1)

The results of the short term predictions showed that:

- Negative changes in catch will be obtained only when decreasing the fishing mortality to above 30%
- Negative changes in SSB will be observed only when Fbar is increased

Table 3: Results the short term analysis

Ffactor	Fbar	Catch_2014	Catch_2015	Catch_2016	Catch_2017	SSB_2016	SSB_2017	Change in SSB 2016-2017 (%)	Change in Catch 2014-2016 (%)
0	0.00	1923.41	2660.34	0.00	3381.61	6175.00	82.61	-100.00	0
0.1	0.13	1923.41	2660.34	798.67	3381.61	5721.36	69.19	-76.52	0.1
0.2	0.26	1923.41	2660.34	1386.66	3381.61	5327.12	57.53	-55.52	0.2
0.3	0.39	1923.41	2660.34	1824.16	3381.61	4983.27	47.36	-36.66	0.3
0.4	0.52	1923.41	2660.34	2153.78	3381.61	4682.26	38.46	-19.63	0.4
0.5	0.65	1923.41	2660.34	2405.71	3381.61	4417.77	30.64	-4.20	0.5
0.6	0.78	1923.41	2660.34	2601.41	3381.61	4184.50	23.74	9.85	0.6
0.7	0.91	1923.41	2660.34	2756.19	3381.61	3977.97	17.64	22.70	0.7
0.8	1.04	1923.41	2660.34	2880.98	3381.61	3794.41	12.21	34.50	0.8
0.9	1.17	1923.41	2660.34	2983.64	3381.61	3630.62	7.36	45.39	0.9
1	**1.30**	**1923.41**	**2660.34**	**3069.81**	**3381.61**	**3483.90**	**3.03**	**55.47**	**1**
1.1	1.43	1923.41	2660.34	3143.61	3381.61	3351.94	-0.88	64.84	1.1
1.2	1.56	1923.41	2660.34	3208.01	3381.61	3232.78	-4.40	73.58	1.2
1.3	1.69	1923.41	2660.34	3265.18	3381.61	3124.75	-7.60	81.76	1.3
1.4	1.83	1923.41	2660.34	3316.73	3381.61	3026.42	-10.50	89.45	1.4
1.5	1.96	1923.41	2660.34	3363.86	3381.61	2936.56	-13.16	96.69	1.5
1.6	2.09	1923.41	2660.34	3407.44	3381.61	2854.12	-15.60	103.54	1.6
1.7	2.22	1923.41	2660.34	3448.15	3381.61	2778.20	-17.84	110.02	1.7
1.8	2.35	1923.41	2660.34	3486.49	3381.61	2708.01	-19.92	116.19	1.8
1.9	2.48	1923.41	2660.34	3522.86	3381.61	2642.88	-21.85	122.07	1.9
2	2.61	1923.41	2660.34	3557.55	3381.61	2582.24	-23.64	127.68	2
0.08	0.10	1923.41	2660.34	634.15	3381.61	5821.34	72.15	-81.75	0.08



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	$F_{0.1}$ = 0.53 Fc = 1.31		$Fc/F_{0.1}$ = 2.48		O_H
	Fishing effort					
	Catch					
Stock abundance	Biomass	$B_{current}$ = 8359		66_{th} percentile 9438		O_I
Recruitment						
Final Diagnosis		In high level of overfishing and overexploited with relative Intermediate biomass				

The results of the assessment revealed a high overfishing status (Fcurr>F0.1). A reduction of fishing mortality towards the proposed reference point is advised.

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)*