



Stock Assessment Form Demersal species

Reference year:2012

Reporting year:2013

STOCK ASSESSMENT OF RED MULLET IN GSA17

In the Adriatic, red mullet is one of the main target species of the trawler fleets. The species is mainly fished by otter bottom trawl nets and smaller quantities are also caught with set nets and rapido trawl. Different management regulation are applied in Italian and in Croatian waters. Fishing closure for Italian trawlers for 45 days in late summer have been enforced in 2011-2012 for the Italian fleet. Before 2011 the closure period was 30 days in summer. Minimum landing sizes: EC regulation 1967/2006 defined 11 cm TL as minimum legal landing size for red mullet. Along Croatian coast bottom trawl fisheries is mainly regulated by spatial and temporal fisheries regulation measures, and about 1/3 of territorial sea is closed for bottom trawl fisheries over whole year. Also bottom trawl fishery is closed half year in the majority of the inner sea. Minimum landing size for red mullet is the same like in the EC regulation. Landings data for the Italian and Slovenia fleet were reported through the Data Collection Framework, while Croatian data comes from official statistics of Fisheries Department and data were collected through logbooks. The Italian catches remained above the 3000 t from 2006 to 2009 and then started to decrease, reaching the minimum in 2012 with less than 2000 t. The Croatian catches remain lower than 1000 tons for all the time series except in 2011, in which the increase to a value around 1000 tons. Considering the results of the XSA analyses conducted the red mullet stock in GSA 17 is subjected to overfishing, being the current F estimated higher than the proposed reference point (F0.1XSA = 0.20 as a proxy of FMSY). A reduction fishing mortality towards the proposed reference point is advised. Considering the overfishing situation of the red mullet stock in GSA 17 a reduction of fishing pressure and an improvement in exploitation pattern, especially of Italian trawlers exploiting a larger amount of Age 0+ group than Croatian and Slovenian trawlers, is advisable. However, from the analysis of the relative biomass observed in 2012 from MEDITS and from the SSB and total biomass estimated for the same year from XSA is possible to conclude that the abundance of the stock is high and there is not risk of stock depletion..

Stock Assessment Form version 1.0 (January 2014)

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Stock assessment form

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Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:						
Mullus barbatus	Red mullet	31						
1 st Geographical sub-area:	2 nd Geographical sub-area:	3 rd Geographical sub-area:						
17								
4 th Geographical sub-area:	5 th Geographical sub-area:	6 th Geographical sub-area:						
1 st Country	2 nd Country	3 rd Country						
Italy	Croatia	Slovenia						
4 th Country	4 th Country 5 th Country							
Stock assessr	nent method: (direct, indirect, com	bined, none)						
	Indirect: XSA							
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2 Stock identification and biological information

Red mullet (*Mullus barbatus*) is uniformly distributed in the whole Adriatic and the isolation of the Adriatic population was assessed by molecular and Bayesian analysis (Maggio *et al.*, 2009). This study proved a limited gene flow attributable to really low adult migration and a reduced passive drift of pelagic larvae from and to the Adriatic Sea. A previous study from Garoia *et al.* (2004) developed a set of dinucleotide microsatellite markers and revealed a significant overall heterogeneity within the red mullet Adriatic stock: this result indicate that this species may constitute local subpopulations that remain partly isolated from each other. However, the randomness of genetic differences among samples indicated that red mullet in the Adriatic likely belongs to a single population. Besides, no correlation between geographic distance and genetic differentiation has been detected. The observed genetic fragmentation could be explained by a passive dispersion of larvae due to marine currents, from random changes in allele frequencies or from fishing pressure. Although the red mullet is distributed in the entire Adriatic, the density of the population is not the same in space. For example, Arneri and Jukić (1986) found that the biomass index between Italian and Croatian waters is about 1:4.

2.1 Stock unit

2.2 Growth and maturity

According to Jardas (1996), red mullet grow up to 30 cm, with females growing faster and bigger than males. The Von Bertalanffy Growth Function parameters available for this species are presented in table 1.

Author	Sex	L_{∞} (cm)	K (yr ⁻¹)	t ₀ (yr)	Ф'
Scaccini (in Levi et al., 1994)	M+F	27.49	0.5	-0.25	5.93
Jukić and Piccinetti, 1988	M+F	27.0	1.8		7.18
Marano, 1994; Ungaro et al., 1994	M+F	19.70	0.360	-1.18	4.94
Vrgoč, 1995 ("Hvar")	M+F	27.75	0.274	-0.616	5.35
	M	27	0.184	-1.92	4.90
Marano, 1996; Marano et al., 1998b, c	F	34.5	0.156	-1.53	5.22
	M+F	31.5	0.182	-1.45	5.19
	M+F (Bhatt)	26.3	0.45		5.74
Ardizzone, 1998	M+F	27.50	0.50		5.93
	M	22.5	0.24	-1.29	4.80
	F	26.2	0.23	-1.41	5.06
Marano, 1998b, c	M+F	22.5	0.38	-0.63	5.26
	M+F (Bhatt)	25.4	0.25		5.08
	M+F (Surf.)	23	0.52		5.62
Vrgoč, 2000	M+F	26.86	0.295		5.36
EC XIV/298/96-EN,	M+F	21.72	0.31		4.99
Ionian and Southern Adriatic					
EC XIV/298/96-EN,	M+F	27.5	0.50		5.94
Adriatic Sea					

Table 1 the Adriatic Sea (the references of the table are from Vrgoc et al., 2004)

Length frequency distributions from the Croatian fleet as well as from survey data were converted into catch at age according to slicing using the growth parameters obtained independently for males and females reported in table 2.3 (Vrgoc N., 2008: PHARE 2005 EuropeAid/123624/D/SER/HR). Red mullet reproduction in GSA 17 occurs in late spring and summer. Specimens reach sexual maturity during the first year of life, at length between 10 and 14 cm (Županović, 1963; Haidar, 1970; Jukić and Piccinetti, 1981; Marano et al., 1998; Vrgoč, 2000). The maturity at age utilized in the assessment is reported in Table 2.2-2.

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 to August
Maximum size observed			28.5	Recruitment season	late summer-autumn
Size at first maturity			11.7	Spawning area	Figure 1
Recruitment size to the fishery			6	Nursery area	Figure 1



Fig. 2

Age	Natural mortality	Proportion of matures
0		
0	1.6	0.1
1		
1	0.84	0.9
2		
2	0.37	1
2		
5	0.29	1
1		
4	0.26	1
5		
5	0.25	1
64		
UT	0.22	1

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

Table 2-3: Growth and length weight model parameters

					Sex	
		Units	female	male	Combined	Years
	L∞				26.86	
Consulta and al	К				0.295	
Growth model	to				-1.1	
	Data source		(Vrgoc Europe	N., 2008 Aid/123	3: PHARE 2005 624/D/SER/HR	
Length weight	а				0.009	
relationship	b				3.076	
	M (scalar)					
	sex ratio (% females/total)					

3 Fisheries information

3.1 Description of the fleet

In the Adriatic, red mullet is mainly fished by bottom trawl nets. Smaller quantities are also caught with trammel-nets and gill nets.

Fishing closure for Italian trawlers: 45 days in late summer have been enforced in 2011-2012 for the Italian fleet. Before 2011 the closure period was 30 days in summer. Minimum landing sizes: EC regulation 1967/2006 defined 11 cm TL as minimum legal landing size for red mullet.

Along Croatian coast bottom trawl fisheries is mainly regulated by spatial and temporal fisheries regulation measures, and about 1/3 of territorial sea is closed for bottom trawl fisheries over whole year. Also bottom trawl fishery is closed half year in the majority of the inner sea. Minimum landing size for red mullet is the same like in the EC regulation.

Mannini and Massa (2000) analyzed trends of the red mullet landings in the Adriatic from 1972 to 1997. In that period, the landings showed an overall increase. This positive trend was constant in the Western Adriatic, while in the Eastern Adriatic landings decreased during the second half of the 1990s.

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	Italy	17		ОТВ	[ISCAAP Group]	Mullus barbtus
Operational Unit 2	Croatia	17		ОТВ	[ISCAAP Group]	Mullus barbtus
Operational Unit 3	Slovenia	17		ОТВ	[ISCAAP Group]	Mullus barbtus

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

Other Discards Catch (T or Fleet Discards (other species kg of the **Operational Units*** (n° of (species species Effort (units) caught species (names and boats)* caught) assessed) assessed) weight) Squilla mantis, Merluccius merluccius, Sepia officinalis, Nephrops Italian OTB 300 Tons norvegicus GT_DAYS_AT_SEA **Croatian OTB** Merlangius merlangus (81,79 t), Eledone moschata 0,14 15063,24 3,75 5,72 (25,49 t), Slovenian OTB 17 Loligo (GT_DAYS_AT_SEA) tons tons tons vulgaris (11,61 t), Sepia officinalis (9,47 t)

Table 3.1-2: Catch,	bycatch,	discards an	d effort by	/ operational	unit in the	reference	vear
							,

Total			

3.2 Historical trends

Landings data for the Italian and Slovenia fleet were reported through the Data Collection Framework, while Croatian data comes from official statistics of Fisheries Department and data were collected through logbooks. The Italian catches remained above the 3000 t from 2006 to 2009 and then started to decrease, reaching the minimum in 2012 with less than 2000 t (Table 4). The Croatian catches remain lower than 1000 tons for all the time series except in 2011, in which the increase to a value around 1000 tons (Fig. 2).

Tab. 4. Annual landings (t) by fishing gear as reported through the DCF data call for Italy and Slovenia, and official statistic data from Croatian Fisheries Department .

Country	Gear	2006	2007	2008	2009	2010	2011	2012
ITA	OTB	3100	3299	3158	2433	1797	2619	1646
ITA	GNS	n/a	n/a	n/a	n/a	n/a	31.225	18
ITA	TBB	n/a	n/a	n/a	n/a	n/a	36	43
CRO	ОТВ	805	950	742	800	750	1100	1318
SLO	ОТВ	1.9	6.4	2	2.6	1.4	6	3.5

The length distribution of Italian and Croatian catches is showed in figure 0.

Discard data for the Italian fleet are available for the period 2010-2012 (Table 5). The amount of discard for the Croatian bottom trawl fisheries is negligible due to the fact that the minimum size in the catches is bigger than the minimum landing size allowed (i.e. there are no juveniles in the catches; Fig. 3).

Tab 5. Discard data (t) by fishing gear as reported through the DCF data call.

Country	Gear	2006	2007	2008	2009	2010	2011	2012
ITA	OTB	n/a	n/a	n/a	n/a	183	796	680
ITA	TBB	n/a	n/a	n/a	n/a	n/a	7.39	0
SLO	OTB	0.012	0.14	0.018	0.03	0	0.121	0.05

In the Italian catches the discard proportion varied between 9 and 30% in the period 2010-2012. The TL of the discards ranged between 4 and 16 cm. For the years without discard data the Italian data has been modified assuming the discard proportion reported in table 6.



Figure 2 – Total landings of Italian, Slovenian and Croatian OTB fleets.



Figure 3 – Length frequency distributions of Italian and Croatian catches.

3.3 Management regulations

Italy and Slovenia :

- In Italy and Slovenia the main rules in force are based on the applicable EU regulations (mainly EC regulation 1967/206):
- Minimum landing sizes: 11 cm TL for red mullet (valid also for Croatia).
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets have been replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.

- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.
- Set net minimum mesh size: 16 mm stretched.
- Set net maximum length x vessel x day: 5,000 m

<u>Croatia</u>

Since the accession of Croatia to the EU the 1st if July 2013, the same regulations of Italy and Slovenia are implemented. Furthermore the following regulation for OTB are applied, especially in specific areas (Fig. 6.13.2.2.1):

1. Ordinance on Commercial Fishing at Sea (Official Journal no. 63/2010, 141/2010, 148/2010, 52/2011 and 144/2011) in parts which remain in force after the Croatian entry into the European Union:

- Article 3, paragraph 1 (minimum size of cod-end in the inner sea)
- Article 4 (spatial regulation considering the power of propelling engine)
- Article 5, paragraph 1 (permanent ban for certain zones)
- Article 6 and 7 (spatial-temporal ban to protect immature fish and other marine organisms)
- Article 8 and 9 regulation in E zone
- Article 10 regulation in F zone
- Article 11 regulation in G zone
- Article 32 ban on the issuance of new licences and entry of new types of fishing (fishing tools and equipment) to the valid licences.

2. Ordinance on fishing gear and equipment for commercial fishing in the sea (Official Journal, no. 148/2010, 25/2010) in parts which provide design and technical characteristics of the fishing gear and equipment, and the amount of gear that can be used in fishing (if it is not regulated by EC Regulations).

3. Ordinance on privileges for commercial fishing at the sea and the register of issued privileges (Official Journal no. 144/2010, 123/2011, 53/2012 and 98/2012.) which defines the conditions for transfer of rights from one valid licence to another valid licence and the terms of transfer of licences from one fishing vessel to another.

4. Ordinance on special habitats of fish and other marine organisms, and regulation of fishing in the Velebit Channel, Novigrad and Karin Sea, Prokljan Lake, Marina Bay and Neretva Channel (Official Journal, no. 148/2004, 152/2004, 55/2005, 96/2006, 123/2009 and 130/2009) which prohibits fishing by bottom trawling tools in specific habitats and in areas of the fishing sea with a special fishing regulation (Velebit Channel, Novigrad and Karin Sea, Prokljan Lake, Marina Bay and the Neretva Channel).



Figure 2. Red mullet GSA 17 - Administrative classification of the fishing sea in the Republic of Croatia.

3.4 Reference points

Indicator	Limit Reference point/emp irical reference value	Value	Target Reference point/empi rical reference value	Value	Comments
В					
SSB					
F	F0.1	0.20			
Y					
CPUE					
Index of Biomass at sea					

Table 3.3-1: List of reference points and empirical reference values previously agreed (if any)

4 Fisheries independent information

4.1 MEDITS

Based on the DCF data call, abundance and biomass indices were calculated. In GSA 17 (including Italian, Slovenian and Croatian parts of Adriatic Sea) the following number of hauls was reported per depth stratum.

4.1.1 Brief description of the direct method used

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

Yst = ? (Yi*Ai) / A V(Yst) = ? (Ai² * si ² / ni) / A²

Where:

.

A=total survey area Ai=area of the i-th stratum si=standard deviation of the i-th stratum ni=number of valid hauls of the i-th stratum n=number of hauls in the GSA Yi=mean of the i-th stratum Yst=stratified mean abundance V(Yst)=variance of the stratified mean

Direct methods: trawl based abundance indices

Table 4.1-1: Trawl survey basic information

Survey	MEDITS		Trawler/RV	Andrea
Sampling s	eason	Summer		
Sampling d	esign	Random		
Sampler (g	ear used)	GOC73		
Cod –end n	nesh size	20 mm		
as opening	in mm			

Investigated depth	igated depth	
range (m)	(m)	

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

Stratum	Total surface (km ²)	Trawlable surface (km ²)	Swept area (km²)	Number of hauls
2111	401,8	307,6	0,085	2
Total (– m)				

Map of hauls positions

Table 4.1-3: Trawl survey abundance and biomass results

Depth Stratum	Years	kg per km²	CV or othe r	N per km²	CV or othe r
21111	1995 - 2012	6,04	2,79	174,6 6	2,5
Total (– m)					

*



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

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

N (Total or sex combined) by	Year			
Length or Age				
Class				
Total				

Sex ratio by Length or Age	Year			
class				

Total		

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 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 se	eason		
Investigated depth range (m)			
Spawnin	g season and peak (month	ıs)	

Table 4.1-8: Trawl surveys; spawners analysis results

Surveys	Area in km ²	N (N of individuals) of spawners per km ²	CV or other	SSB per km ²	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 e trends

4.1.2 Spatial distribution of the resources



Fig. 4

4.1.3 Historical trends

- 5 Ecological information
- 5.1 Protected species potentially affected by the fisheries
- 5.2 Environmental indexes

6 Stock Assessment

In this section there will be one subsection for each different model used, and also different model assumptions runs should be documented when all are presented as alternative assessment options.

6.1 XSA

6.1.1 Model assumptions

Data coming from DCF and Croatian Fisheries Department for the period 2006-2012 were used to perform an Extended Survivor Analysis (XSA) calibrated with fishery independent data (i.e. MEDITS) and using FLR (www.r-project.org). Data included information on total landings and catch at age of M. barbatus in GSA 17 for both the Italian , Croatian and Slovenia OTB fleets. Discard data from the Italian fleet (available for 2010-2012) were also included in the analyses.

The XSA runs were made using the following settings:

- Catchability dependent on stock size for ages = 0
- Catchability independent of age for ages >= 2
- S.E. of the mean to which the estimates are shrunk = 1
- Minimum standard error for population estimates derived from each fleet = 0.300
- The number of ages used for the shrinkage mean: 5
- Fbar: 0-5

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



Catch at age data utilized in the XSA

Catch at age in numbers (x 1000)							
ОТВ	0	1	2	3	4	5	6+
2006	37291	70672	15911	2520	317	90	28
2007	44539	79443	16829	2956	376	106	34
2008	43599	73473	14121	2715	379	77	14
2009	12589	75384	27098	5790	708	98	26
2010	12994	40241	26193	4757	976	76	38
2011	31771	59477	29426	8235	1326	218	68
2012	24583	58973	36055	4535	484	83	29

PERIOD	0	1	2	3	4	5	6+
2006-2012	0.018	0.026	0.043	0.072	0.10	0.125	0.147
					0		
Mean weight in stock (kg)							•
PERIOD	0	1	2	3	4	5	6+
2006-2012	0.01	0.018	0.043	0.072	0.100	0.125	0.147

Abundance index							
Medits	0	1	2	3	4	5	6+
2006	113.912	584.839	222.273	52.331	10.992	1.36	1.293
2007	61.417	241.857	148.838	32.217	7.739	2.019	0.7
2008	7.258	448.063	386.663	65.936	11.235	2.291	0.657
2009	3.332	350.515	249.27	73.18	10.535	1.244	0.638
2010	5.532	469.74	309.555	65.853	13.936	1.768	0.587

2011	159.047	541.47	183.235	45.531	6.673	1.362	0.558
2012	141.861	1415.38	334.406	42.599	5.755	1.336	0.853

Natural mortality (M)

,	· /						
PERIOD	0	1	2	3	4	5	6+
2006-2012	1.6	0.84	0.37	0.29	0.26	0.25	0.22

6.1.4 Results

<u>State of exploitation</u>: Exploitation fluctuated from the beginning of the time-series, with a more pronounced increase in 2011. The mean value of the last 3 years if F is 1.06.

<u>State of the juveniles (recruits)</u>: Recruitment varied without any trend in the years 2006-2012, reaching a minimum in 2009, followed by an increase until 2011.

<u>State of the adult biomass</u>: The SSB showed an increasing trend from 2006 to 2012. The last estimate of SSB in 2012 is around 5,000 tons.



6.1.5 Robustness analysis

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

XSA Diagnostics in the form of residuals by survey and retrospective analyses are shown in Figure below. No particular. trends are evidenced in residuals and the retrospective analyses is adequate.





6.1.7 Assessment quality

7 Stock predictions



- 7.1 Short term predictions
- 7.2 Medium term predictions
- 7.3 Long term predictions

8 Draft scientific advice

Considering the results of the analyses conducted the red mullet stock in GSA 17 is subjected to overfishing, being the current F estimated higher than the proposed reference point (F0.1XSA = 0.20 as a proxy of FMSY). A reduction fishing mortality towards the proposed reference point is advised. Considering the overfishing situation of the red mullet stock in GSA 17 a reduction of fishing pressure and an improvement in exploitation pattern, especially of Italian trawlers exploiting a larger amount of Age 0+ group than Croatian and Slovenian trawlers, is advisable. However, from the analysis of the relative biomass observed in 2012 from MEDITS and from the SSB and total biomass estimated for the same year from XSA is possible to conclude that the abundance of the stock is high and there is not risk of stock depletion.

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} , = 0.20)			1	IO		
	Fishing effort							
	Catch							
Stock abundance	Relative Biomass	47.6 kg/km ²		33th - MEDITS - kg/km ² : 20.3 66th - MEDITS - kg/km ² : 23.6	1	N		
Recruitment								
Final Diagnosis		High overfishing and high stock abundance						

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 (O₁): 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)