Stock Assessment Form

Small Pelagics

Reference Year: 2014

Reporting Year: 2015

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Please include your name*

Stock assessment form

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
	[Black Sea anchovy]	[ISCAAP Group]
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
[GSA_29]		
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
1st Country	2nd Country	3rd Country
Turkey	Georgia	Bulgaria
4th Country	5th Country	6th Country
Ukraine	Romania	
Stock assessment method: (direct, indirect, combined, none)		
Authors:		
[Ali Cemal Gücü]		
Affiliation:		

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

The assessments conducted in GFCM and as well as in STECF, assume that the anchovy exploited by countries providing data are of a single stock. On the other hand it is well documented that there are at least two different subspecies in the Black Sea, *Engraulis encrasicolus ponticus*, and *E. e. maeticus*. (Chashchin 1996, Ivanova et al.,201X). These subspecies are typical geographic populations (races), spawning areas of which are limited to different reservoirs. The Azov anchovy breeds in summer in the Sea of Azov, and the Black sea anchovy breeds in the Black Sea at the same time. For the anchovy cannot exist at the water temperature below 6°C for a long time, its schools migrate from the northern part of the sea southward as winter cold sets in. In such event the Azov anchovy goes to the Black sea through the Kerch strait. The population structure of the anchovy in Black Sea and the Sea of Azov and the relationships between its subspecies have been studied rather well to date (Chashchin, Shlyakhov et. al, 2015). The anchovy race (subspecies) identification was carried out in the previous studies, with the use of morphological characters (otolith shape, body length, head and body proportions) (Skazkina, 1965; Gubanov& Limansky, 1968; Shevchenko, 1980; Chashchin 1985), as well as genetic methods. Last ones included the identification of blood groups by means of erythrocytes heteroagglutination reactions with pig and horse serums; as well as isocytratedehydrogenase and esterase isoenzymes allele frequencies detecting (Altukhov, 1974; Kalnin et al, 1984, 1985). Divergence by muscle proteins was found out as well (Ivanova&Dobrovolov, 2006). The individuals of two populations differ in the physiological processes directions as well. While consuming the forage zooplankton in summer in a basin which is richer with the fodder base, Azov population individuals deposit more fat in visceral cavity and in muscles, than the Black Sea individuals (Shulman, 1972). Thereby an earlier readiness to leave the Sea of Azov is being achieved, for the autumn temperature fall occurs in the Sea of Azov already in October.

Although these two forms are quite similar morphologically and cannot be distinguished easily, there are significant differences in their growth rates; Black Sea anchovy growing faster. As the fisheries targeting these different subspecies are not the same, occurrence of different forms of anchovy has not been a matter of concern from assessment point of view until recently.

However, more recently some evidences, such as cohorts with unusually low mean length and weight observed well beyond the known geographical limits of Azov anchovy, point out that the range of the species might have been expanded towards south. The most probably reason is the great increasing of Azov anchovy biomass in some years. According to YugNIRO lampara survey's data the highest level of Azov anchovy stock was registered in the period of 2011-2014 especially. And the wide spreading of Azov anchovy population all over the northern part of the Black Sea was observed in this period. (Chashchin, Shlyakhov et. al, 2015).

At the moment it is not known what the degree of mixing is in the main fishing grounds in south. The question needs to be answered is at what percentage the Azov anchovy is represented in the catch of the southern countries such as Georgia and Turkey, and if this percentage is critically high to affect the results of the assessment. In case the level of mixing is higher than a negligible level a method to distinguish the Azov anchovy and disintegrate the catch into its components and it needs to be practical and cheap.

One important tool that might be and actually being used is the otoliths. Given that the anchovy forms of different origin represents different growth rates, this evidently has imprints on the otoliths. Examination

of the growth rings on the otoliths or any other hard structures on the fish, is a standard element of an age structure model used in the stock assessment. Therefore, analyzing the otoliths and give the percentages of those displaying abnormal growth pattern which supposedly mark the Azov anchovy among the Black Sea anchovies would not be an expensive work or a very heavy burden.

For that purpose, the step needs to be taken are; i) detailed comparison of otoliths of the anchovy sampled within the Azov Sea during the spawning season with those collected in the Black Sea during the same period; ii) basing on step "i" preparation of a guideline to be used by the age readers; iii) basing on new findings, re-analysis of a set of old/new otoliths to quantify the level of mixing.

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**	
Maximum size observed			15	**Recruitment season**	November-December
Size at first maturity				**Spawning area**	Uncertain and seems variable over the entire basin
Recruitment size to the fishery			7 cm	**Nursery area**	All Black Sea

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

Size/Age	Natural mortality	Proportion of matures
0	*1.32*	*0*
1	*0.81*	*1*
2	*0.56*	*1*
3	*0.48*	*1*
…	…	…

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

Size/Age	Natural mortality	Proportion of matures
0	*1.32*	*0*
1	*0.81*	*1*
2	*0.56*	*1*
3	*0.48*	*1*

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**	Cm			13.26	
	K	year			0.66	
	t_0	Year			-0.81475	
	Data source					
Length weight relationship	**a**				0.005097	
	b				3.0944	
	M (scalar)				0.73	
	sex ratio (% females/total)					

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*	[Country1]	[GSA1]	[Fleet Segment1]	[Fishing Gear Class1]	[ISCAAP Group]	
Operational Unit 2	[Country2]	[GSA2]	[Fleet Segment2]	[Fishing Gear Class2]	[ISCAAP Group]	
Operational Unit 3	[Country3]	[GSA3]	[Fleet Segment3]	[Fishing Gear Class3]	[ISCAAP Group]	
Operational Unit 4	[Country4]	[GSA4]	[Fleet Segment4]	[Fishing Gear Class4]	[ISCAAP Group]	
Operational Unit 5	[Country5]	[GSA5]	[Fleet Segment5]	[Fishing Gear Class5]	[ISCAAP Group]	
Operational Unit 6	[Country6]	[GSA6]	[Fleet Segment6]	[Fishing Gear Class6]	[ISCAAP Group]	

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]						
[Operational Unit2]						
[Operational Unit3]						
[Operational Unit4]						
[Operational Unit5]						
Total						

3.2 Historical trends

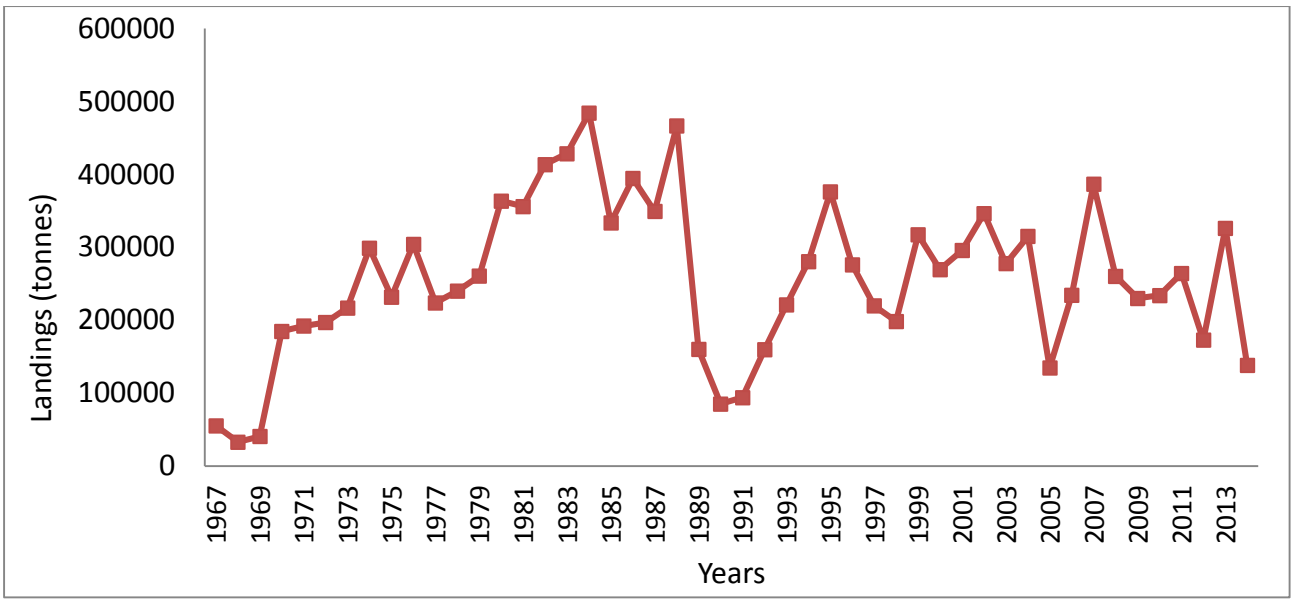
Time series analysis with tables and figures showing the observed trends in catches, landings, fishing capacity or effort .

Year	Bulgaria	Georgia[1]	Romania	Russian Federation	Turkey	Ukraine[2]	USSR[2]	Total
1980	209				239289		124100	363598
1981	70				259767		96222	356059
1982	266				266523		146834	413623
1983	784				289860		137918	428562
1984	239				318917		164841	483997
1985	92				273274		60395	333761
1986	96				274740		119781	394617
1987	13				295902		53482	349397
1988	115				295000		171452	466567
1989					96806		63289	160095
1990					66409		18824	85233
1991		6871			79225		7906	87131
1992		1656			155417	2572		164860
1993		857			218866	1598		222120
1994		1301	197		278667	242		279963
1995	35	1232	190		373782	888		376196
1996	23	2288	140		273239	596		275230
1997	44	2346	45		213780	3623		219780
1998	48	1264	146		195996	1039		199575
1999	36	1487	155		310801	4872		317128
2000	64	941	204		260670	7719		270144
2001	102	927	186		288616	6915		295760
2002	237	2665	296		336419	6739		344618
2003	131	2562	160		266069	8868		277893
2004	88	2600	135		306656	5687		315128
2005	14	9222	154		119255	6200		128223
2006	6	17446	23		212081	4907		226239
2007	60	25972	87		357089	3363		378046
2008	28	31338	15		225344	3761		255086
2009	42	39857	21		185606	4653		221660
2010	65	25918	50		203026	5051		248049
2011	18	11006	41		246390[2]	6932		279300
2012	7	56777	18		109187[2]	6823		171036
2013	10	70795	111		255309[2]	0		326130
2014	370	66000	62	300	71530[3]	200		157462

1) The national experts recognized inconsistency in the Georgian landinh data used previously and provided official landings

2) The landing data has been corrected by the Ukrainian experts by removing the landings of Azov anchovy caught in the Black Sea by the former USSR and Ukrainian fleets

3) The Turkish landings were taken from TurkStat, however for the last four years the landing figures were taken from the reports of a national anchovy monitoring program carried out in Turkey



Total Black Sea anchovy landings by year

3.3 Management regulations

In the Black Sea countries, anchovy fisheries are generally regulated by i) closed seasons (May April to October/November for Bulgaria and Romania, April to September for Turkey, and no closed season for Ukraine), ii) closed areas, iii) mesh size regulations, iv) minimum landing size (9 cm total length in general and 7 cm TL for Georgia, allowable minimum length size is not applied for the Black Sea anchovy in Ukraine). The Black Sea and Azov anchovy are treated as two different stocks in Ukraine and in the Russian Federation and the fishery is managed separately for each stock.

Turkey, having the main fleet fishing the Black Sea anchovy, enforced additional measured to control the size of the fishing fleet. These include:

a) fishing capacity had developed over the years and finally overcapitalized beyond profitability within the last 3 decades. The issue and its consequences on the fish stocks have been recognized in mid-1990s when a significant reduction in the stocks hit the fishing sector. However a comprehensive measure has been enforced only at the beginning of 2000's. As a first step, licensing new fishing boats has been stopped in 2002 with the aim of reducing the fishing pressure on the stocks and to maintain sustainable fisheries. Despite interruptions during 2004 and 2005, the applied policy had positive effects on control of increasing fleet capacity. Since then, new entries to the fleet are only allowed when a vessel of same size is exiting from the fleet. In summary the size of the main anchovy fishing fleet in the Black Sea is stable since 2005.

b) another very substantial and promising remedy is the fishing boat buyback program launched in 2012 and repeated in 2013. Given that by far greater part of the catch is landed by the industrial boats, the first phase of the program targets fishing vessels larger than 12 meters in 2012. Although the ultimate goal is to reach greater percentages in time, with the available funds allocated for the buyback program only 407 boats (156 boats of them were registered to the port on the Black Sea coast) has been removed from the fleet at this first phase in 2013. In the second phase launched in 2014 another 529 boats have been decommissioned within this campaign.

c) a series of new regulations and methodological reforms have been enforced within the last 2 years to enhance accuracy of the landing statistics,

d) as of 18.08.2012 the minimum depth limit allowed for purse seine and for pelagic trawls has been increased from 18 to 24 meters. Considering that the anchovy overwintering on the Anatolian coast are confined to 0 to 100 meters, the regulation has noticeable positive effect on the reduction of fishing pressure on the anchovy stocks.

3.4 Reference points

Table 3.3-1: 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 {NAME OF THE DIRECT METHOD}

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

4.1.1 Brief description of the chosen method and assumptions used

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

Direct methods: DEPM

Table 4.1-1: Egg production cruise information.

Date					
Cruise				**R/V**	
Total area (km^2)		Positive		**Negative**	
Egg sampler					
Adult sampler					

Table 4.1-2: Parameters of the egg mortality curve

Parameters (exponential decay model)			**value**	**CV**
P_0 (# of eggs /0.05 m^2)				
Z ($days^{-1}$)				
Temperature range	ºC	ºC		

Table 4.1-3: DEPM Model parameters

Model parameters	**value**	**CV**
P_0 (# of eggs/0.05 m^2 per day)		
A (surface of region 0.05 m^2)		
W (average female weight in gr)		
F (batch fecundity: eggs / batch per mature female)		
S (spawning fraction: # spawning female per mature female)		
R (sex ratio: females/total)		

Table 4.1-4: DEPM based estimates

Result	value	CV
Biomass (t)		

Direct methods: acoustics

- Specify if numbers are per km^2 or raised to the area, assuming the same catchability .
- Specify the ageing method or the age slicing procedure applied, specify the maturity scale used.
- In case maturity ogive has not been estimated by year, report information for groups of years.

Table 4.1-5: Acoustic cruise information.

Date			
Cruise		**R/V**	
Target species			
Sampling strategy			
Sampling season			
Investigated depth range (m)			
Echo-sounder			
Fish sampler			
Cod –end mesh size as opening (mm)			
ESDU (i.e. 1 nautical mile)			
TS (Target Strength)/species			
Software used in the post-processing			
Samples (gear used)			
Biological data obtained			
Age slicing method			
Maturity ogive used			

Table 4.1-6: Acoustic results, if available by age or length class

	Biomass in metric tons	**fish numbers**	**Nautical Area Scattering Coefficient**	**Indicator …**	**Indicator …**

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

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 Extended Survival Analysis, XSA

6.1.1 Model assumptions

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)					
Age class	1988	1989	1990	1991	1992	1993
0	2.1658E+06	1.6431E+07	1.6682E+07	1.0516E+07	1.3458E+07	1.9240E+07
1	1.5012E+07	5.2201E+06	1.2431E+06	4.5237E+06	1.2080E+07	1.5584E+07
2	1.3372E+07	2.5237E+05	4.0325E+05	8.5490E+05	1.1773E+06	2.6300E+06
3	5.7913E+05	8.1006E+04	1.2565E+05	4.5262E+04	2.6407E+04	1.4766E+05
4 +	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03

	Catch-at-age (thousands)					
Age class	1994	1995	1996	1997	1998	1999
0	4.2080E+07	2.5591E+07	1.6214E+07	5.8387E+06	5.3934E+06	8.8121E+06
1	1.5898E+07	2.1919E+07	1.5724E+07	1.3528E+07	1.2465E+07	2.0147E+07
2	2.9398E+06	8.5563E+06	6.9648E+06	6.1555E+06	5.6594E+06	8.9692E+06
3	2.4386E+04	1.2367E+06	9.4767E+05	7.6818E+05	7.0572E+05	1.1174E+06
4 +	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	1.1100E+02	6.8000E+01

	Catch-at-age (thousands)					
Age class	2000	2001	2002	2003	2004	2005
0	7.3224E+06	1.6474E+06	1.8008E+06	1.5738E+06	8.1135E+06	6.0330E+06
1	1.7378E+07	1.2232E+07	1.4500E+07	1.1758E+07	1.6438E+07	3.6669E+06
2	7.6064E+06	1.1845E+07	1.3828E+07	1.0971E+07	9.0204E+06	4.5980E+06
3	9.4786E+05	2.3129E+06	2.7005E+06	2.1360E+06	7.1839E+05	3.2514E+05
4 +	2.2900E+02	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03

	Catch-at-age (thousands)					
Age class	2006	2007	2008	2009	2010	2011
0	1.4559E+07	2.3494E+07	8.2195E+06	1.0250E+07	7.3238E+06	9.2256E+06
1	1.1646E+07	1.9873E+07	1.2262E+07	9.5315E+06	1.0027E+07	1.3583E+07
2	4.8485E+06	7.5636E+06	8.5702E+06	5.1850E+06	9.8997E+06	6.0863E+06

3	1.6285E+05	2.2425E+05	3.1818E+05	1.9928E+05	4.2850E+05	3.2631E+05
4 +	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	1.0000E-03	6.6482E+04

	Catch-at-age (thousands)		
Age class	2012	2013	2014
0	2.3787E+07	5.3948E+06	3.4650E+06
1	1.0899E+07	2.1267E+07	1.3140E+07
2	2.1920E+06	5.8056E+06	6.9390E+06
3	2.1837E+05	3.9252E+05	6.6450E+05
4 +	1.4938E+05	1.0000E-03	1.1860E+05

6.1.4 Tuning data

	Catch-at-age (thousands)					
Age class	1988	1989	1990	1991	1992	1993
0	9.8979E+03	6.7228E+04	6.3046E+04	4.0980E+04	9.3459E+04	7.4816E+04
1	6.8603E+04	2.1359E+04	4.6981E+03	1.7629E+04	8.3894E+04	6.0596E+04
2	6.1108E+04	1.0326E+03	1.5240E+03	3.3316E+03	8.1762E+03	1.0226E+04
3	2.6466E+03	3.3145E+02	4.7485E+02	1.7639E+02	1.8339E+02	5.7416E+02
4 +	4.5700E-06	4.0917E-06	3.7792E-06	3.8970E-06	6.9447E-06	3.8884E-06

	Catch-at-age (thousands)					
Age class	1994	1995	1996	1997	1998	1999
0	1.9281E+05	1.0796E+05	6.0976E+04	2.3905E+04	2.0333E+04	3.8398E+04
1	7.2846E+04	9.2467E+04	5.9136E+04	5.5386E+04	4.6991E+04	8.7791E+04
2	1.3471E+04	3.6096E+04	2.6193E+04	2.5202E+04	2.1336E+04	3.9082E+04
3	1.1174E+02	5.2170E+03	3.5640E+03	3.1451E+03	2.6605E+03	4.8692E+03
4 +	4.5821E-06	4.2186E-06	3.7608E-06	4.0942E-06	4.1847E-01	2.9631E-01

	Catch-at-age (thousands)					
Age class	2000	2001	2002	2003	2004	2005
0	2.9952E+04	5.0192E+03	4.3551E+03	2.9699E+03	2.0822E+04	1.1863E+04
1	7.1085E+04	3.7269E+04	3.5066E+04	2.2188E+04	4.2185E+04	7.2102E+03
2	3.1114E+04	3.6088E+04	3.3440E+04	2.0703E+04	2.3149E+04	9.0409E+03
3	3.8772E+03	7.0470E+03	6.5307E+03	4.0308E+03	1.8436E+03	6.3932E+02
4 +	9.3673E-01	3.0468E-06	2.4184E-06	1.8871E-06	2.5663E-06	1.9663E-06

	Catch-at-age (thousands)					
Age class	2006	2007	2008	2009	2010	2011
0	3.1473E+04	5.1903E+04	1.5514E+04	2.5310E+04	1.7328E+04	2.2865E+04
1	2.5176E+04	4.3903E+04	2.3143E+04	2.3536E+04	2.3724E+04	3.3664E+04
2	1.0481E+04	1.6709E+04	1.6176E+04	1.2803E+04	2.3422E+04	1.5084E+04
3	3.5204E+02	4.9541E+02	6.0054E+02	4.9209E+02	1.0138E+03	8.0872E+02

4 +	2.1617E-06	2.2092E-06	1.8874E-06	2.4693E-06	2.3659E-06	1.6477E+02

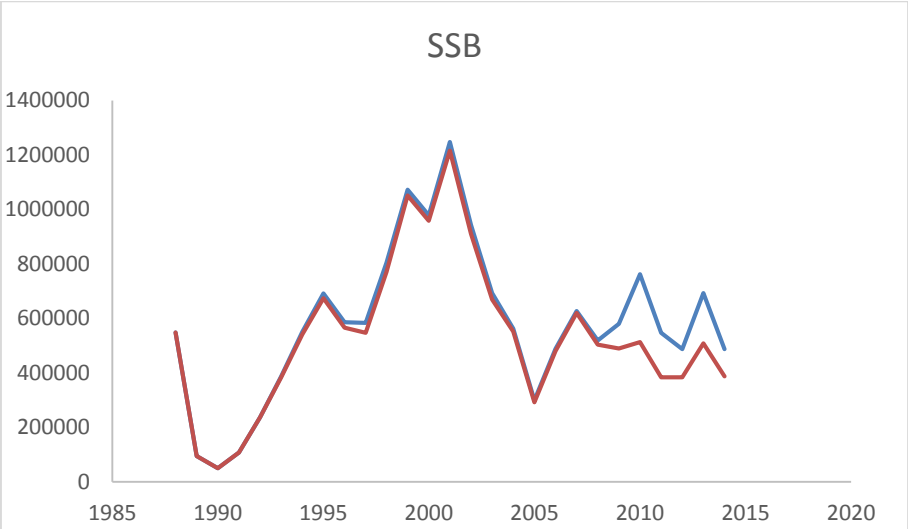
	Catch-at-age (thousands)		
Age class	2012	2013	2014
0	5.2776E+04	2.4549E+04	1.2400E+04
1	2.4183E+04	9.6775E+04	5.2200E+04
2	4.8634E+03	2.6418E+04	2.7500E+04
3	4.8451E+02	1.7862E+03	2.9600E+03
4 +	3.3143E+02	4.5505E-06	4.4000E+02

If it is the case add a table per gear (i.e. VIT)

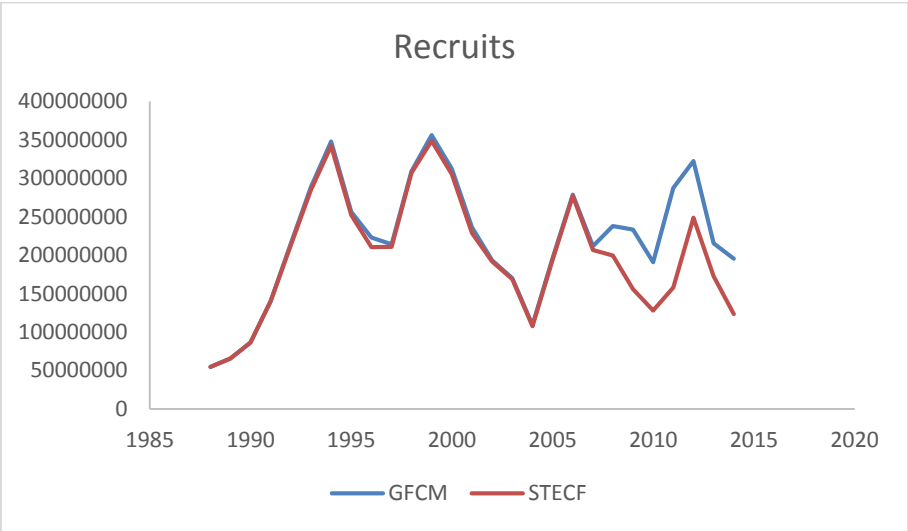
Add a table with input parameters and model settings

6.1.5 Results

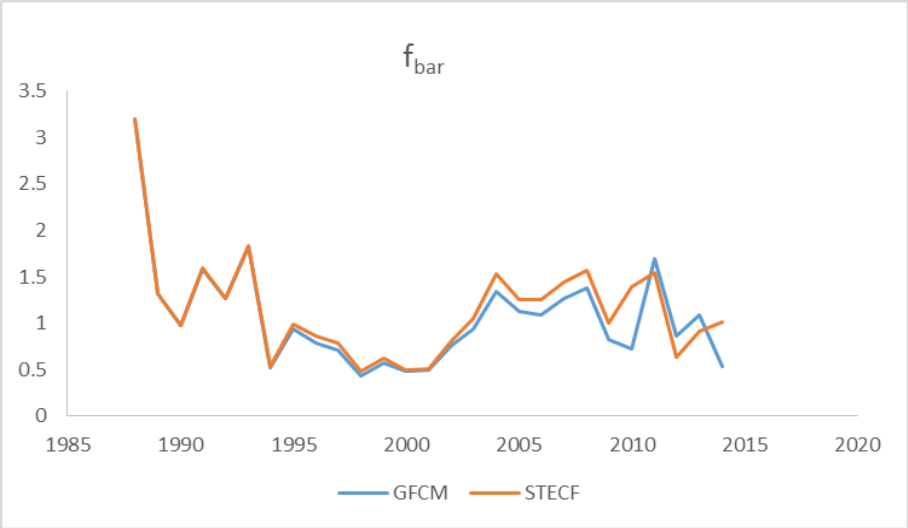
Tables and graphs of Total biomass, SSB, Recruitment, F or other outcomes of the stock assessment model with comments on trends in stock size, recruitment and exploitation.



Model estimated spawning stock biomass and comparison with STECF (2015)

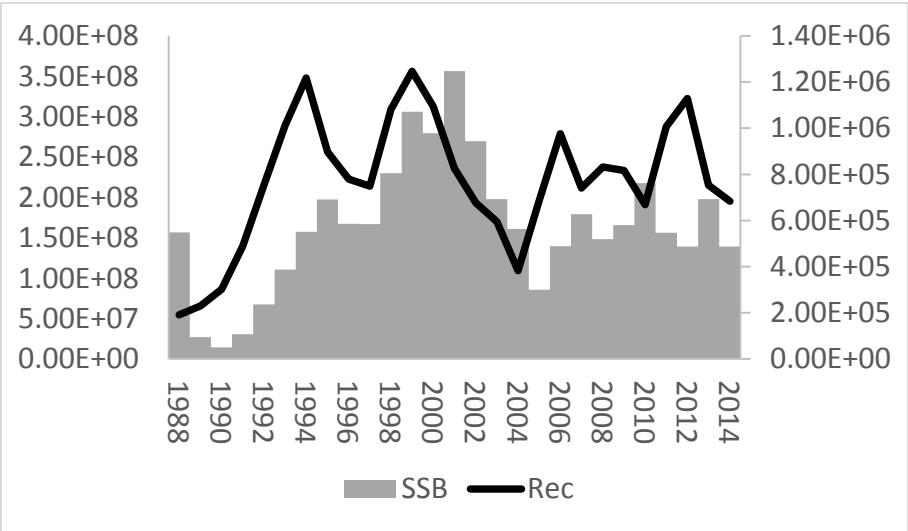


Model estimated recruitment pattern and comparison with STECF (2015)



Model estimated harvest and comparison with STECF (2015)

The results of the analysis display a very strong year class entry in 2012, which, as all assessment results agrees, increased the SSB in the following year. The F, however, which had been dropped noticeably, slightly increased in 2013 and dropped again in 2014. The current exploitation rate (E=0.53), estimated based on the average $F_{[1:3]}$of the last 3 years, exceeds the precautionary threshold 0.4 recommended for small pelagic fish (Patterson, 1992). On the other hand, the high variance of the F estimates averaged over the last 5 years hampers to make meaningful short term predictions. General trend in the last ten years, however, indicates a slight decrease in the fisheries mortality.

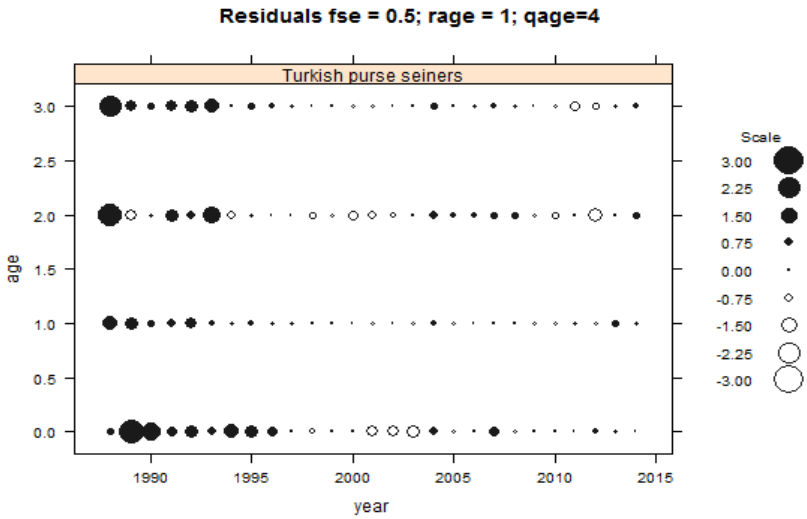


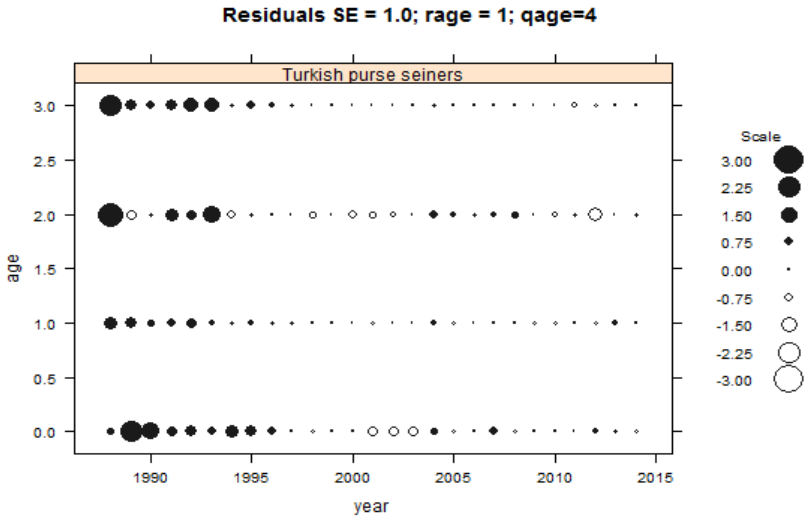
SSB and Recruits by year

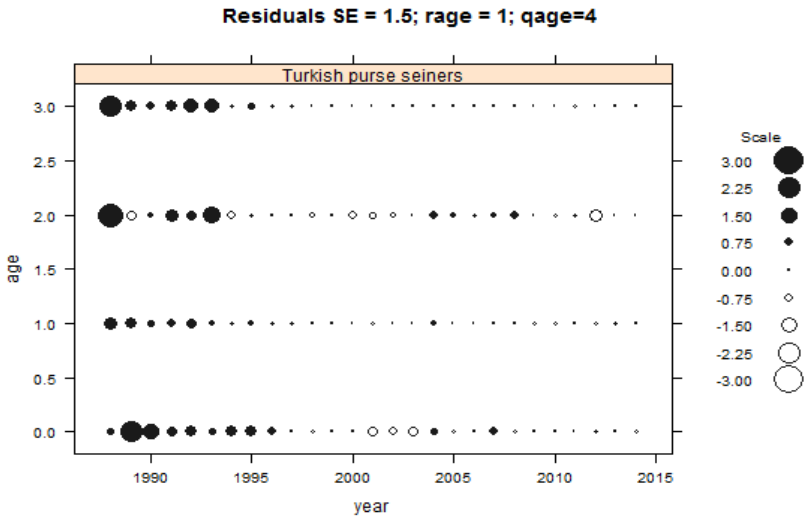
In all model runs recruitment displayed a cyclic pattern with peaking values observed in 1994, 1999, 2006, 2012 (Figure 5.2.4.7.3.4.), which usually followed by a drop within the last 25 years. The pulse of a strong

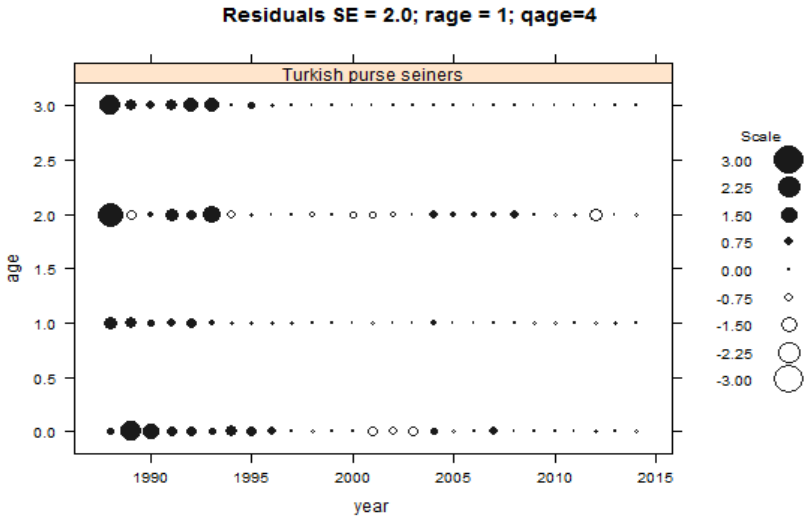
year class usually effects the next years SSB. This is what happened in 2013; the strong recruitment gave rise to the number of spawners next year. The same pattern has been observed, at varying degrees, few years after the strong recruitment years.

6.1.6 Robustness analysis

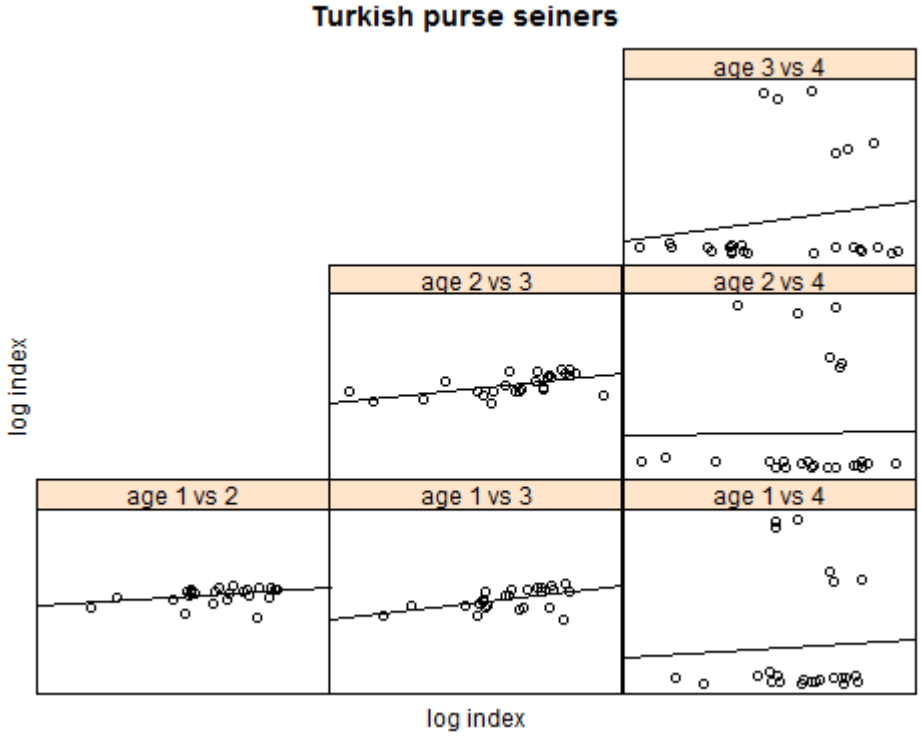






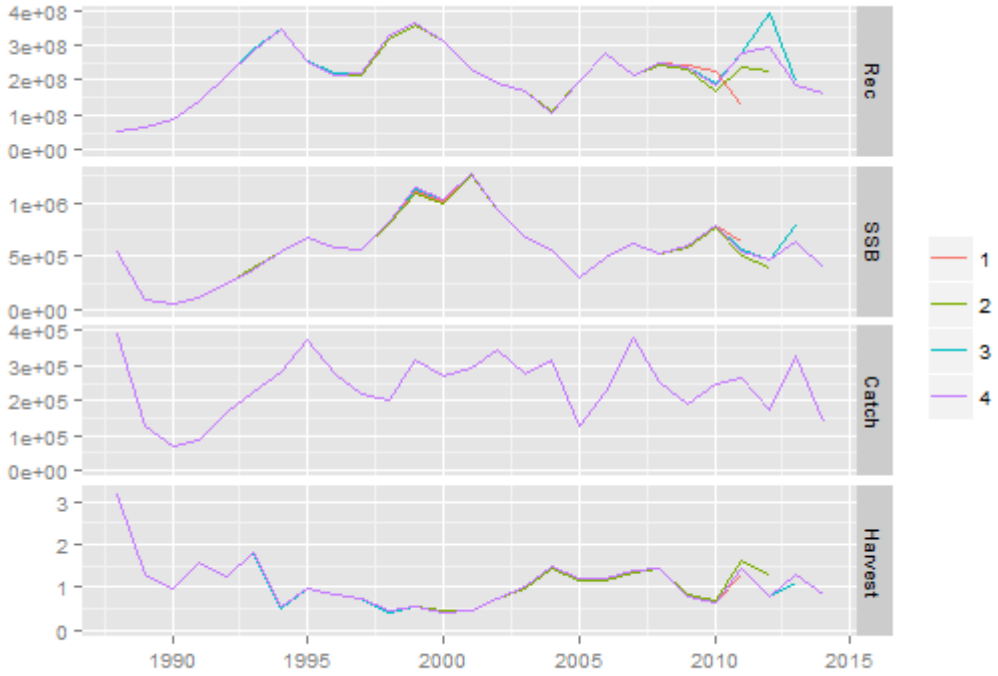


Magnitude and distribution of the residuals

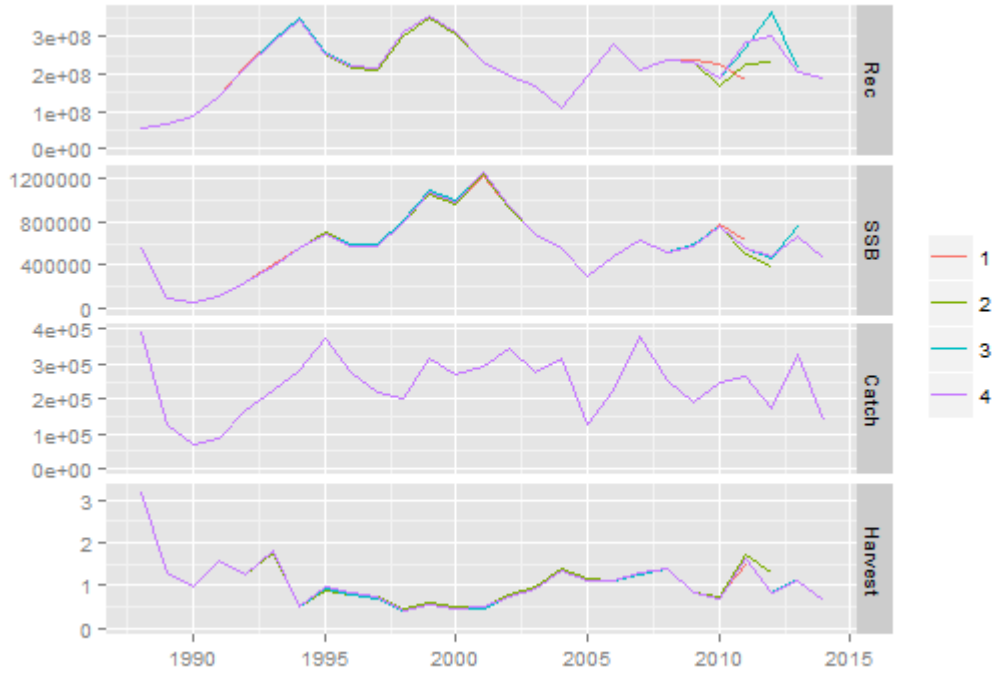


Internal consistency for tuning index (commercial CPUE)

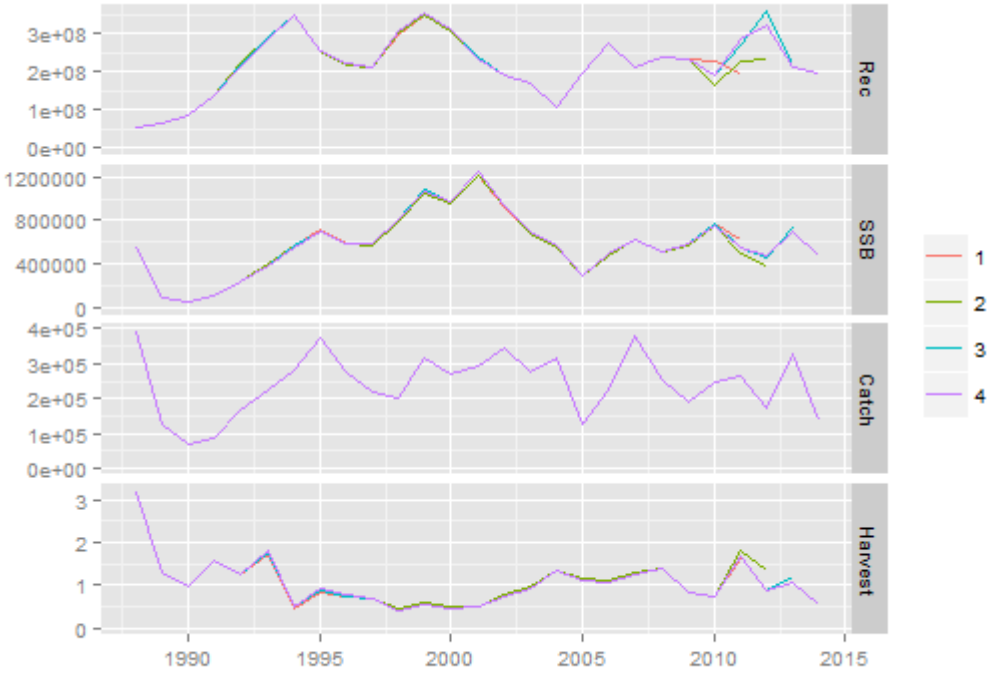
6.1.7 Retrospective analysis, comparison between model runs, sensitivity analysis, etc.



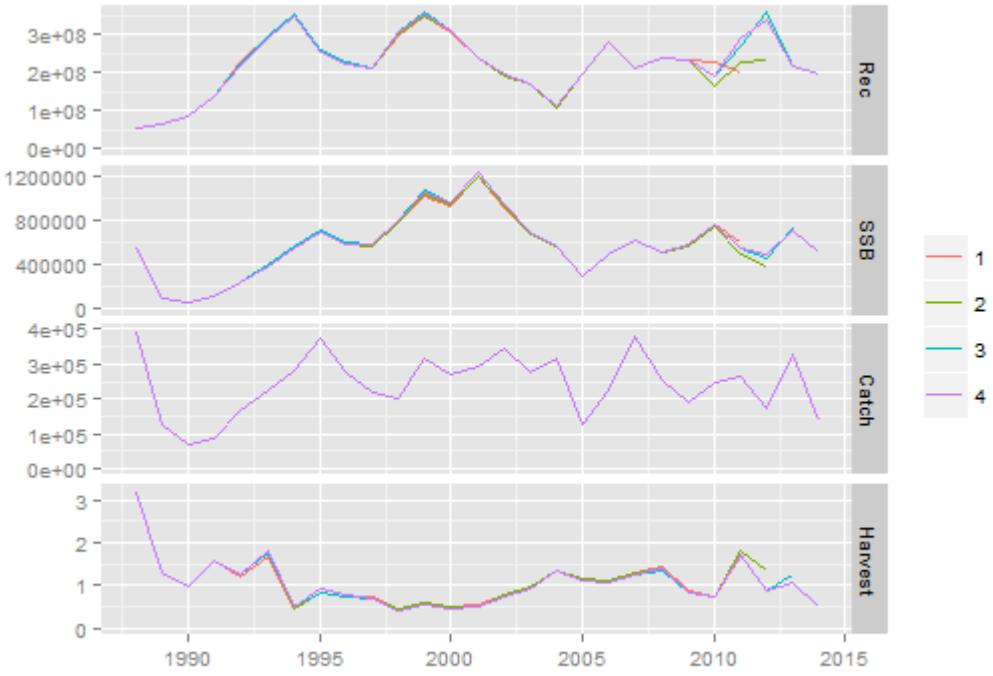
Retrospective analysis for fse=0.5; rage =1 ; qage=4



Retrospective analysis for fse=0.5; rage =1 ; qage=4



Retrospective analysis for fse=0.5; rage =1 ; qage=4



Retrospective analysis for fse=0.5; rage =1 ; qage=4

6.1.8 Assessment quality

The problem in ageing, which was discussed in depth in the stock related issues session of the WG is very clearly reflected on the inconsistency of weight at ages reported by the countries, and more importantly on the significant difference observed in the reported and estimated landings. The difference is balanced using SOP correction however its consequences on the assessment quality could not been evaluated.

In the time serious there is a 4 successive years of missing data (landing at age and weight at age). The gap is filled by the data published in grey literature. The results of the analysis covering that part displays extremely high SSB value. Various test has been done to check whether or not these high values are the outcomes of incompatibility of the data used to fill the gap; however no clear answer has been reached.

The survey data (hydro-acoustic) displayed very high internal inconsistency and increased the residuals remarkably, therefore they were not used. The reason is most probably due the shortage of the area coverage in the surveys. Anchovy is a transboundary fish, however the surveys are limited to one country. It is necessary to enlarge the geographical coverage of the surveys.

The researches carried out by YugNIRO in the Crimea, have revealed the absence of Black Sea anchovy accumulations in winter period. Only few catches have been registered there, mainly as by-catch during Azov anchovy fishery. The data concerning the part of the Black Sea that of Abkhazia (northern part of Georgia) where very heavy anchovy fishery takes place, was not included in the analysis. Given that the overwintering grounds of these peripatetic fish, where they were fished is, to a great extent, determined by the SST, it is not known whether the drop in the total landings is real or the overwintering grounds of the anchovy were expanded towards the countries who did not provided data to GFCM.

7 Stock predictions

No short term forecast was performed.

7.1 Short term predictions

7.2 Medium term predictions

7.3 Long term predictions

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)	Status
Fishing mortality	Fishing mortality		E_{curr} = 0.53	E = 0.4	N	IO_L
	Fishing effort		F_{curr} = 0.54 $F_{[2012-14]}$= 0.83		D	
	Catch				D	
Stock abundance	Biomass					
	SSB				D	
Recruitment					C	
Final Diagnosis		In intermediate level of overfishing				

The reference points produced by FLBRP, such as $F_{0.1}$ or F_{max} were quite unrealistic and high. Therefore Patterson's (1992) precautionary exploitation rate of E=0.4 is used to evaluate the status of the stock. The average of the last three years F was used for the calculation of F used in the estimation of exploitation rate.

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)*