Stock Assessment Form

Small Pelagics

Reference Year: 2016

Reporting Year: 2017

Horse mackerel, *Trachurus mediterraneus ponticus* (Aleev, 1956), is a major commercial fishery for the waters of the Black Sea and belongs to the family Carangidae. This family is represented by 200 species that are widely distributed in tropical, subtropical, and moderate areas of all oceans and adjoining seas. Mackerel stocks in the Black Sea are usually caught by Turkish fisherman by using active (bottom trawler, pelagic trawlerand large purse seine) and passive (extension and longline) nets. Almost the whole horse mackerel catch (98.2%) in Turkish waters is caught by large purse seine.

Stock Assessment Form version 1.0 (January 2014)

Uploader: Maria Yankova

Stock assessment form

Contents

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Trachurus mediterraneus ponticus	Horse mackerel	37.4
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
29	29	29
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
29	29	29
1st Country	**2nd Country**	**3rd Country**
Bulgaria	Georgia	Romania
4th Country	**5th Country**	**6th Country**
Russian Federation	Turkey	Ukraine
Stock assessment method: (direct, indirect, combined, none)		
Authors:		
Affiliation:		

Practically, the horse mackerel (Trachurus mediterraneus ponticus), one of the intensively exploited pelagic species off the Black Sea Coast stock assessment is possible when the whole area of distribution of the species is included into examination. Therefore, collection of samples in the waters of all Black Sea states (Bulgaria, Georgia, Romania, Russia, Turkey, Ukraine) and producing data for this pelagic species should take place.

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/collec

tion/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

The Black sea horse mackerel is a subspecies of the Mediterranean horse mackerel *Trachurus mediterraneus*. Although in the past the Black sea horse mackerel has been attributed to various subpopulations, in a more recent study Prodanov *et al*. (1997) brought evidence that the horse mackerel rather exists as a single population in the Black sea, and thus all Black sea horse mackerel fished across the region should be treated as a unit stock. The genetic analysis demonstrated that two scads shoal groups migrate in the Bulgarian adulatory sector of the Black Sea (Dobrovolov, 2000). The horse mackerel is a migratory species distributed in the whole Black Sea (Ivanov and Beverton, 1985). In the spring it migrates to the north for reproduction and feeding. In summer the horse mackerel is distributed preferably in the shelf waters above the seasonal thermocline. In the autumn it migrates towards the withering grounds along the Anatolian and Caucasian coasts migration (Ivanov and Beverton, 1985). The horse mackerel population in the Black Sea mainly winters along the Crimean, Caucasian and Anatolian coasts and warm sections of the Marmara Sea. They winter at a depth ranging between 20 and 90 meters off Crimea and between 20 and 60 meters off the Caucasian coasts. The horse mackerel population continuously remains in the eastern Black Sea winters in an area north-east of Trabzon. The population migrating between Marmara and the eastern Black Sea spend the winter in the Bosphorus area and off the Marmara Sea at optimal depths ranging between 30 and 50 meters. Depending on water temperature, feeding migration starts in mid-April or towards the end of that month (Demir, 1958). Horse mackerel groups migrate from the Bosphorus to the Bulgarian and Romanian coasts in the north. They are also believed to migrate from Crimea to the north-west and from the Caucasian and north-eastern Anatolian coasts to the Crimean coasts. Autumn migration starts in September and reaches a peak in October and November (Ivanov and Beverton, 1985).

2.1 Stock unit

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**	**Summer(June- August**
Maximum size observed			19.5	**Recruitment season**	
Size at first maturity	11.6			**Spawning area**	Southern Black Sea
Recruitment size to the fishery				**Nursery area**	Southern Black Sea

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

Size/Age	**Natural mortality**	**Proportion of matures**
…	…	…

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

Size/Age	**Natural mortality**	**Proportion of matures**
0		*0*
1		*0.8*
2		*1*
3	…	*1*
4		*1*
5		*1*
6		*1*

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model TURKEY	L_∞	cm			22.664	2016
	K				0.257	2016
	t_0				-1.295	2016
	Data source					
Length weight relationship	a				0.0058	2016
	b				3.1218	2016
	M (scalar)					
	sex ratio (% females/total)					

			Sex			
		Units	female	male	Combined	Years
Growth model ROMANIA	L_∞	cm			16.32	2016
	K				0.583	2016
	t_0				-0.595	2016
	Data source					
Length weight relationship	a				0.0149	2016
	b				2.7607	2016
	M (scalar)				1.27	
	sex ratio (% females/total)					

			Sex			
		Units	female	male	Combined	Years

Growth model BULGARIA	**L_∞**	cm	19.45	18.92	20.17	2016
	K		0.3109	0.29945	0.3045	2016
	t_0		-0.897	-0.915	-0.911	2016
	Data source					
Length weight relationship	**a**		0.0032	0.0029	0.0030	2016
	b		3.311	3.3007	3.3045	2016
	M (scalar)					
	sex ratio (% females/total)	54/46				

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model RUSSIA	**L_∞ (SL)**	cm			18.5	2008
	K				0.343	2008
	t_0				-0.66	2008
	Data source					
Length weight relationship	**a**				0.1883	2008
	b				1.74	2008
	M (scalar)				0.4	
	sex ratio (% females/total)	50/50				

3 Fisheries information

3.1 Description of the fleet

The horse mackerel (*Trachurus mediterraneus*) fishery operates mainly on the wintering grounds in the southern Black Sea using purse seine and mid -water trawls. The horse mackerel of age 1-3 years generally prevails in the commercial catches, but strong year classes (for example, the 1969- year class) may enter into exploitation at age of 0.5 year and may prevail up to age 5 -6 years. Over the last 40 years, highest horse mackerel catches were reported in the years preceding *M. leidyi* outbreak (1988-1990) (Prodanov et al., 1997; FAO, 2007). The maximum catch of 141 thousand tons was recorded in 1985, from which ~100 thousand tons were caught by Turkey (Prodanov et al., 1997). In the next four years catches remained at the level of 9 7-105 thousand tons. In the period 1971-1989, the stock increased, although years of high abundance alternated with years of low abundance due to year class's fluctuations, typical of this fish. VPA estimates showed that the stock was highest in 1984-1988 (Prodanov *et al*., 1997). Scientists (Chashchin, 1998) believed that the intensive fishing in Turkish waters in 1985-1989 has led to overfishing of horse mackerel population and reduction of the stock and catches in the next years. A drastic decline in stock abundance occurred after 1990 when the stock diminished by 56%. In 1991 the horse mackerel stock dropped to a minimum of 75 thousand tons and the catch dropped to 4.7 thousand tons that is a twenty fold reduction compared to the average annual catch in 1 985 -1989. In 1992 was achieved a catch of 21065 t. Upon 1994 the amounts of catches decreased especially in 1998-1999 period. In 2013 decrease in catches of horse mackerel was reported, at the level of 20213.51t. The catches of Black Sea horse mackerel were realized by active (pelagic trawls and purse seine) and passive fishing gears (gill netting, trawl net, trap nets). Horse mackerel stocks in the Black Sea are usually caught by Turkish fishermen by using active (bottom trawler, pelagic trawler and large purse seine) and passive (extension and longline) nets. Almost the whole horse mackerel catch (98.2%) in Turkish waters is caught by large purse seine.

3.2 Historical trends

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*	Turkey	29	<12 m	Purse Seine	Small Pelagics	Anchovy Horse Mackerel Bonito
Operational Unit 2						
Operational						
Unit 3						
Operational Unit 4						
Operational Unit 5						
Operational Unit 6						

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						

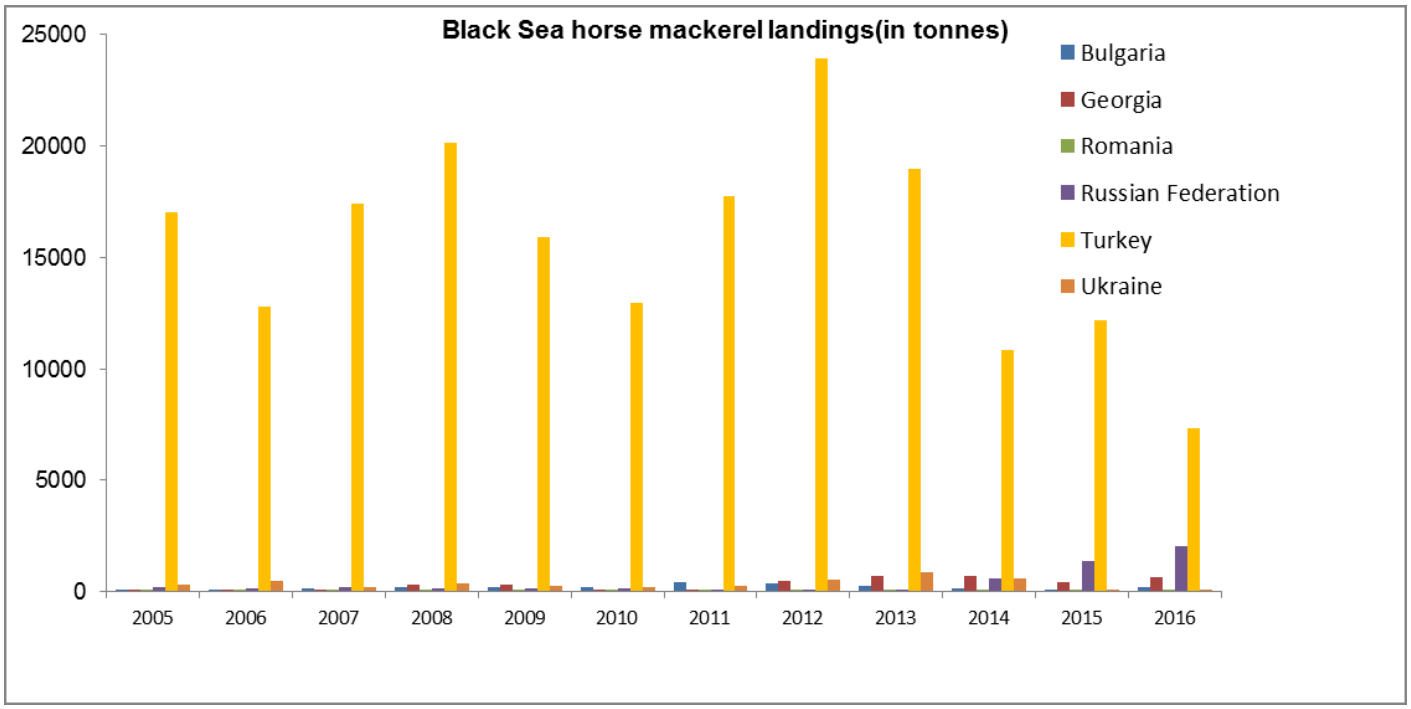


Figure 3.1. Horse mackerel in GSA 29. Landings (in tonnes) by countries during the period 2005 - 2016.

3.3 Management regulations

List current and past (recent) management regulations that affect the different operational fleets and/or the whole fishery.

Turkey

The Ministry of Food, Agriculture and Livestock is the main state organization responsible for fisheries administration, regulation, protection, promotion and technical assistance through four General Directorates. All activities in fisheries and aquaculture are based on the Fisheries Law No. 1380, enacted in 1971. With this law, and its related bureaucracy, definitions were codified. Based on this law, regulations, circulars and notification are prepared to regulate fisheries. This arrangement was followed by new management criteria brought into force for horse mackerel fishery (Ak and Dağtekin, 2014). These measures cover (Notification: 2012/65)

i. Minimum catch size: 13 cm total length. Only 15% on weight bases undersized fish permitted in the landing.

ii. Fishing area: There are no restrictions for fishing areas.

iii. Fishing gear: Fishing is allowed for purse seiners, trawlers, gillnet and long liners.

iv. Time periods: Though pelagic fishing period starts in 1 September and lasts to 15 April bottom trawling between 15 September and 15 April. Pelagic trawl fishing period between 15 September and 15 May. But, pelagic trawl permitted for only sprat fisheries between 15 April and 15 May. Also gillnet can be used during the whole year. Horse mackerel fishing can be done all day.

v. Depth: The pelagic fishery is banned in waters shallower than 24 m in all seasons.

vi. Others: Small pelagic have to be carried in cases or boxes with net weight of 12 kg

(± 10%). Certificate of origin and transportation is essential. Fisheries cooperatives are authorized

for the issuing of this document.

Bulgaria

The commercial fishery is forbidden with all kind of gears of the following zones:

i. the zone from Cape Siviburun to the mouth of Cape Emine in 3 mile zone;
ii. in zone, restricted by the coastal line till the line “Emine – Nessebar”;
iii. in zone restricted by the coastal line till the line “Nessebar” – Chernomoretz, South Cape.
iv. from village Chernomoretz, South Cape till the mouth of Rezovska River in the one mile zone;
v. the closed for fishery zones are free for fishery with pelagic trawls in the period of 15 August to 15 September for catching migrating schooling species .In the presence of by catch of the individuals from species under quota, after the quota exhausting, all the individuals should be returned in the water, no matter what is their condition**.**
vi. minimum admissible length for HMM is 12 cm total length;

Romania

In the economic fishing activity, it is banned to use:

i. the trawl in marine zone under the 20 m depths;
ii. gears type dredge and bottom trawl in the Black Sea;
iii. It is banned to utilize the fishing gears with minimum mesh size smaller then: a = 7 mm, 2a = 14 mm respectively, at the trawl in the Black Sea;
iv. minimum dimensions of the fish in centimeters and other living aquatic resources able to be fished are regulated by Order no. 342/2008 on minimal size of the aquatic living resources;
v. minimum admissible length for HMM is 12 cm total length;

Ukraine

i. TAC – no;
ii. minimum catch size – 10 cm (Standard length); iii. allowable percentage by-catch of smaller fishes – 20%;

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

Effort data (number of vessels and number of days) are available for the Turkish fleet from 2005 to 2016 and were used to calculate a nominal CPUE (Catch/vessels*days). The index was then converted into numbers at length and then numbers at age using the length frequency distribution and the ALK from the catch data (fig xx on the left). No additional information on effort or fishing pattern was available during the meeting, it was therefore impossible to standardize the CPUE time series. Several shortcomings are associated to the use of a nominal CPUE: among the others, was highlighted the great similarity of the so calculated CPUE-at-age with the catch at age matrix (see fig 4.1), due to the extremely high catches of Turkey compared to the other country.

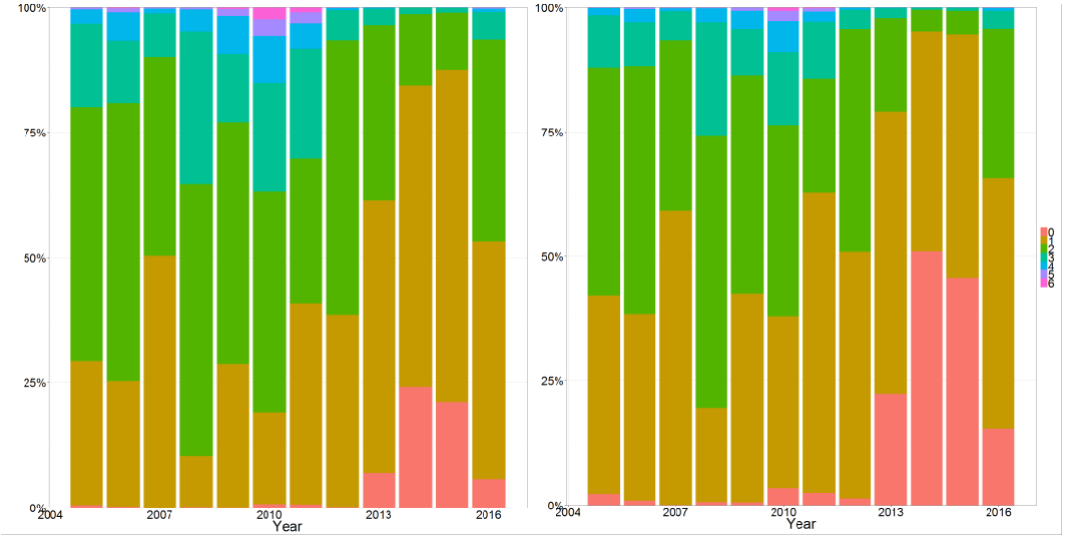


Figure 4.1 Proportion at age for the CPUE index (on the left) and the catch at age matrix (to the right) used in the assessment of HMM.

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

Stock assessment of Horse mackerel was conducted by the means of Extended Survivors Analysis (XSA; Shepherd, 1992): together with that, sensitivity to the influence of the commercial CPUE index was carried out.

{Name of the Model} XSA

6.1.1 Model assumptions 6.1.2 Scripts

The script is available on the GFCM sharepoint.

6.1.3 Input data and Parameters

XSA analysis was performed using 2005-2016 data using catch at age data provided by countries. No available data for age-weight length key for Georgia for 2015 and 2016. EWG 17 11 decided to use Turkish key for Georgia.

The assessment model was tuned with an index based on commercial CPUE data from a Turkish fleet. Data from 2004 were discarded since covered only the first 4 ages and age 3 presented large catches.

A constant natural mortality value of 0.4 was assumed.

Table 6.1.3.1 Aggregated catch at age in number 10 -3of Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine during the period 2005-2016.

Year	0	1	2			3	4	5	6
2005			510230.8	117165.3	15977.08			2078.61	54.25073633
2006	7151.435	287250.5	381368.6			68281.31	19603.05	2295.039	554.5084096
2007	639.3249	632981.9	366102.7			61953.55	6101.333	2765.661	5.60681E-05
2008	6643.617	190684.9	553032.5			232511.9	27449.61	2587.16	26.64898495
2009	5349.363	409245.2	426372.5			89722.66	36180.1	5880.999	1007.716036
2010	29609.28	304327.2	337209.8			129106.4	54752.34	17557.59	6459.113337
2011	28976.77	713923.2	273337.9			134608.5	23782.33	7488.454	3073.7
2012	18965.66	708867.6	638611.4			55458.22	6478.214	1115.092	92.50705397
2013	381392.1	963444.7	322122.8			32615.7	2774.848	1399.784	44.76323894
2014	790901.9	685629.9	68479.3			5586.424	1257.775	923.9148	81.6900007
2015	752722.8	807333.7	78659.7			10309.21	1916.054	378.5589	52.10530171
2016	102554.0	339351.3	202339			23530.04	3682.258	801.4304	232.0510056

6.1.4 Tuning data

Table 6.1.4.1 Tuning fleet data from Turkish commercial CPUE.

Year/Age	0	1	2	3	4	5	6
2004	5.75	16.712	56.703	1571.74	0.001	0.001	0.001
2005	9.502	526.523	932.523	305.137	50.317	8.218	0.001
2006	3.821	402.208	896.453	199.775	91.04	12.706	3.545
2007	0.13	1337.12	1054.302	233.291	24.878	7.139	0.001
2008	3.44	264.512	1428.759	795.583	115.93	12.088	0.001
2009	2.375	711.841	1200.634	340.883	187.074	33.301	9.049
2010	14.074	351.141	848.592	417.379	181.883	65.929	44.96
2011	13.988	913.577	662.271	497.828	116.348	48.617	22.498
2012	4.869	1268.245	1811.319	199.51	13.323	5.385	0.001
2013	168.115	1310.86	845.355	77.952	4.351	1.92	0.001
2014	446.469	1113.157	265.274	23.825	1.367	0.261	0.059
2015	457.944	1452.679	249.127	20.293	2.436	1.302	0.001
2016	107.269	877.804	751.067	102.36	11.963	3.242	2.002

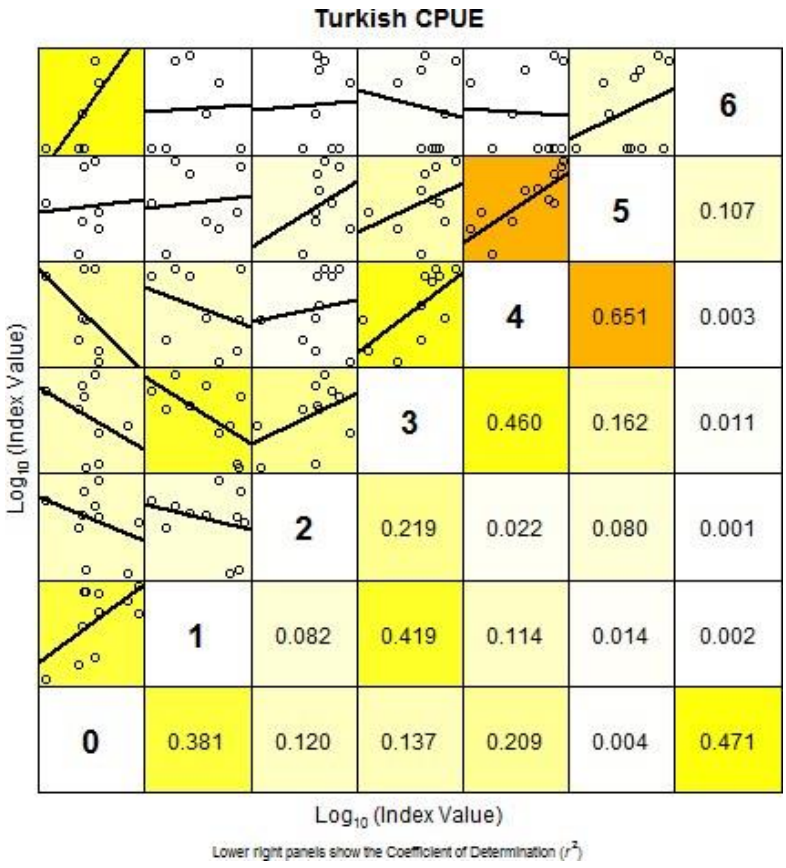


Figure 6.1.4.1. Horse mackerel in GSA 29. Internal consistency plot of the first tuning data (Turkish commercial CPUE).

Table 6.1.4.2 Proportion of matures at age used in XSA.

Age Year	0	1	2	3	4	5	6
2005	0	0.8	1	1	1	1	1
2006	0	0.8	1	1	1	1	1
2007	0	0.8	1	1	1	1	1
2008	0	0.8	1	1	1	1	1
2009	0	0.8	1	1	1	1	1
2010	0	0.8	1	1	1	1	1
2011	0	0.8	1	1	1	1	1
2012	0	0.8	1	1	1	1	1
2013	0	0.8	1	1	1	1	1
2014	0	0.8	1	1	1	1	1
2015	0	0.8	1	1	1	1	1
2016	0	0.8	1	1	1	1	1

Table 6.1.4.3 Weight at age in the catch (in g).

Age Year	0	1	2	3	4	5	6
2005	4.20	13.20	20.60	29.70	38.60	45.80	43.60
2006	6.10	13.70	21.20	29.20	42.10	51.80	57.20
2007	9.40	14.70	20.10	28.00	36.10	42.60	49.20
2008	7.20	12.70	22.90	30.00	38.80	50.30	41.20
2009	6.00	13.00	20.70	29.00	40.90	48.90	67.40
2010	4.50	10.10	21.90	30.10	42.10	61.20	62.00
2011	4.70	12.70	24.70	37.80	50.90	65.50	67.20
2012	6.50	14.40	23.20	33.60	34.20	48.30	40.90
2013	3.50	11.90	23.70	32.80	33.20	44.00	63.00
2014	3.50	10.20	25.80	37.90	34.50	36.20	44.70
2015	3.50	11.20	21.90	31.90	31.50	37.10	42.70
2016	5.00	12.50	22.00	31.20	31.20	34.70	56.50

Table 6.1.4.4 Natural mortality at age used in XSA.

Age Year	0	1	2	3	4	5	6
2005	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2006	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2007	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2008	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2009	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2010	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2011	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2012	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2013	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2014	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2015	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2016	0.4	0.4	0.4	0.4	0.4	0.4	0.4

6.1.5 Results

The XSA model was run with the following settings:

fse	0.47
rage	0
qage	3
shk.yrs	3
shk.ages	2
tsrange	20
tspower	3

The choice was driven from a sensitivity analysis carried out on the values for rage, qage and fse. Since the choice of qage and rage was not affecting the stock assessment results and the diagnostics, it was decided to keep the values used during the last EWG meeting. The value for the f standard error affect the weight given to the tuning index, i.e. the lower the value, the lower the weight of the tuning: considering the shortcomings of the nominal CPUE available, it was decided to test for values between 0.1 and 1, and discard all the run with fse higher than 1. The run with the lowest Residuals Sum of Squares (RSS) had the *fse* = 0.47 and was therefore chosen for advice.

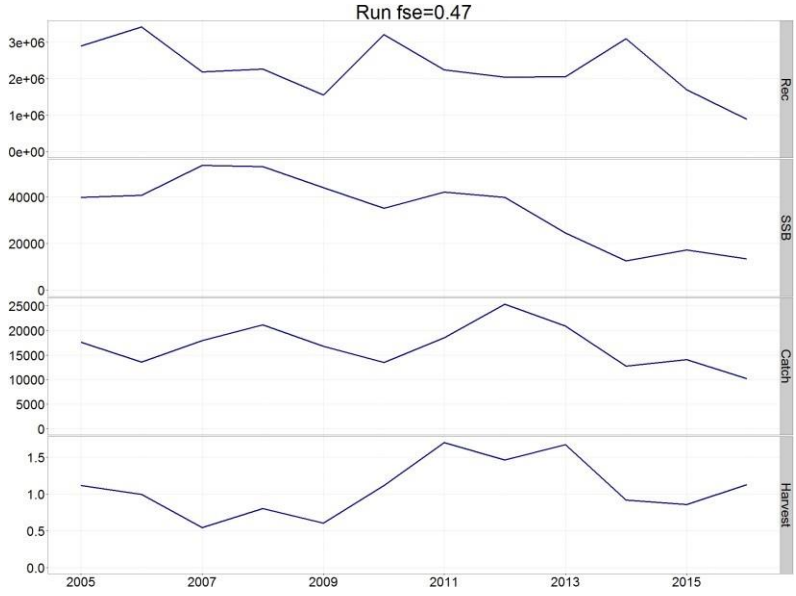


Figure 6.1.5.1 Horse mackerel in GSA 29. XSA outputs for run with fse = 0.47.

Table 6.1.5.1 Horse mackerel GSA 19. Summary table of the main results from XSA assessment model from 2005 to 2016.

	ssb	var	fbar	var	rec	var
2005	39703	31	1.118	0.0012	2907302	65
2006	40694	36	0.998	0.0008	3433933	134
2007	53449	28	0.542	0.0114	2186938	22
2008	52888	17	0.801	0.0037	2271177	322
2009	43861	19	0.606	0.0070	1559782	1857
2010	35150	10	1.118	0.0004	3218968	556
2011	42109	25	1.699	0.0036	2247496	611
2012	39753	31	1.463	0.0062	2044564	3956
2013	24448	52	1.676	0.0452	2061515	321
2014	12494	62	0.916	0.0769	3107839	11745
2015	17215	18	0.858	0.0431	1699731	14534
2016	13419	177	1.127	0.0175	884047	556826

Residuals from tuning fleets (Turkish CPUE) per age and year were relatively low (fig xxx) and look good on the overall, even though a pattern in time for ages 0 and 1 is observed, with the model overestimating the CPUE in the first part of the time series and underestimating it in the second part.

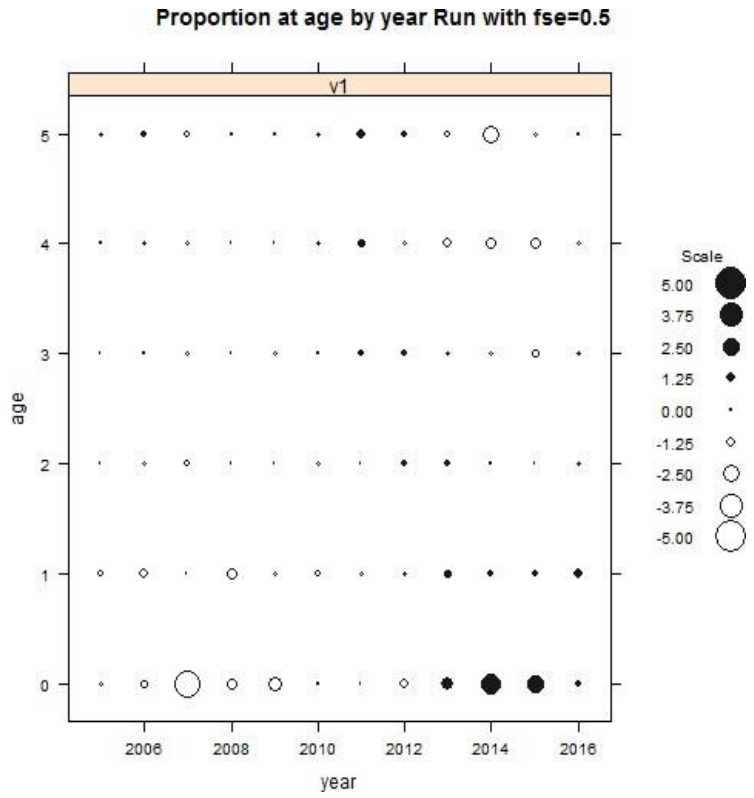


Figure 6.1.5.2 Horse mackerel in GSA 29. Log residuals for the tuning fleet (fse=0.47)

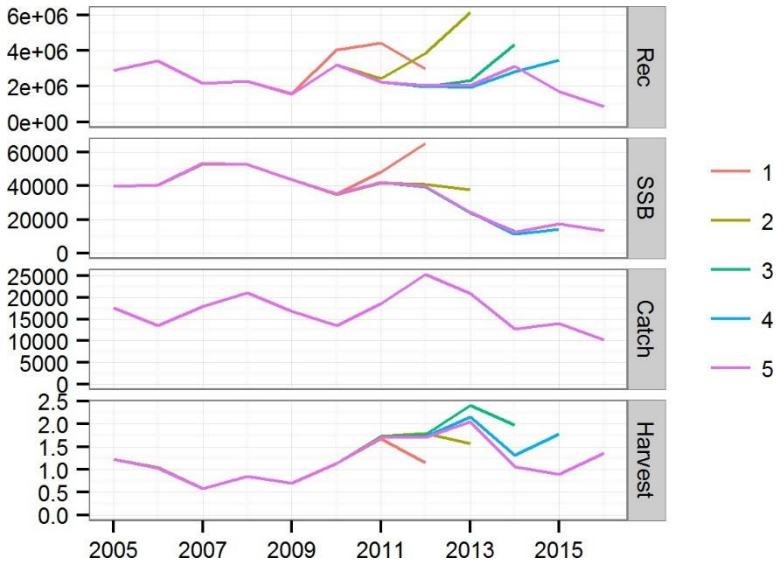


Figure 6.1.5.3 Horse mackerel in GSA 29. Retrospective analysis with shrinkage set at 0.47.

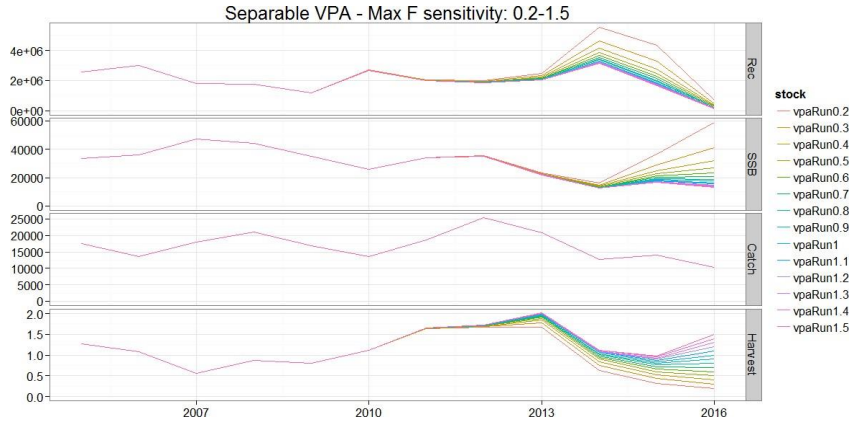
Exploitation rate is equal to 0.71 (average of F for the last three year), therefore higher than the Patterson's reference point for small pelagic equal to 0.4.

6.1.6 Robustness analysis

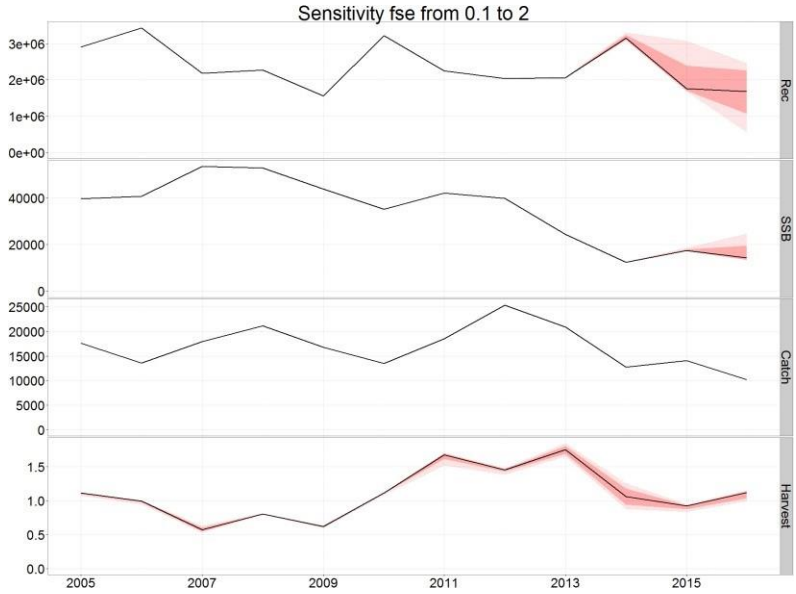
6.1.7 Retrospective analysis, comparison between model runs, sensitivity analysis, etc.

Sensitivity analysis to test the effect of the nominal CPUE on the assessment model was carried out. For the purpose, we run: i) a separable VPA with different options for the terminal F; ii) XSA testing values for fse from 0.1 to 1 (when fse = 0.1 the XSA emulated the separable VPA).

Recruitment estimates in the separable VPA were quite robust to the choice of terminal F, and show a big drop in the last 3 years of the assessment period.



On the other hand, in the XSA assessment while harvest and SSB appeared to be quite robust to the choice of shrinkage, the recruitment was strongly affected by it. In particular, the tuning appears to amplify the increase in age 0 observed in the catches in the recent period, resulting in really high values for the recruitment.



As a consequence of these results, and considering the fact that the nominal CPUE (as it is currently estimated) is considered not appropriate to be used as tuning for the assessment of horse mackerel, it was decided to use the assessment in a semi-quantitative fashion, providing values for the current exploitation rate, but without carrying out forecast.

6.1.8 Assessment quality

Currently the assessment is tuned only with a CPUE index: the availability of a fishery independent survey would strongly increase the reliability of the XSA assessment.

7 Stock predictions

Given the uncertainty in the recruitment estimation, stock predictions were not carried out for the horse mackerel stock in GSA 29.

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		$E_{curr.}$=0.71	E=0.4		
	Fishing effort					
	Catch					
Stock abundance	Biomass					
	SSB				N	
Recruitment		D				
Final Diagnosis		**overexploited**				

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)*