Stock Assessment Form
Demersal species

Reference Year: 2016

Reporting Year: 2017

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Silvia Angelini*

Stock assessment form

Contents

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Merluccius merluccius	European hake	32
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
GSA 17	GSA 18	
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
1st Country	2nd Country	3rd Country
Italy	Croatia	Albania
4th Country	5th Country	6th Country
Montenegro		
Stock assessment method: (direct, indirect, combined, none)		
Combined: survey and SCAA		
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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/a

sfis/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 stock of European hake was assumed in the boundaries of the whole Adriatic Sea (GSA 17-18) (Fig. 2.1), as suggested by the genetic results of the MAREA StockMed project that shows a common sub-population of hake throughout the Adriatic Sea. However, project identifies two distinct stock units in the Adriatic Sea, uncorrelated with the GSA units (Fiorentino et al., 2014).

The northern Adriatic Sea is characterized by generally shallow waters, whereas the central part hosts a three consecutive depressions, called Pomo/Jabuka Pits, that reach ca. 270 m in their deepest part.

The Southern Adriatic Sea is characterized by the presence of a deep central depression known as the “South Adriatic Pit” (or Bari Pit) where the seabed reaches a depth of 1,233 m.

The northern and southern portions of the Southern Adriatic Sea feature substantial differences; the first contains a wide continental shelf (the distance between the coastline and a depth of 200 m is around 45 nautical miles) and a very gradual slope; in the second, the isobathic contours are very close, with a depth of 200 m already found at around 8 miles from the Cape of Otranto.

The continental shelf break is at a depth of around 160-200 m and is furrowed by the heads of canyons running perpendicular to the line of the shelf.

The Adriatic Sea, together with the Levant basin, is one of three areas in the Mediterranean where down-welling processes produced by surface cooling lead to the formation of so-called “dense waters”, rich in oxygen, which supply the lower levels.

The species depth distribution (Fig. 2.2) ranges between several meters in the coastal area down to 800 m in the South Adriatic Pit (Kirinčić and Lepetić, 1955; Ungaro et al., 1993), though it is most abundant at depths between 100 and 200 m, where the catches are mainly composed of juveniles (Bello et al., 1986; Vrgoč, 2000). In the northern and central part of the Adriatic Sea adults are mainly caught at depths of 100 to 150 m (Vrgoč et al., 2004), whereas in the south Adriatic largest individuals are caught in waters deeper than 200 m and medium-sized fish appear in waters not deeper than 100 m (Ungaro et al., 1993).

The geographical distribution pattern of European hake has been studied in the area using trawl- survey data and geostatistical methods. This species presents the greatest abundance in the central Adriatic Sea in water deeper than 100 meters, whereas the greatest biomass is found in the eastern part of the Adriatic Sea, where the biggest sizes individuals are concentrated (Piccinetti et al., 2012). Nursery areas are located in the central Adriatic Sea, off Gargano promontory and in the southern part of Albanian coasts (Frattini and Paolini, 1995; Lembo et al., 2000; Carlucci et al., 2009) (Fig. 2.3), whereas the spawning grounds are located among the Croatian channels (Fig. 2.4).

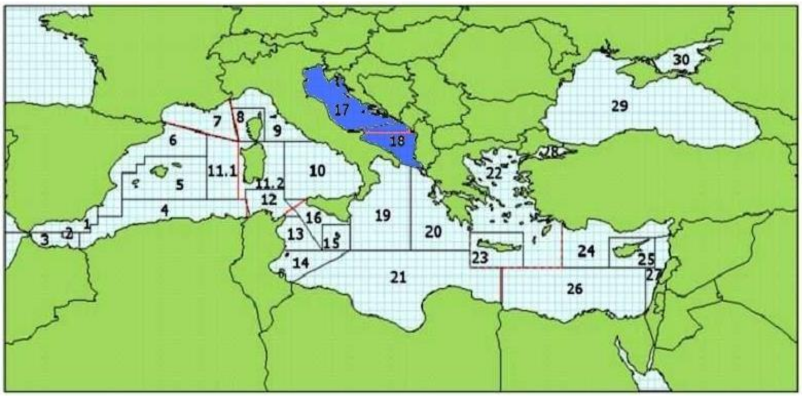


Fig. 2.1. Geographical location of GSA 17 and 18.

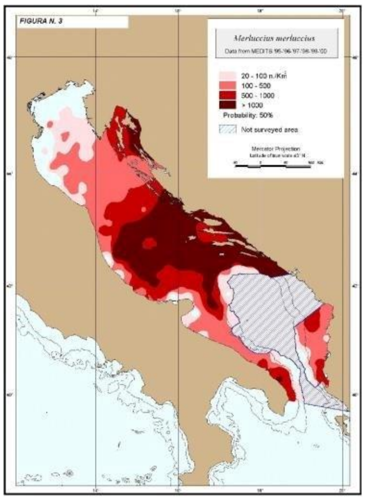
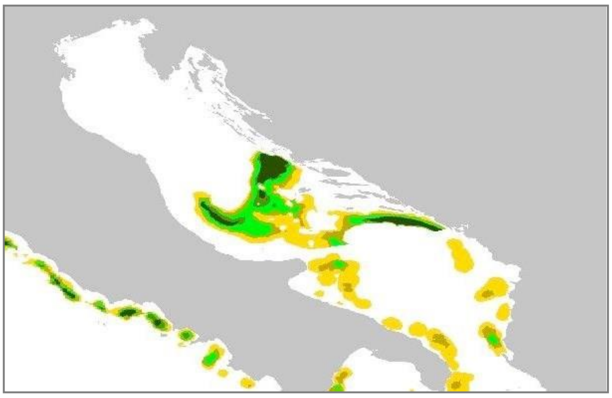


Fig. 2.2 - Distribution map of Merluccius merluccius in the Adriatic Sea (Sabatella and Piccinetti, 2005) from Medits Programme.



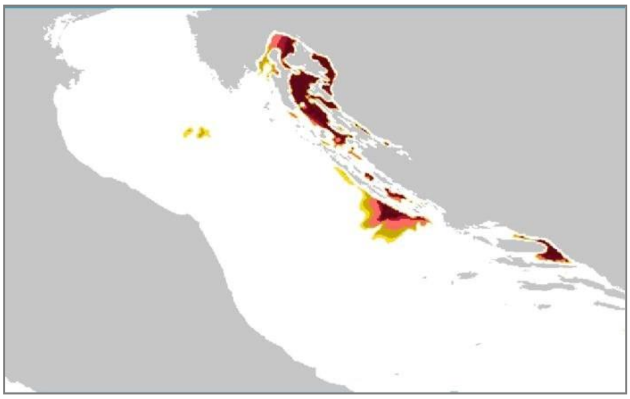


Fig. 2.3 Position of persistent nursery in GSA 17 from MEDISEH

Fig. 2.4 Position of persistent areas of potential in the GSA 18 from MEDISEH

2.1 Stock unit

2.2 Growth and maturity

European hake can grow to 107 cm (Grubišić, 1959) of total length. The observed maximum lengths of European hake were 93.5 cm for females and 66.5 cm for males both registered during Medits samplings. In the commercial sampling also a female of 93.5 cm length was observed in 2009. However, its usual length in trawl catches is from 10 to 60 cm. This is a long-lived species, it can live more than 20 years. In the Adriatic, however, the exploited stock is mainly composed in number of 0, 1 and 2 year-old individuals, even if there is dedicated fishery targeting the bigger individuals (longlines).

In the DCF framework the growth has been studied ageing fish by otolith readings using the whole sagitta and thin sections for older individuals. However, the growth parameters used in this assessment come from the literature and specifically the VBGP reported in García-Rodríguez and Esteban (2002) were chosen (Table 2.2-3).

Females attain larger size than males, which grow more slowly after maturation at the age of three or four years. Consequently, the proportion of males in the population is higher in the lower length classes and proportion of females is higher for greater lengths. In the central and northern Adriatic, females already start dominating the population at lengths of about 30 to 33 cm. In trawl catches over 38 to 40 cm, almost all the specimens are females (Vrgoč, 2000).

In the Adriatic Sea, European hake spawn throughout the year, but with different intensities. The spawning peaks are in the summer and winter periods (Karlovac, 1965; Županović, 1968; Županović and Jardas, 1986, Županović and Jardas, 1989; Jukić and Piccinetti, 1981; Ungaro *et al.*, 1993). Hake is a partial spawner. Females spawn usually four or five times without ovarian rests. In females in the pre-spawning stage, fish 70 cm long can contain more than 400,000 oocytes (Sarano, 1986). The earliest spawning in the Pomo/Jabuka Pit occurs in winter in deeper water (up to 200 m). As the season progresses into the spring-summer period, spawning occurs in more shallow waters. The recruitment of young individuals into the breeding stock has two different maxima. The first one is in the spring and the second one in the autumn.

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 - Winter**
Maximum size observed			107**	**Recruitment season**	Spring - Autumn
Size at first maturity	23.0 – 33.0*	20.00 – 28.00*		**Spawning area**	Eastern Adriatic
Recruitment size to the fishery				**Nursery area**	Pomo / Jabuka Pit

* Županović and Jardas, 1986 ** Grubišić, 1959

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

Age	Natural mortality	Proportion of matures
0	0.2	0
1 - 20	0.2	1

Table 2.2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**				106.8	
	K				0.1	
	t_0				-0.994	
	Data source	García-Rodríguez and Esteban, 2002				
Length weight relationship	**a**				0.0043	
	b				3.2	
	M (scalar)					
	sex ratio (% females/total)	50				

3 Fisheries information

3.1 Description of the fleet

European hake is one of the principal demersal species fished in the Adriatic Sea, accounting for high landing quantity among demersal species. Fishing grounds mostly correspond to the distribution of the stock. The principal gears exploiting this stock are bottom trawls and longlines. Longlines are particularly important in Croatia and in the Italian side of the GSA 18 and they target mostly larger individuals.

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	ITA	17	E – Trawlers (12- 24 metres)	03 - Trawls	33 – Demersal shelf species	Hake
Operational Unit 2	HRV	17	E – Trawlers (12- 24 metres)	03 - Trawls	33 – Demersal shelf species	Hake
Operational Unit 3	HRV	17	I - Long line (> 6 metres)	09 - Hooks and Lines	33 – Demersal shelf species	Hake
Operational Unit 4	ITA	18	E – Trawlers (12- 24 metres)	03 - Trawls	33 – Demersal shelf species	Hake
Operational Unit 5	ITA	18	F – Trawlers (>24 metres)	03 - Trawls	33 – Demersal shelf species	Hake
Operational Unit 6	ITA	18	I - Long line (> 6 metres)	09 - Hooks and Lines	33 – Demersal shelf species	Hake
Operational Unit 7	ALB	18	E – Trawlers (12- 24 metres)	03 - Trawls	33 – Demersal shelf species	Hake
Operational Unit 8	ALB	18	D – Trawls (6-12 m)	03 – Trawls	33 – Demersal shelf species	HKE
Operational Unit 9	ALB	18	F – Trawls (>24 m)	03 – Trawls	33 – Demersal shelf species	HKE
Operational Unit 10	MNE	18	E – Trawls (12-24 m)	03 – Trawls	33 – Demersal shelf species	HKE
Operational Unit 11	MNE	18	B – Minor gear with engine (<6 m)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	HKE
Operational Unit 12	MNE	18	C – Minor gear with engine (6-12 m)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	HKE

Table 3.1-2: Catch, bycatch, discards and effort by operational unit in the reference year

Operational Units*	Fleet (n° of boats) *	Catch (T of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
ITA 17 E 03 33 - HKE	505*	1792				
HRV 17 E 03 33 - HKE	431++	712				
HRV 17 I 09 33 - HKE	214	124				
ITA 18 E 03 33 – HKE + ITA 18 F 03 33 - HKE	428*	1779				
ITA 18 I 09 33 - HKE	243***	492				
ALB 18 d 03 33 – HKE + ALB 18 E 03 33 – HKE + ALB 18 F 03 33 – HKE	157+	206**				
MNE 18 E 03 33 – HKE + MNE 18 B 03 33 – HKE + MNE 18 C 03 33 - HKE	23#	39				

*Mean number of vessels from DCF official data

**Catch data for 2016 is missing, thus it is assumed equal to the quantity landed in 2015

***Fisheries and Maritime Affairs' Fleet Register, 2017

+ Ministry of Agriculture of Albania

++ Including vessels 6-12 m (no. 135)

Fisheries Information System, Ministry of Agriculture and Rural Development (FIS-MARD) Montenegro

3.2 Historical trends

European hake catch estimated by FishStatJ – GFCM database and DCF data.

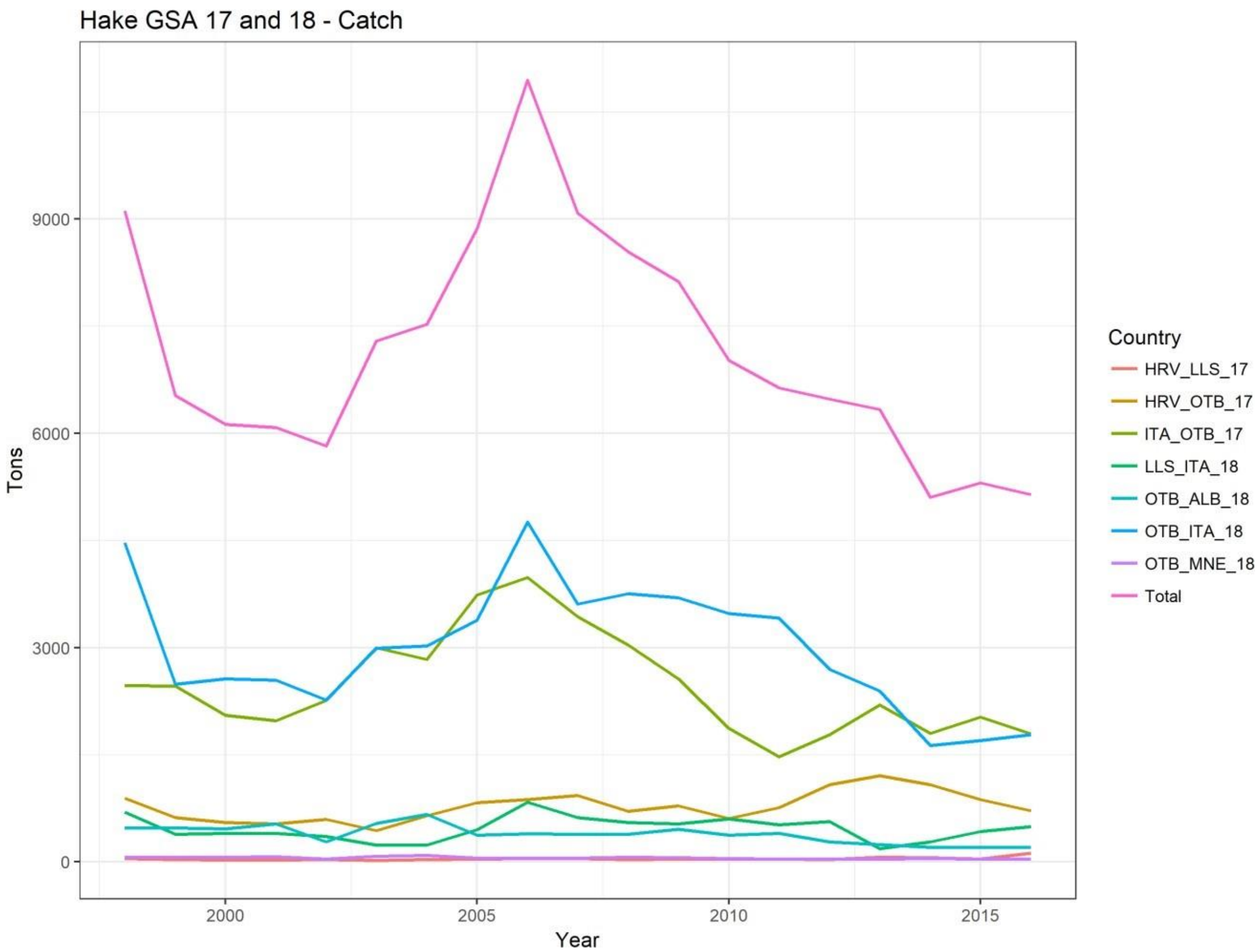


Figure 3.2.1 – Catch of European hake in GSA 17 and 18

3.3 Management regulations

Italy

Management regulations are determined by the EU regulations (mainly EC regulation 1967/2006): - Minimum landing sizes: 20 cm TL for European hake - Fishing closure for trawling: 30-45 days in summer.

- Codend 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

- From the 26 of July 2015 to the 26 of July 2016 the Pomo Pit area was closed to the activity of the bottom trawlers (MIPAAF, D.M. 20/07/2015). Following, other restrictions regarding this area were introduced, in particular the zone defined as "Scalata del Fondaletto" was closed to any fishing activities.

Croatia

Since the accession of Croatia to the EU the 1st of July 2013, the same regulations as in the Italy are implemented. Furthermore the following regulations are applied:

Bottom trawl fisheries is closed one and half NM from the coast and island in inner sea, 2 NM around island on the open sea, and 3 NM about several island in the central Adriatic. For vessel smaller than 15 meters, according derogation in sea deeper than 50 meters bottom trawl fisheries is forbidden till 1NM of the coast. Bottom trawl fishery is closed also in the majority of channel area and bays. About 1/3 of the territorial waters is closed for bottom trawl fisheries over whole year and additionally 10% is closed from 100-300 days per years. Minimum mesh size on the bottom trawl net was 20 mm ("knot to knot") in the open sea, and 24 mm ("knot to knot") in the inner sea. Recently, mesh site regulation is according EC 1967/2006 (ie. 40 mm square or 50 mm diamond).

In 2015 the no-take zone was established in Jabuka Pit. The establishment of Marine managed area (MMA) was based on long-time assessment of biological resources and analysis carried out by working group through FAO AdriaMed project that showed a decline in biomass of these commercial species. The proposed MMA covers the waters closed to trawling through a bilateral agreement between Republic of Italy and Republic of Croatia. The Pit was re-opened to trawling in 2016. Recently, following the growing support for a MMA in the Jabuka/Pomo Pit, Croatia and Italy agreed to reintroduce a fishing closure from the 1st of September 2017 to 31st of August 2020.

Other interventional fisheries regulation measures were introduced in Croatia such as temporal ban of trawl fisheries in open part of central Adriatic and in channel area of northern Adriatic. The aim of those measures were protection of commercially important species (e.g. European hake and Norway lobster) in critical period (spawning or recruitment period).

Montenegro

In Montenegro, management regulations are based on technical regulations, such as mesh size (Official Gazette of Montenegro, 8/2011), including the minimum landing sizes (Official Gazette of Montenegro, 8/2011), and a regulated number of fishing licenses and area limitation (no–fishing zone up to 3 NM from the coastline or 8 NM for trawlers of 24+ m LOA). Currently there are no MPAs or fishing bans in Montenegrin waters.

Mesh size in Montenegro is according to the EC 1967/2006 (ie. 40 mm square or 50 mm diamond).

The landing data for Montenegro used in assesments are estimates, based on collecting data from a small number of vessels, and then raised to the total fleet in order to obtain the yearly estimate. Current national data collection in Montenegro is based on different methods (used by different agencies, namely, Statistical office of Montenegro –

MONSTAT and the Ministry of agriculture and rural development, Department for agriculture statistics) which are not fully compliant with the requirements of the EU DCF, and are considered incomplete and not suitable for realistic analyses.

Albania

In Albania, a new law "On fishery" has now been approved, repealing the Law n. 7908. The new law is based on the main principles of the CFP, it reflects Reg. 1224/2009 CE ; Reg.1005/2008 CE; Reg. 2371/2002 CE; Reg. 1198/2006 CE; Reg. 1967/2006 CE; Reg. 104/2000; Reg. 1543/2000 as well as the GFCM recommendations. The legal regime governing access to marine resources is being regulated by a licensing system. Regarding conservation and management measures, minimum legal sizes and minimum mesh sizes is those reflected in the CE Regulations. Albania has already an operational vessel register system. It is forbidden to trawl at less than 3 nautical miles (nm) from the coast or inside the 50m isobath when this distance is reached at a smaller distance from the shore.

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	$F_{0.1}$	0.21			Reference: WGSAD 2016
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1.1 MEDITS SURVEY - Brief description of the direct method used

European Union funded the MEDITS (MEDiterranean International Trawl Survey) survey in 1994. At the beginning only EU members (Italy, Spain, French and Greece) participated at this program, but from 1996 also Albania, Croatia and Slovenia joined this activity. This survey is included in the Data Collection Framework and it takes place every year during springtime. Its methodological sampling is common to all the countries involved in this project and was defined by Bertrand et al. (2002). Stations were selected on the basis of a stratified scheme with random selection of stations in every stratum (10-50m; 50-100m; 100-200m; 200-500m and over 500m). The number of stations in each stratum is proportional to the surface of the stratum. The sampling gear is a bottom trawl made of four panels, called GOC 73 bottom trawl made of four panels.

For this assessment the time series considered goes from year 1998 to year 2016; three survey series were taken in account: 1) Italy GSA 17 and Slovenia, 2) Croatia and 3) GSA 18.

Abundance and biomass indexes from MEDITS survey were computed using AtrIS software (Gramolini et al., 2005) which also allow drawing GIS maps of the spatial distribution of the stock, spawning females and juveniles. The abundance and biomass indices 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 area in the GSA 17:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

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

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

4.1.2 MEDITS ITA AND SLO GSA 17

Direct methods: trawl based abundance indices

Table 4.1.2-1: Trawl survey basic information

Survey	MEDITS	**Trawler/RV**	Andrea
Sampling season	Spring - Summer		
Sampling design	Random		
Sampler (gear used)	Trawl		
Cod –end mesh size as opening in mm	20		
Investigated depth range (m)	0 – 500		

Table 4.1.2-2: Trawl survey sampling area and number of hauls - MEDITS

Year	Total surface (km^2)	Trawlable surface (km^2)	Swept area (km^2)	Number of hauls
1998	59584			88
1999	59584			86
2000	60534			86
2001	60534			88
2002	60534			121
2003	60534			122
2004	60534			120
2005	59400			120
2006	59584			122
2007	59584			130
2008	59584			123
2009	59584			123
2010	59584			122
2011	59584			122
2012	59584			122
2013	59584			182
2014	59584			182
2015	59584			182
2016	59584			180

Table 4.1.2-3: Trawl survey abundance and biomass results - MEDITS

Depth Stratum	Years	kg per km²	CV or other	N per km²	CV or other
	1998	22.17	0.11	593.05	0.14
	1999	33.36	0.12	625.26	0.17
	2000	19.86	0.13	636.86	0.18
	2001	18.10	0.08	691.42	0.13
	2002	24.39	0.07	887.88	0.09
	2003	17.98	0.07	542.11	0.12
	2004	27.43	0.07	935.25	0.10
	2005	34.60	0.12	2038.00	0.17
	2006	33.49	0.07	1113.04	0.12
	2007	28.33	0.06	774.86	0.07
	2008	31.53	0.08	847.01	0.11
	2009	20.41	0.09	259.38	0.09
	2010	12.58	0.10	250.13	0.13
	2011	14.25	0.09	338.84	0.10
	2012	13.06	0.09	342.62	0.16
	2013	23.30	0.09	339.71	0.15
	2014	22.95	0.07	446.09	0.08
	2015	13.23	0.07	314.91	0.10
	2016	9.09	0.08	505.8	0.08

Direct methods: trawl based Recruitment analysis

Table 4.1.2-4: Trawl surveys; recruitment analysis summary

Survey	MEDITS	Trawler/RV	Andrea
Survey season		Spring - Summer	
Cod –end mesh size as opening in mm		20	
Investigated depth range (m)		0 – 500	
Recruitment season and peak (months)		May – June – October - November	
Age at fishing-grounds recruitment		0	
Length at fishing-grounds recruitment		3	

Table 4.1.2-5: Trawl surveys; recruitment analysis results - MEDITS

Years	Area in km^2	N of recruit per km^2	CV or other
1998		498.41	0.15
1999		444.60	0.20
2000		580.52	0.20
2001		622.33	0.15
2002		806.51	0.10
2003		478.65	0.14
2004		828.27	0.11
2005		1941.62	0.18
2006		980.95	0.14
2007		674.12	0.08
2008		724.73	0.12
2009		159.60	0.12
2010		153.15	0.11
2011		254.89	0.13
2012		293.76	0.19
2013		247.18	0.18
2014		344.95	0.10
2015		275.03	0.12
2016		432.65	0.09

Recruits were estimated on the base of the LFD observed from the survey (0 – 20 cm) (Fig. 4.1.2-1). Recruits inhabit the entire Adriatic, with exception for the northernmost part of the basin and particularly abundant in the Central Adriatic Sea and in Croatian waters (Fig. 2.4).

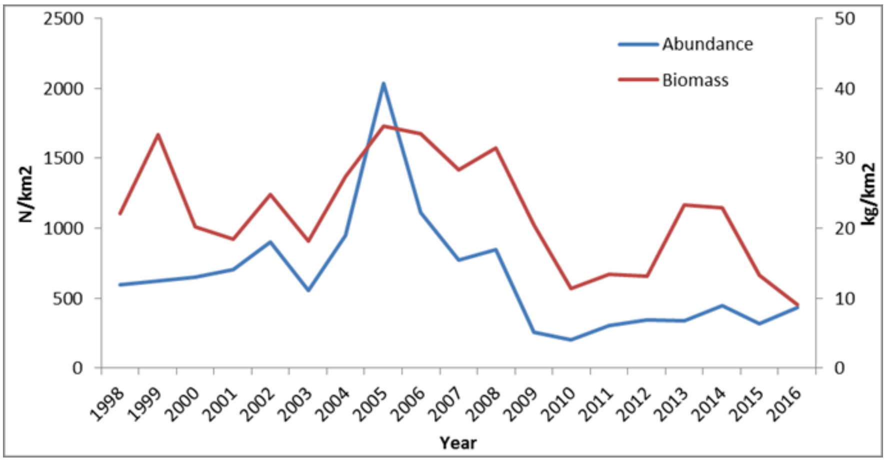


Fig. 4.1.2-1 Abundance and biomass indices of hake obtained from MEDITS surveys

Direct methods: trawl based Spawner analysis

Table 4.1.2-6: Trawl surveys; spawners analysis summary

Survey	**MEDITS**	**Trawler/RV**	**Andrea**
Survey season			Spring - Summer
Investigated depth range (m)			0 – 500
Spawning season and peak (months)			June – July – January – February

Table 4.1.2-7: Trawl surveys; spawners analysis results - MEDITS

Surveys	Area in km²	N (N of individuals) of spawners per km²	CV	SSB per km²	CV
1998		3.07	0.34	4.34	0.39
1999		6.07	0.21	12.32	0.22
2000		3.80	0.37	5.74	0.25
2001		2.60	0.23	5.60	0.23
2002		2.30	0.22	5.17	0.23
2003		2.12	0.21	4.95	0.21
2004		3.37	0.29	7.07	0.32
2005		2.04	0.36	4.75	0.37
2006		4.68	0.23	8.41	0.21
2007		4.35	0.18	8.35	0.16
2008		6.51	0.21	11.25	0.20
2009		3.97	0.19	7.90	0.19
2010		2.82	0.24	4.38	0.20
2011		2.92	0.20	5.41	0.19
2012		2.84	0.20	6.09	0.19
2013		4.87	0.16	9.33	0.14
2014		3.35	0.18	5.53	0.16
2015		3.77	0.18	6.02	0.14
2016		6.63	0.16	3.71	0.17

Figure 4.1.2-2 shows the trends of abundance and biomass of spawners (individuals ≥ 35 cm). Maps shows that the spawners aggregates in the Central Adriatic, particularly in the Pomo/Jabuka Pit area and in Croatian waters (Fig. 2.3).

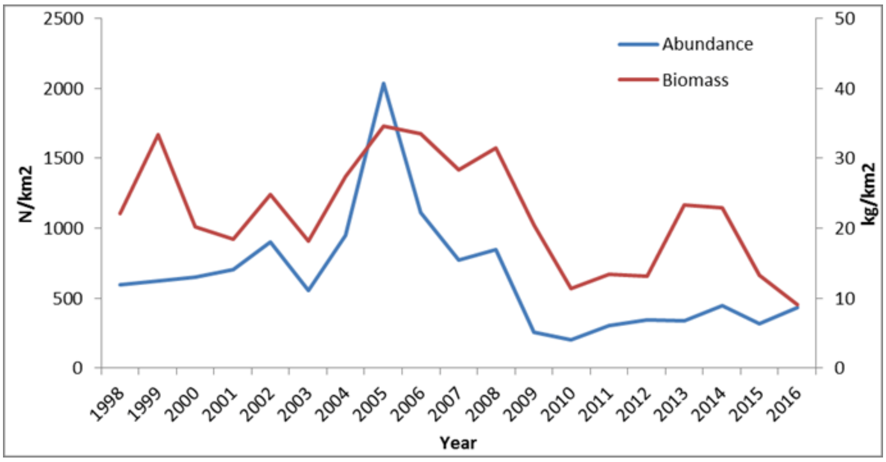


Fig. 4.1.2-2 Abundance and biomass indices of hake spawners obtained from MEDITS surveys

4.1.3 MEDITS CROATIA

Direct methods: trawl based abundance indices

Table 4.1.3-1: Trawl survey basic information

Survey	MEDITS	**Trawler/RV**	Andrea / Bios
Sampling season	Spring - Summer		
Sampling design	Random		
Sampler (gear used)	Trawl		
Cod –end mesh size as opening in mm	20		
Investigated depth range (m)	0 – 500		

Table 4.1.3-2: Trawl survey sampling area and number of hauls - MEDITS

Year	Total surface (km^2)	Trawlable surface (km^2)	Swept area (km^2)	Number of hauls
1998	31727			50
2000	31727			47
2001	31727			48
2002	31727			59
2003	31727			59
2004	31727			61
2005	31727			59
2006	31727			59
2007	31727			61
2008	31727			59
2009	31727			60
2010	31727			60
2011	31727			61
2012	31727			60
2013	31727			59
2014	31727			56
2015	31727			65
2016	31727			56

Table 4.1.3-3: Trawl survey abundance and biomass results - MEDITS

Depth Stratum	Years	kg per km²	CV or other	N per km²	CV or other
	1998	66.028	0.200	1154.149	0.137
	2000	33.018	0.106	749.449	0.112
	2001	44.089	0.133	887.231	0.181
	2002	55.269	0.128	1172.241	0.187
	2003	51.248	0.109	972.440	0.105
	2004	55.626	0.119	1126.081	0.099
	2005	66.063	0.096	1778.223	0.125
	2006	89.168	0.123	1713.346	0.110
	2007	63.883	0.130	1327.673	0.110
	2008	61.586	0.117	1445.093	0.160
	2009	47.199	0.140	608.547	0.135
	2010	28.983	0.124	603.742	0.119
	2011	30.502	0.120	603.991	0.108
	2012	43.217	0.093	1252.722	0.158
	2013	51.273	0.133	773.981	0.122
	2014	45.234	0.181	1006.351	0.287
	2015	44.016	0.098	916.138	0.129
	2016	32.62	0.11	663.68	0.13

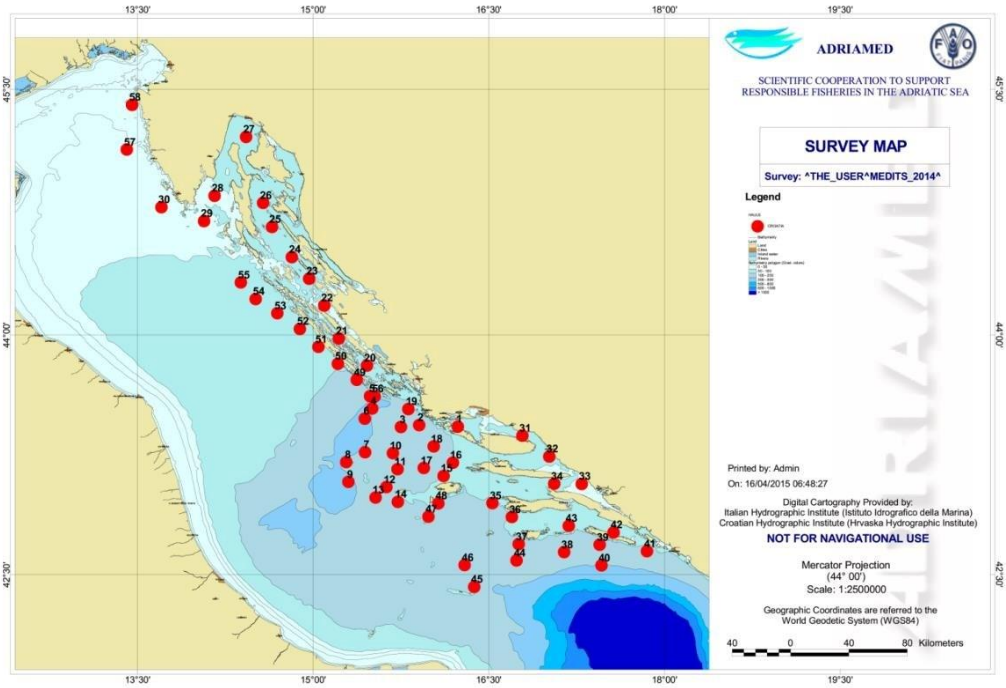


Fig. 4.1.2-3. Map of MEDITS haul positions in the GSA 17 Eastern side.

Direct m ethods: trawl based Recruitment analysis

Table 4.1.3-4: Trawl surveys; recruitment analysis summary

Survey	**MEDITS**	**Trawler/RV**	**Andrea / Bios**
Survey season		Spring - Summer	
Cod –end mesh size as opening in mm		20	
Investigated depth range (m)		0 – 500	
Recruitment season and peak (months)		May – June – October - November	
Age at fishing-grounds recruitment		0	
Length at fishing-grounds recruitment		3	

-

Table 4.1.3 5: Trawl surveys; recruitment analysis results - MEDITS

Years	Area in km²	N of recruit per km²	CV or other
1998	31727	812.330	0.142
2000	31727	580.900	0.136
2001	31727	650.500	0.233
2002	31727	886.100	0.232
2003	31727	733.730	0.132
2004	31727	825.100	0.121
2005	31727	1388.980	0.152
2006	31727	1295.980	0.122
2007	31727	1030.840	0.131
2008	31727	1175.000	0.183
2009	31727	342.900	0.137
2010	31727	464.690	0.148
2011	31727	454.020	0.123
2012	31727	1071.430	0.181
2013	31727	497.290	0.135
2014	31727	397.750	0.144
2015	31727	716.400	0.154
2016	31727	505.75	0.134

Recruits were estimated on the base of the LFD observed from the survey (0 – 20 cm) (Fig. 4.1.3-1). Recruits inhabit the entire Adriatic, with exception for the northernmost part of the basin and particularly abundant in the Central Adriatic Sea and in Croatian waters (Fig. 2.3).

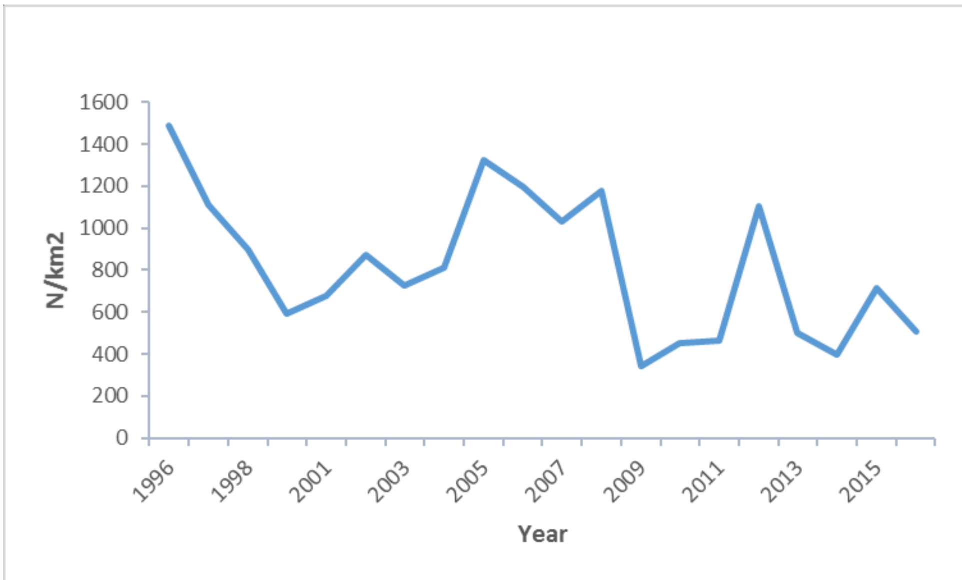


Fig. 4.1.3-1 Abundance indices of hake obtained from MEDITS surveys

Direct methods: trawl based Spawner analysis

Table 4.1.3-6: Trawl surveys; spawners analysis summary

Survey	**MEDITS**	**Trawler/RV**	**Andrea / Bios**
Survey season			Spring - Summer
Investigated depth range (m)			0 – 500
Spawning season and peak (months)			June – July – January – February

-

Table 4.1.3 7: Trawl surveys; spawners analysis results - MEDITS

Surveys	Area in km²	N (N of individuals) of spawners per km²	CV
1998	31727	19.720	0.387
2000	31727	9.970	0.314
2001	31727	13.260	0.239
2002	31727	20.680	0.194
2003	31727	12.890	0.158
2004	31727	17.740	0.200
2005	31727	16.730	0.198
2006	31727	31.890	0.185
2007	31727	28.130	0.197
2008	31727	30.070	0.202
2009	31727	18.500	0.238
2010	31727	13.830	0.228
2011	31727	8.590	0.243
2012	31727	17.880	0.152
2013	31727	20.090	0.151
2014	31727	17.580	0.200
2015	31727	28.180	0.157
2016	31727	16.10	0.230

Figure 4.1.3-2 shows the trends of abundance and biomass of spawners (individuals≥ 35 cm). Maps shows that the spawners aggregates in the Central Adriatic, particularly in the Pomo/Jabuka Pit area and in Croatian waters (Fig. 2.4).

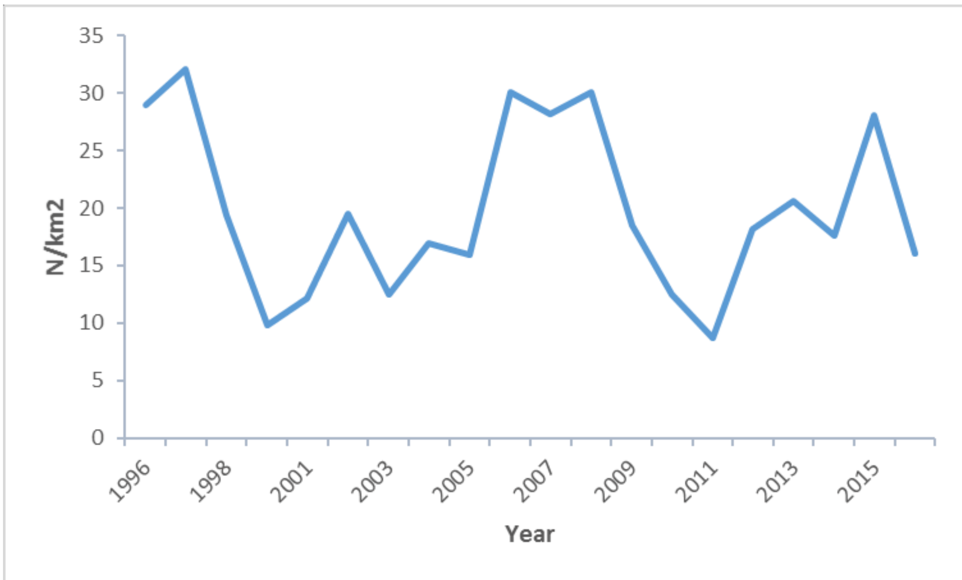


Fig. 4.1.3-2 Abundance indices of hake spawners obtained from MEDITS surveys

MEDITS GSA 18

Direct methods: trawl based abundance indices

Table 4.1.4-1: Trawl survey basic information

Survey	MEDITS	**Trawler/RV**	PEC
Sampling season	Summer		
Sampling design	Stratified sampling design with the number of hauls proportionate to the strata surface		
Sampler (gear used)	GOC 73		
Cod –end mesh size as opening in mm	20		
Investigated depth range (m)	0 – 800		

-

Table 4.1.4 2: Trawl survey sampling area and number of hauls – MEDITS

Stratum	Total surface (km²)	Trawlable surface (km²)	Swept area (km²)	Number of hauls
10 – 50 m	3430			12
50 – 100 m	6435			20
100 – 200 m	9664			31
200 – 500 m	4761			13
500 – 800 m	4718			14
Total (10 – 800 m)	29008			90

Table 4.1.4-4: Trawl survey abundance and biomass results - MEDITS

Depth Stratum	Years	kg per km²	CV or other	N per km²	CV or other
	1998			431.663	0.11
	1999			292.687	0.129
	2000			503.129	0.0996
	2001			400.011	0.088
	2002			730.811	0.117
	2003			417.452	0.08
	2004			657.500	0.186
	2005			1586.058	0.182
	2006			641.128	0.224
	2007			532.420	0.097
	2008			1090.621	0.124
	2009			781.782	0.092
	2010			599.551	0.142
	2011			413.604	0.14
	2012			1441.646	0.137
	2013			556.180	0.129
	2014			508.292	0.157
	2015			168.560	0.188
	2016			461.653	0.110

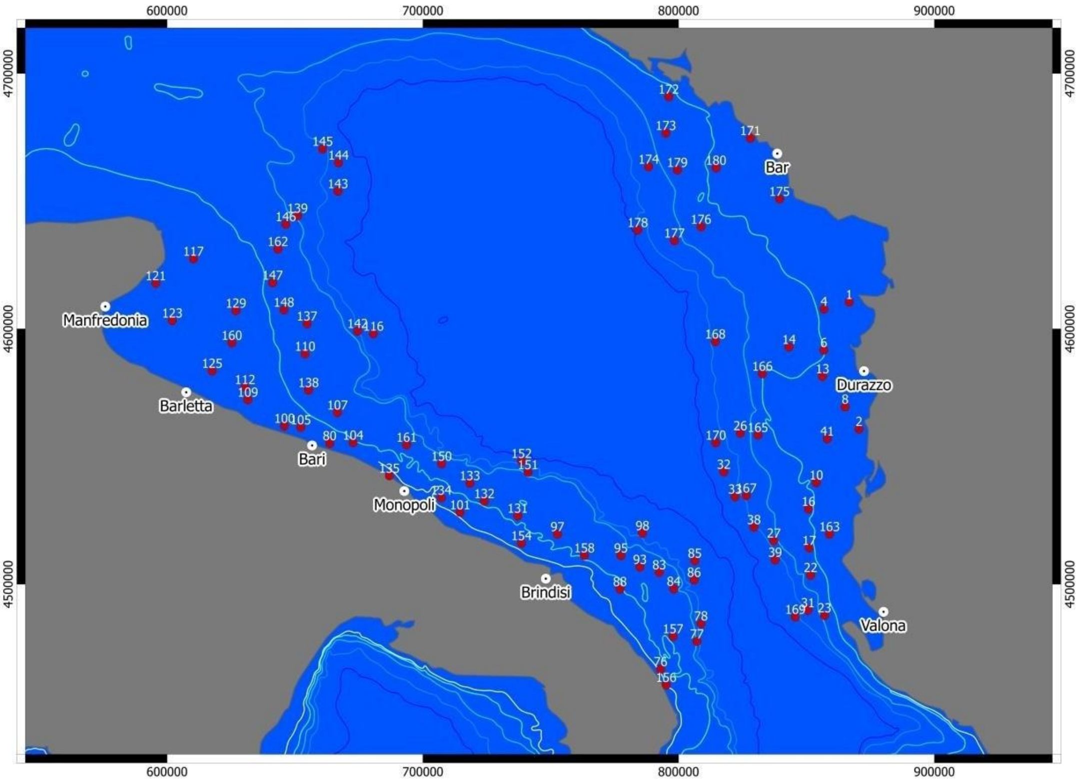


Fig. 4.1.4-1. Map of MEDITS haul positions in the GSA 18

Direct methods: trawl based Recruitment analysis

Table 4.1.4-4: Trawl surveys; recruitment analysis summary

Survey	**MEDITS**	**Trawler/RV**	
Survey season		Summer	
Cod –end mesh size as opening in mm		20	
Investigated depth range (m)		10-800	
Recruitment season and peak (months)		winter and late spring	
Age at fishing-grounds recruitment			
Length at fishing-grounds recruitment			

Table 3.4-5: Trawl surveys; recruitment analysis results – MEDITS (<= 14 cm)

Years	Area in km^2	N of recruit per km^2	CV or other
1998	29008	203	0.237
1999	29008	139	0.243
2000	29008	344	0.156
2001	29008	232	0.214
2002	29008	568	0.150
2003	29008	257	0.112
2004	29008	480	0.149
2005	29008	1070	0.103
2006	29008	396	0.225
2007	29008	280	0.274
2008	29008	750	0.284
2009	29008	430	0.106
2010	29008	418	0.159
2011	29008	264	0.134
2012	29008	1282	0.165
2013	29008	327	0.227
2014	29008	372	0.188
2015	29008	94	0.197
2016	29008	279	0.174

MEDITS Recruitment index (<=14 cm)

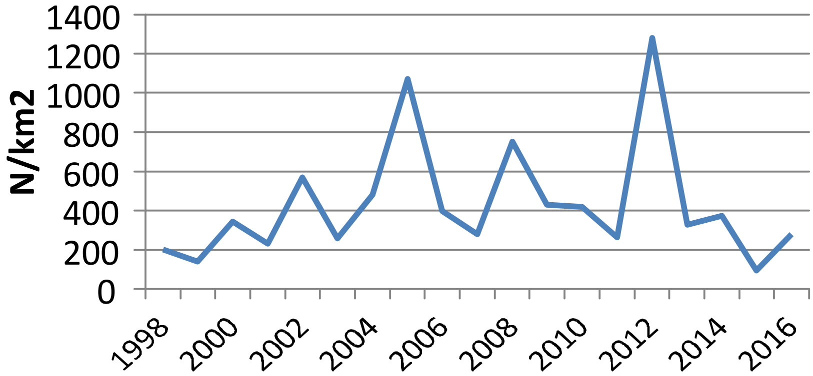


Fig. 4.1.4-2: Recruitment index of hake obtained from MEDITS surveys in GSA 18

Direct methods: trawl based Spawner analysis

Table 4.1.4-6: Trawl surveys; spawners analysis summary

Survey	**MEDITS**	**Trawler/RV**	
Survey season			Summer
Investigated depth range (m)			10-800
Spawning season and peak (months)			Summer and winter

Table 4.1.4-7: Trawl surveys; spawners analysis results – MEDITS (>= 35 cm)

Surveys	Area in km^2	N (N of individuals) of spawners per km^2	CV
1998	29008	6	0.214
1999	29008	5	0.199
2000	29008	5	0.199
2001	29008	5	0.182
2002	29008	4	0.283
2003	29008	6	0.239
2004	29008	5	0.236
2005	29008	13	0.173
2006	29008	11	0.165
2007	29008	10	0.211
2008	29008	8	0.254
2009	29008	17	0.129
2010	29008	10	0.162
2011	29008	7	0.165
2012	29008	7	0.196
2013	29008	12	0.182
2014	29008	13	0.212
2015	29008	7	0.165
2016	29008	7	0.145

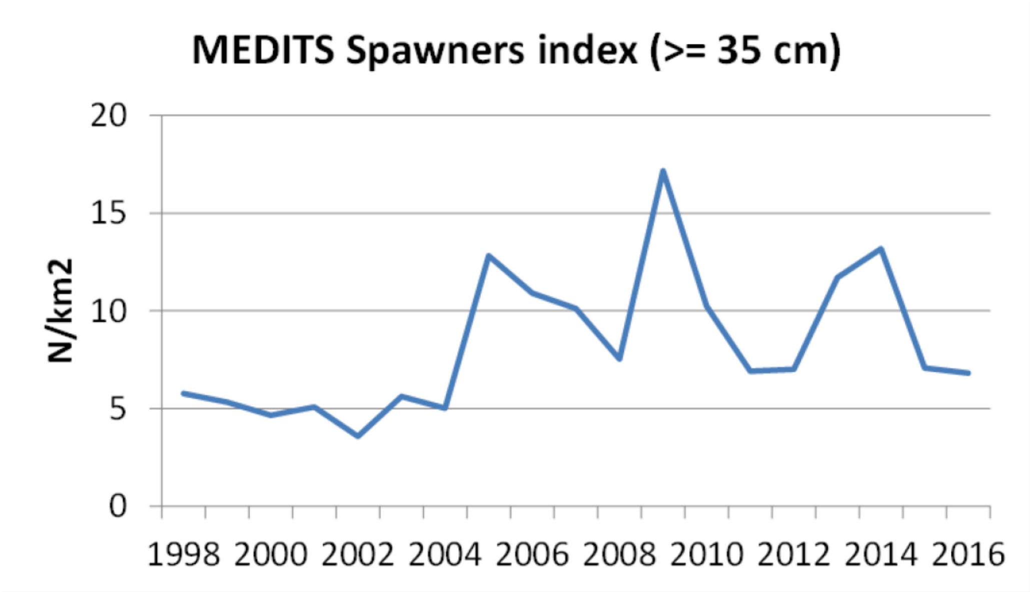


Fig. 4.1.4-3 Spawners index of hake obtained from MEDITS surveys in GSA 18

4.2.2 Spatial distribution of the resources

(see point 2)

4.2.3 Historical trends

The MEDITS trawl surveys provide data either on hake total abundance and biomass as well as on important biological events (recruitment, spawning).

Figure 4.2.3-1 shows the abundance indices of hake obtained from 1998 to 2016. The tree surveys (Medits ITA GSA 17, Medits HRV GSA 17 and MEDITS ITA GSA 18) show a generally fluctuating decreasing trend with a peak in 2005, whereas the 2012 peak is highlighted only by the Medits survey in GSA 18 and in the Croatian waters.

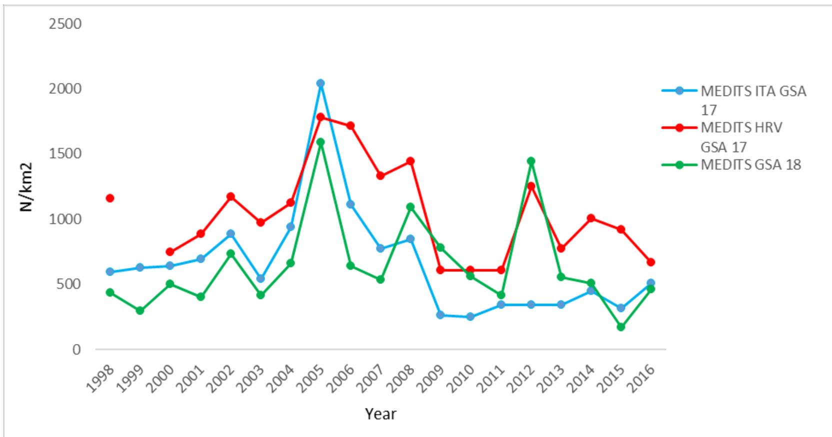


Fig. 4.2.3-1 Abundance and biomass indices of hake obtained from MEDITS survey

5 Ecological information

5.1 Protected species potentially affected by the fisheries

5.2 Environmental indexes

6 Stock Assessment

6.1 Statistical catch at age (SS3 model – Italy and Croatia)

6.1.1 Model assumptions

Stock Synthesis 3 (SS3) provides a statistical framework for the calibration of a population dynamics model using fishery and survey data. It is designed to accommodate both population age and size structure data and multiple stock sub-areas can be analyzed. It uses forward projection of population in the "statistical catch-at-age" (hereafter SCAA) approach. SCAA estimates initial abundance at age, recruitments, fishing mortality and selectivity. Differently from VPA based approaches (e.g. by XSA) SCAA calculates abundance forward in time and allows for errors in the catch at age matrices. Selectivity has been generated as age-specific by fleet, with the ability to capture the major effect of age-specific survivorship. The overall model contains subcomponents which simulate the population dynamics of the stock and fisheries, derive the expected values for the various observed data, and quantify the magnitude of difference between observed and expected data. Some SS3 features include ageing error, growth estimation, spawner-recruitment relationship, movement between areas; in the present assessment such features are not summarized in the results. The ADMB C++ software in which SS is written searches for the set of parameter values that maximize the goodness-of-fit, then calculates the variance of these parameters using inverse Hessian methods. The F at age has been estimated from the Z at age estimated by the model (subtracting M at age used in input); then, the Fbar has been estimated as average on ages 1 to 6.

The model allowed to specify the different source of data, providing different uncertainties estimates for each data set. In order to facilitate the convergence of the model a higher number of ages has been employed for natural mortality, fecundity and weight at age.

The SS3 analyses has been carried out considering the following ten fleets, 7 fishing fleets and 3 surveys.

1. Fishing
    a) Italian bottom trawl GSA 17;
    b) Croatian bottom trawl;
    c) Croatian longlines;
    d) Italian bottom trawl GSA 18;
    e) Italian longlines GSA 18;
    f) Montenegrin bottom trawl and nets;
    g) Albania bottom trawls;
2. Survey
    a) Italian Medits GSA 17;

b) Croatian Medits;

c) Medits GSA 18.

The length frequency distributions for each years and gear are shown in figures from 6.1.3.1 to 6.1.3.6, whereas survey information are summarized in figures from 6.1.3.7 to 6.1.3.11.

6.1.2 Scripts

All the input files and the software are available in the share point.

6.1.3 Input data and Parameters

The following figures represent the length frequency distributions of each fishery and each year, together with the fitting of the model and the respective residuals.

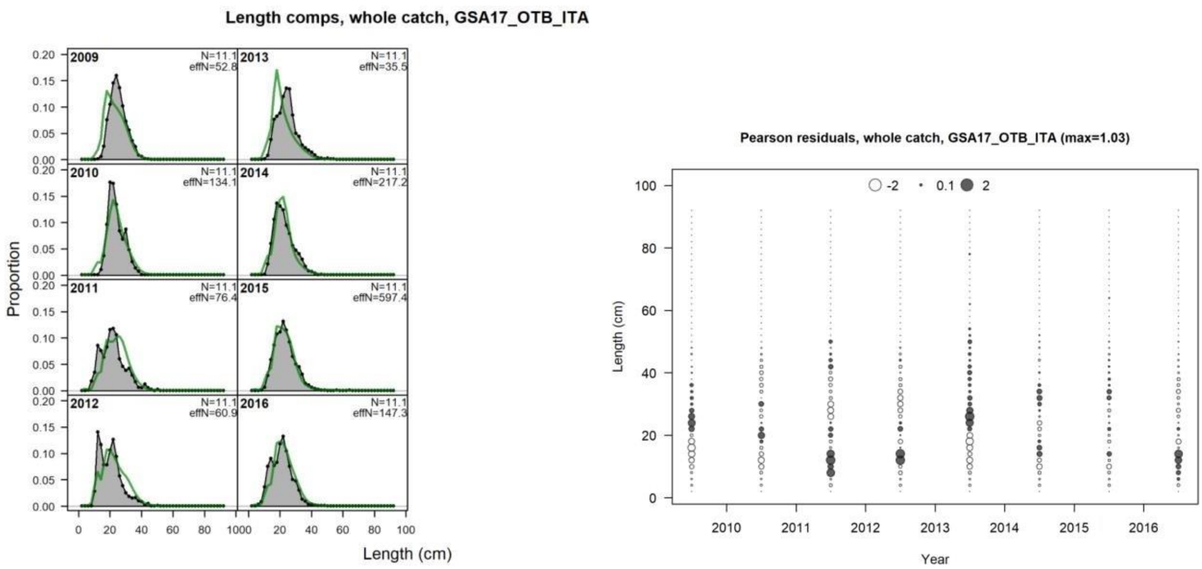


Figure 6.1.3.1 – Length frequency distribution on the left and residuals on the right for the Italian bottom trawlers in GSA 17

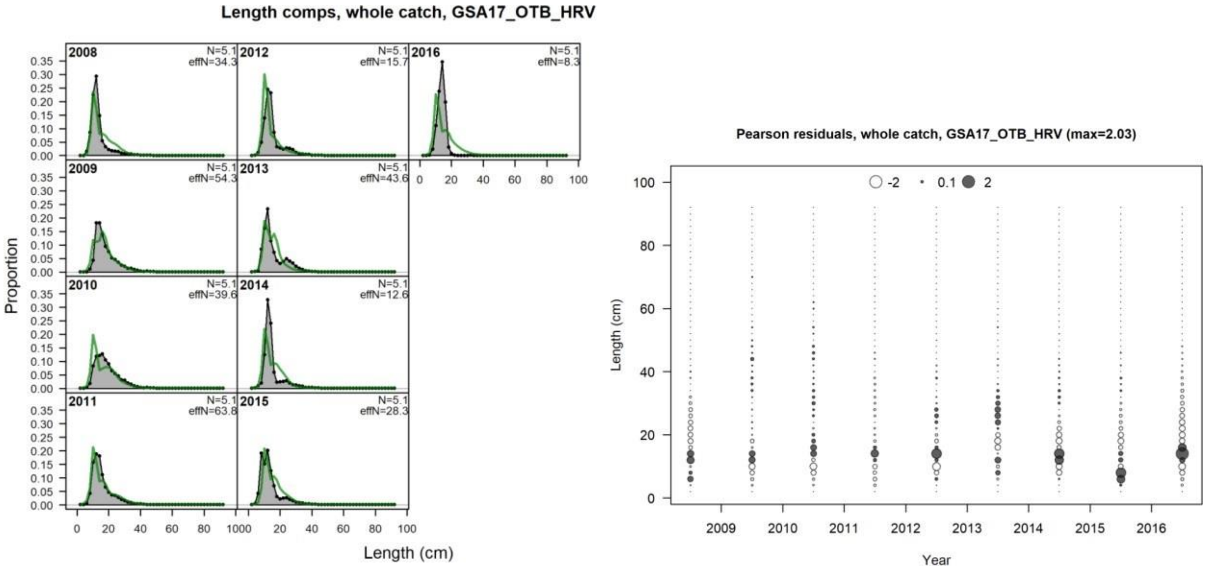


Figure 6.1.3.2 – Length frequency distribution for the Croatian bottom trawlers

Croatian territorial waters are divided by fishing zone and the DCF sample is already organized taking in account these differences. The resulting LFDs are showed in figure 6.1.3.2 and 6.1.3.3.

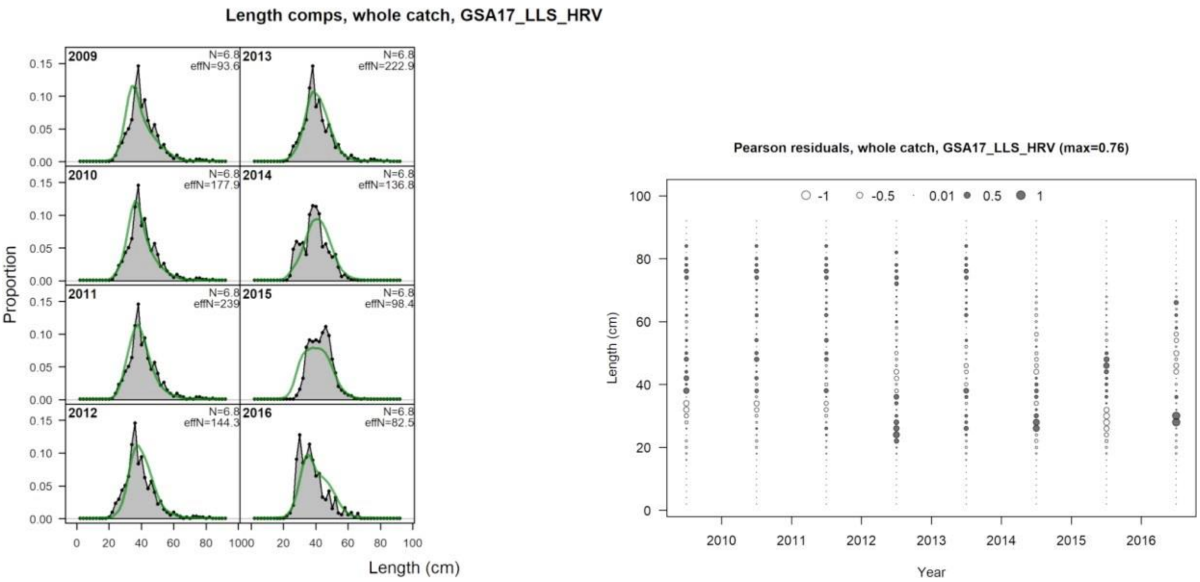


Figure 6.1.3.3 – Length frequency distribution for the Croatian longlines

The following figures show the length frequency distributions for the Italian bottom trawlers in GSA 18 (Fig. 6.1.3.4), the Italian longlines in GSA 18 (Fig. 6.1.3.5) and for the bottom trawls of Montenegro (Fig. 6.1.3.6).

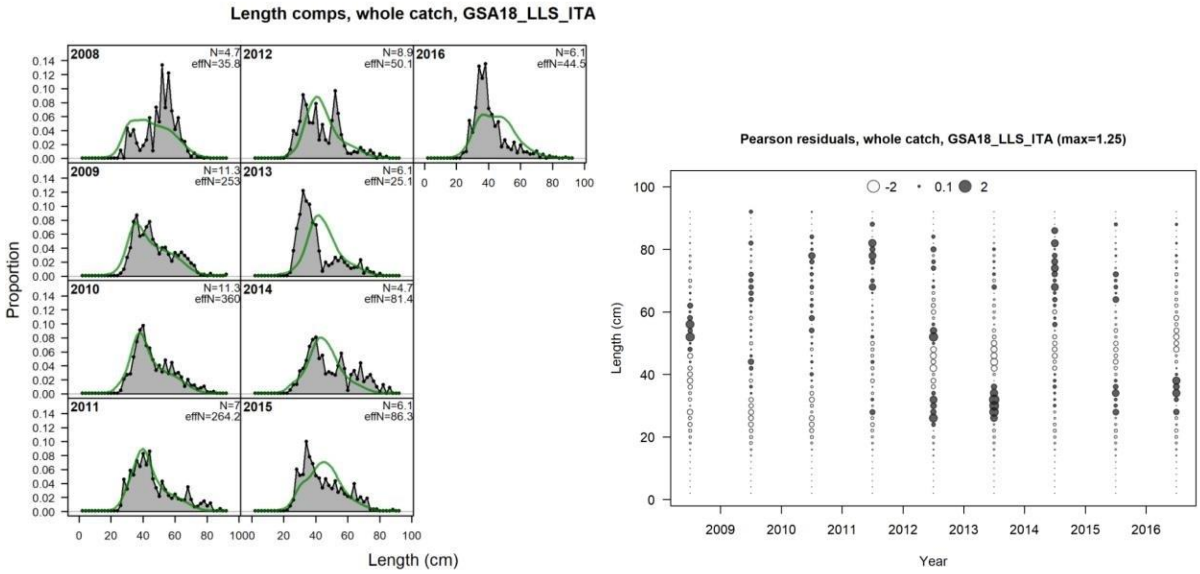


Figure 6.1.3.4 – Length frequency distribution for the Italian bottom trawlers in GSA 18

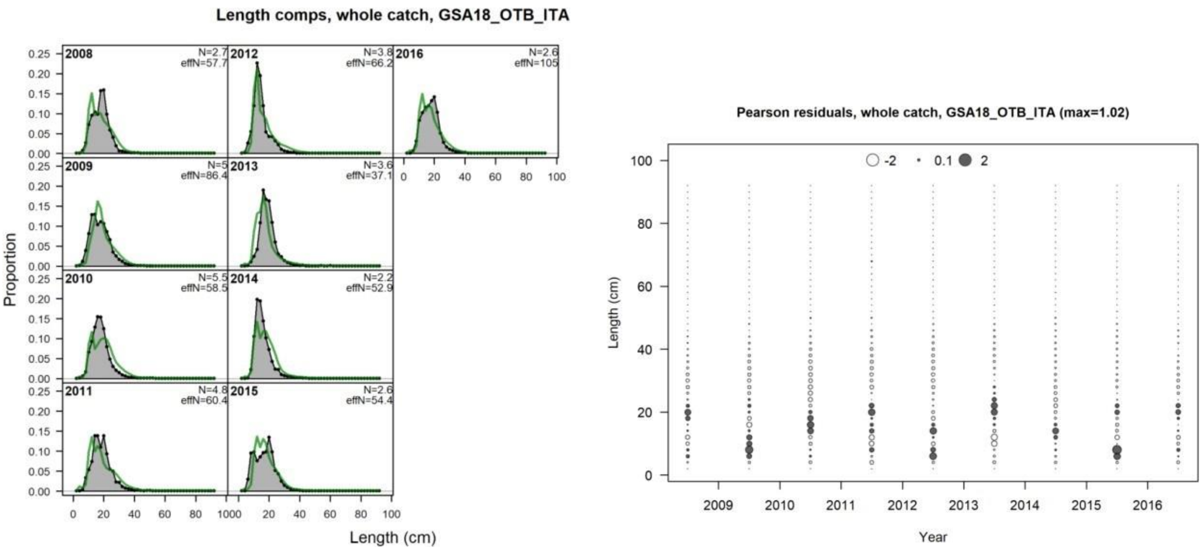


Figure 6.1.3.5 – Length frequency distribution for the Italian longlines in GSA 18

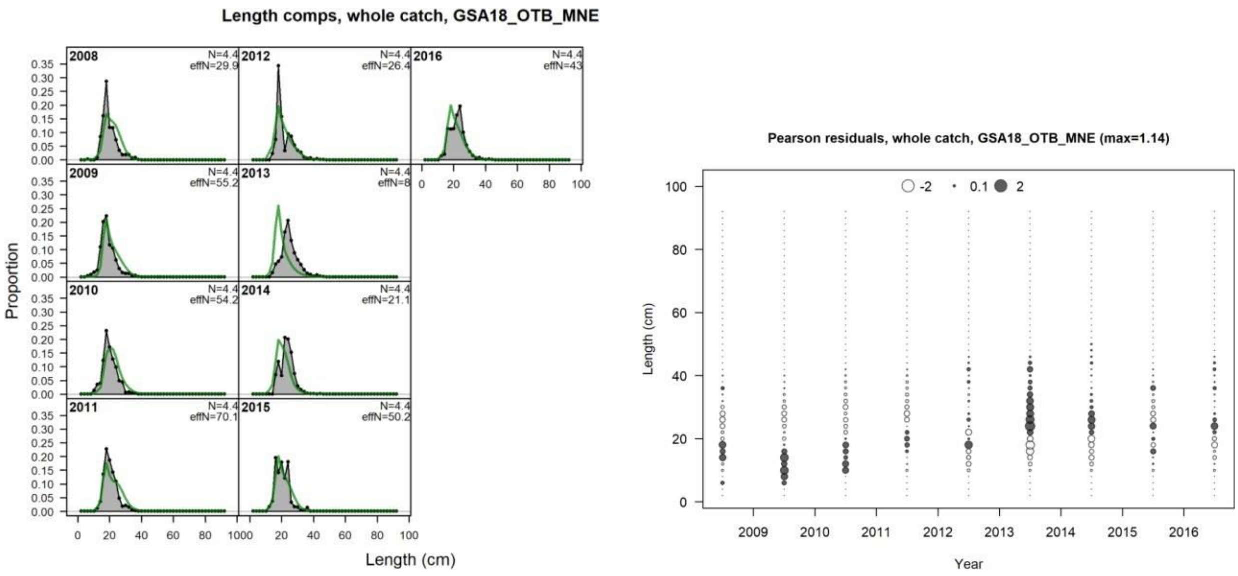


Figure 6.1.3.6 – Length frequency distribution for the bottom trawlers of Montenegro.

Landing and length frequency distributions from Albania are currently under revision, for this reason LFDs were not considered in this assessment. However, the last version of the landing data made available from the last GSA 18 hake stock assessment (GFCM 2015) was included in this assessment and for this reason the landing value of 2016 was assumed equal to the one of 2015.

Both abundance indexes (Figure 6.1.3.7, 6.1.3.8 and 6.1.3.9) and length frequency distributions together with the residuals from MEDITS survey are included in this model.

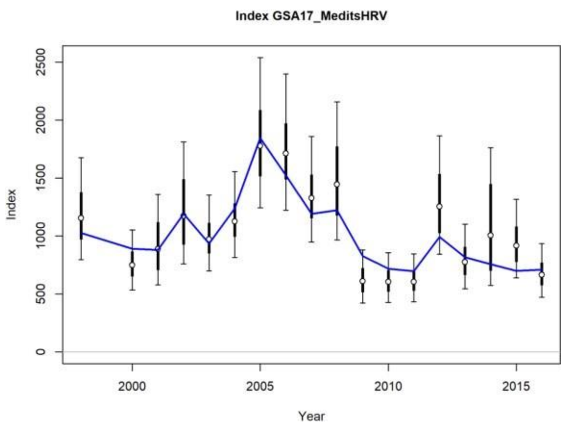


Figure 6.1.3.7 Abundance index – MEDITS survey HRV GSA 17

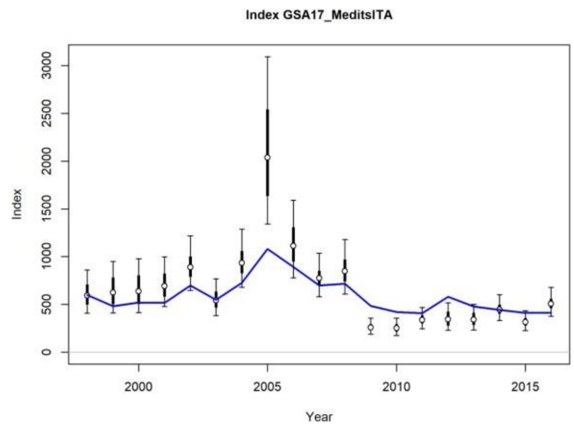


Figure 6.1.3.8 Abundance index – MEDITS survey ITA GSA 17

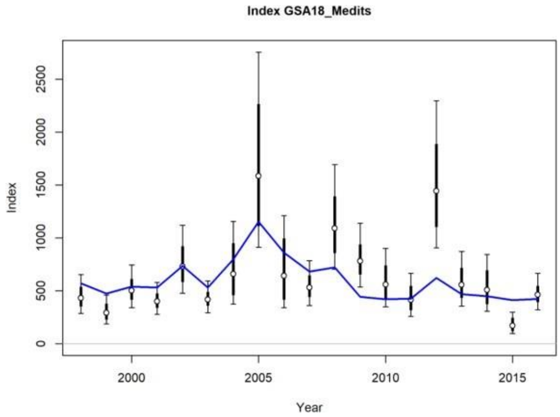
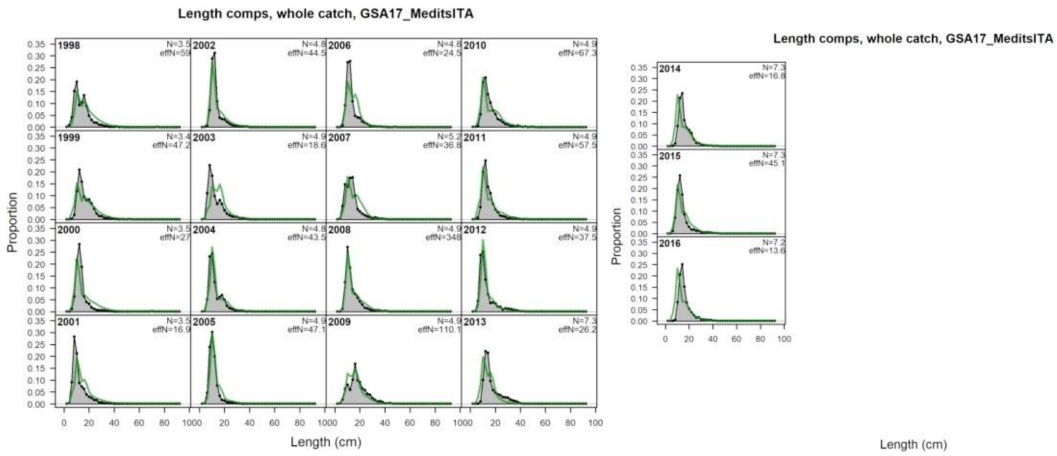


Figure 6.1.3.9 Abundance index – MEDITS survey GSA 18



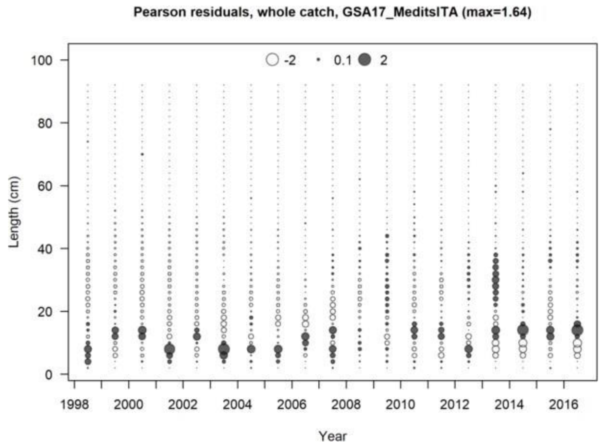


Figure 6.1.3.9 Length frequency distribution – MEDITS ITA GSA 17

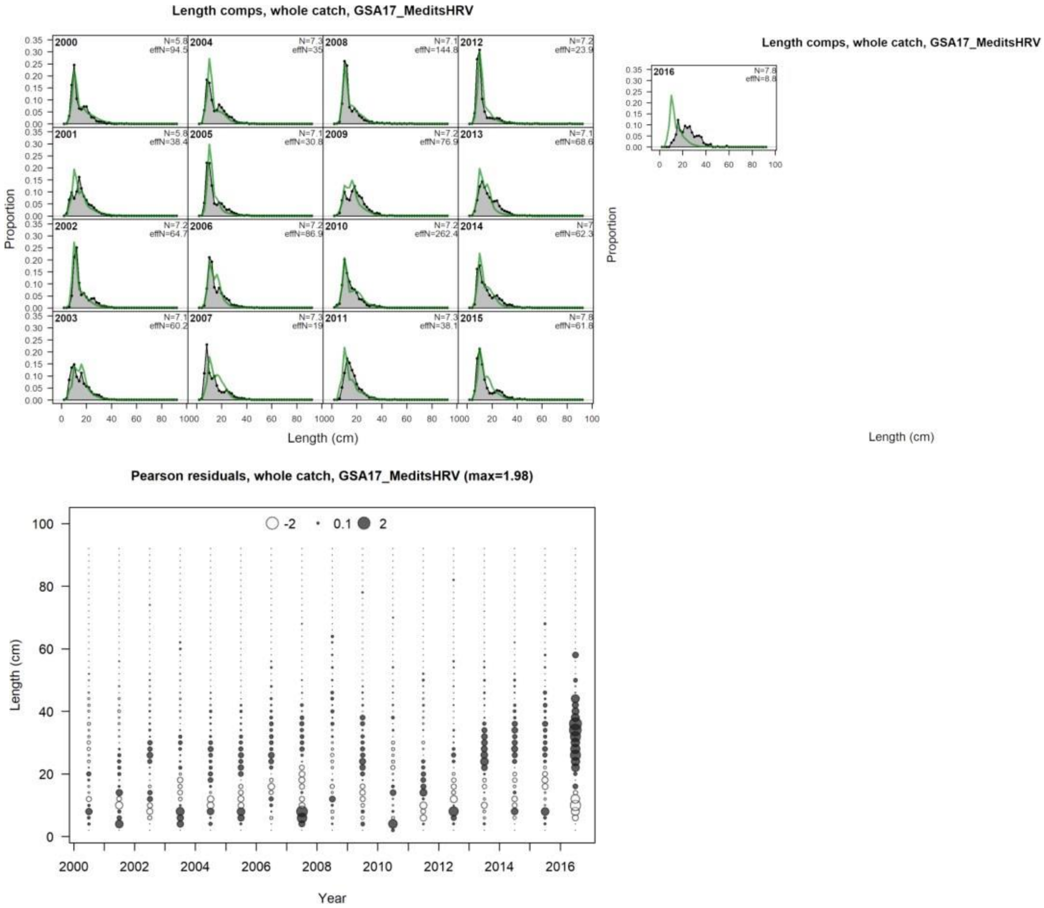


Figure 6.1.3.10 Length frequency distribution – MEDITS HRV GSA 17

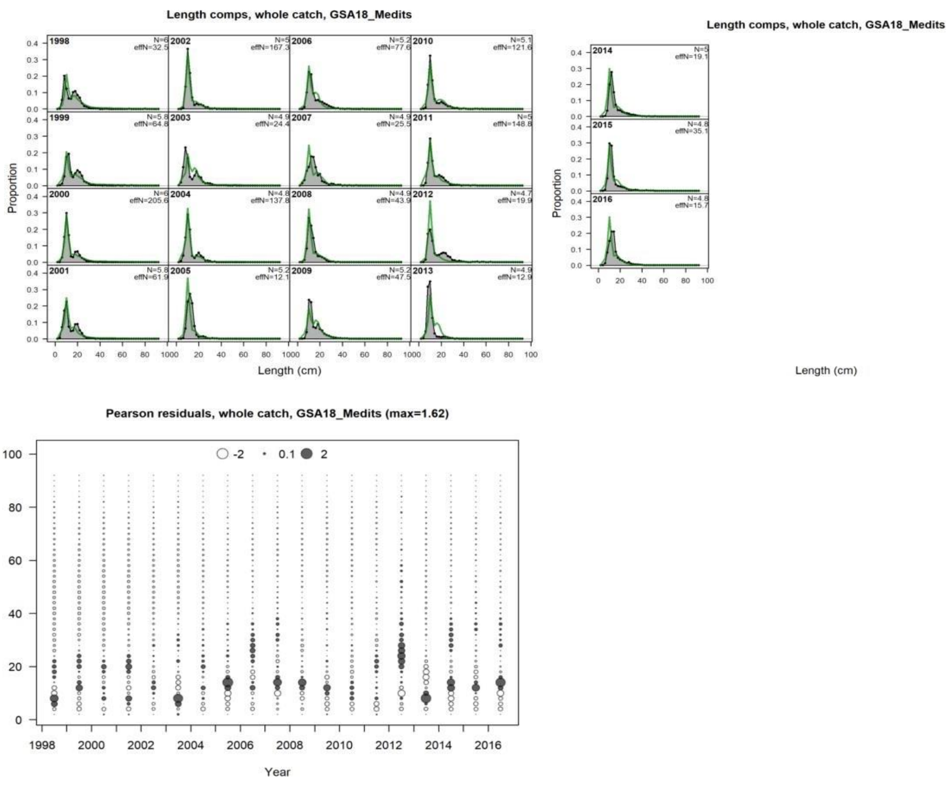


Figure 6.1.3.11 – MEDITS GSA 18

The figures above show the model fitting to the data. Considering the fluctuating LFDs of each fishery, we can state that the model has a quite good fitting both for the fishing fleet and for the scientific survey.

Input data are summarized in Figure 6.1.3.12.

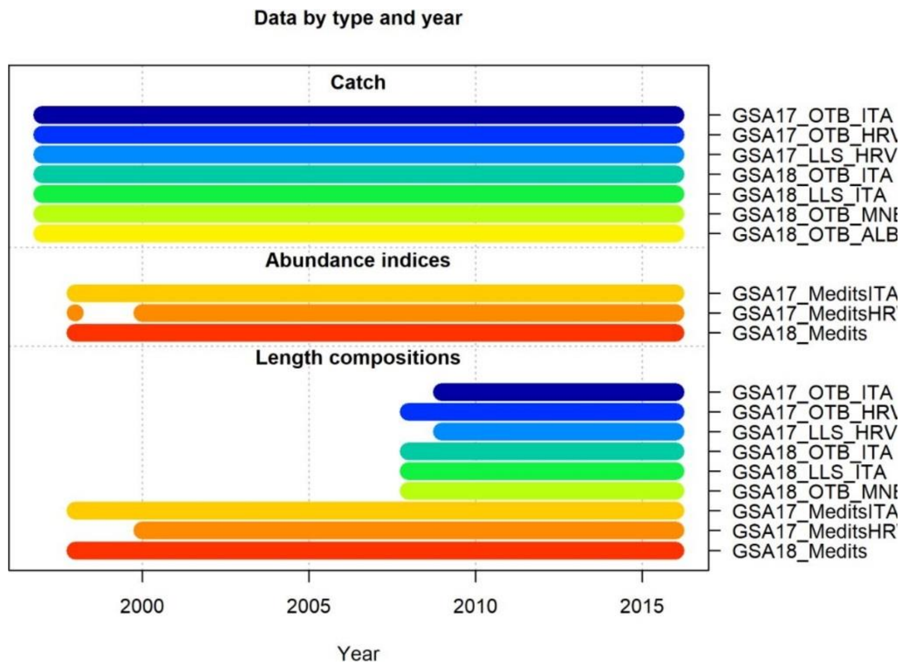


Figure 6.1.3.12 - Summary of input data used in the SS3 model

6.1.4 Results

SS3 allows to describe the selectivity for each fishery considered in the model. All the fisheries present a dome shaped selectivity, obtained using the length selectivity pattern 24 (double normal with defined initial and final selectivity level) or 27 (cubic spline). The resulting selectivity curves are showed in the next figures.

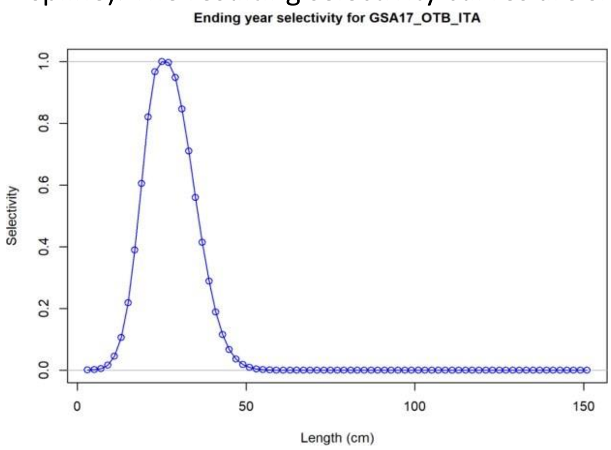


Figure 6.1.4.1 Selectivity pattern for Italian bottom trawlers in GSA 17

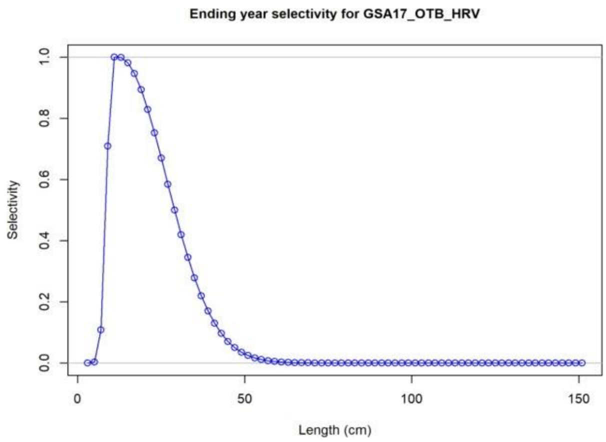


Figure 6.1.4.2 Selectivity pattern for Croatian bottom trawlers in GSA 17

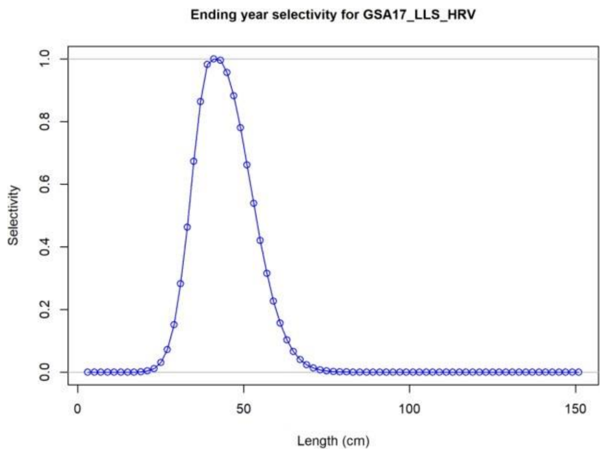


Figure 6.1.4.3 Selectivity pattern for Croatian bottom longlines in GSA 17

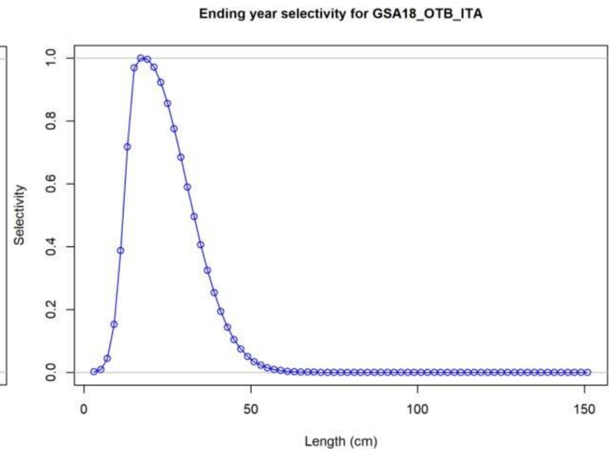


Figure 6.1.4.4 Selectivity pattern for Italian trawlers in GSA 18

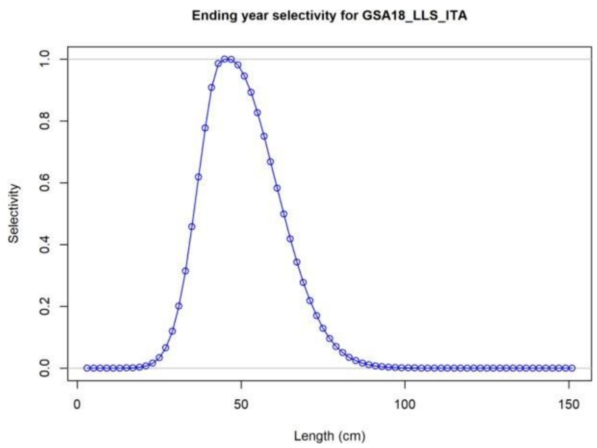


Figure 6.1.4.5 Selectivity pattern for Italian longlines in GSA 18

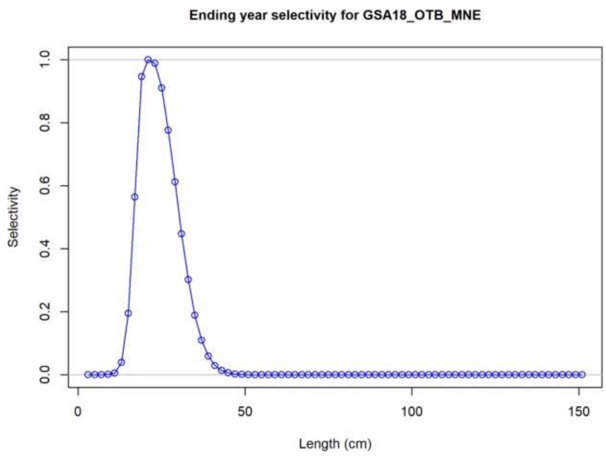


Figure 6.1.4.6 Selectivity pattern for bottom trawlers from Montenegro

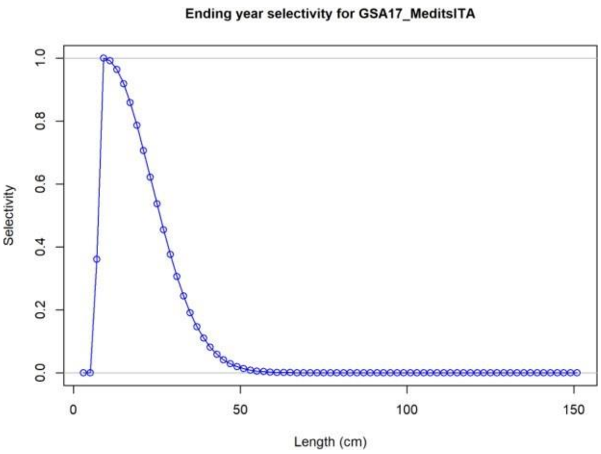


Figure 6.1.4.7 Selectivity pattern for the Italian Medits survey in GSA 17

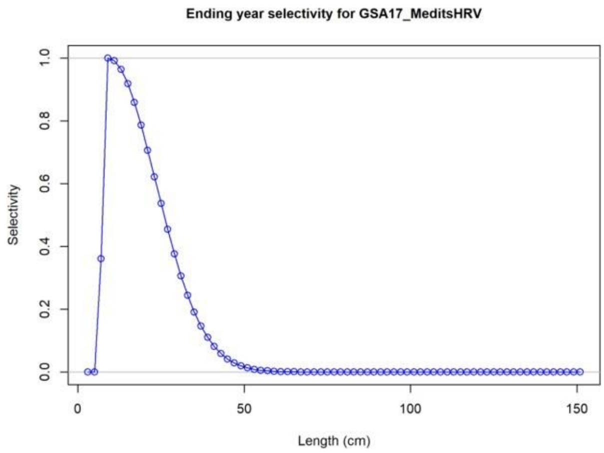


Figure 6.1.4.8 Selectivity pattern for the Croatian MEDITS survey in GSA 17

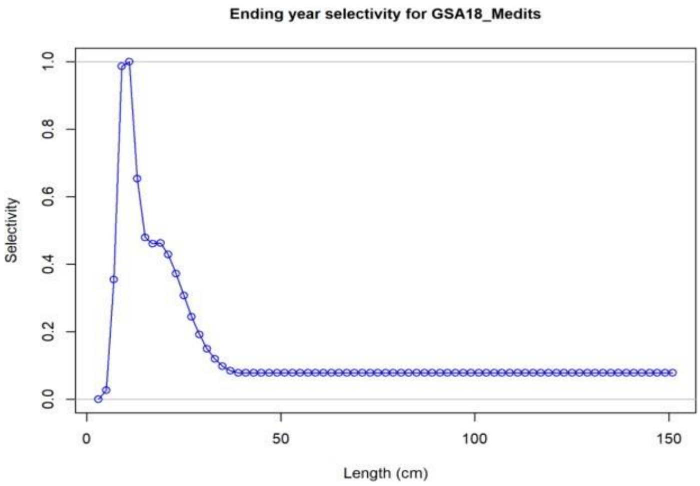
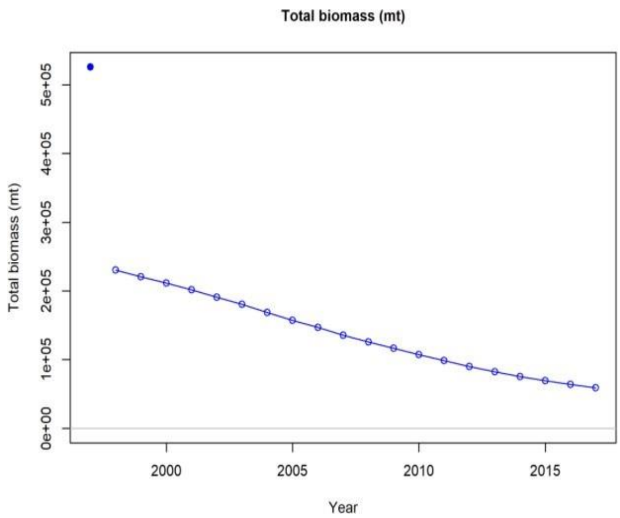


Figure 6.1.4.9 Selectivity pattern for the MEDITS survey in GSA 18

The stock of European hake in GSA 17 and 18 show a concerning trend. In fact, both the total (Fig. 6.1.4.14) and the spawning biomass (Fig. 6.1.4.15) depict a decreasing trend over the years, accounting for the lowest value in 2015 (29,870 tonnes). Recruitment (Fig. 6.1.4.16) presents a fluctuating trend with peak in 2002, 2005 and 2012. The fishing mortality increases over the years. Specifically, F_{bar} was calculated considering the ages between 1 and 6 and it reaches the highest value in 2015 (F_{bar} = 0.546) (Fig. 6.1.4.17). The SS3 model allows to estimate the fishing mortality also by fleet (Fig. 6.1.4.18). Italian bottom trawlers of both GSA 17 and 18 account for the highest fishing mortality, whereas Croatian bottom trawlers start to increase their impact from 2011.



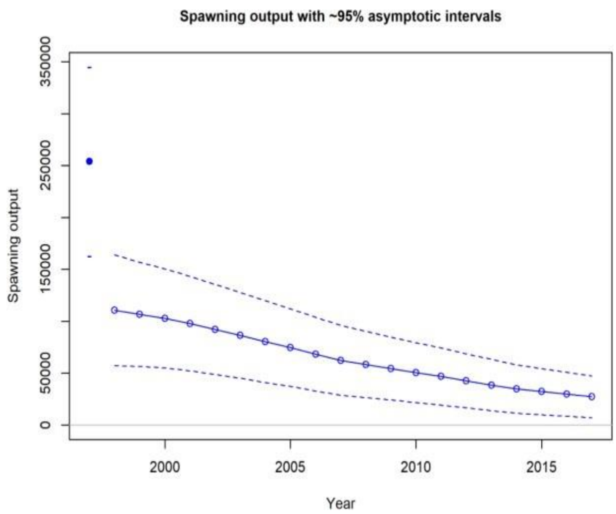


Figure 6.1.4.14 Result – Estimated total biomass from SS3 model

Figure 6.1.4.15 Result – Estimated spawning biomass from SS3 model.

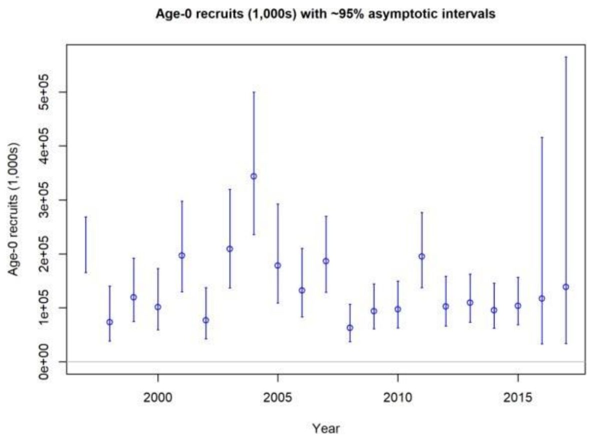


Figure 6.1.4.16 Result – Number of recruits estimated by the SS3 model

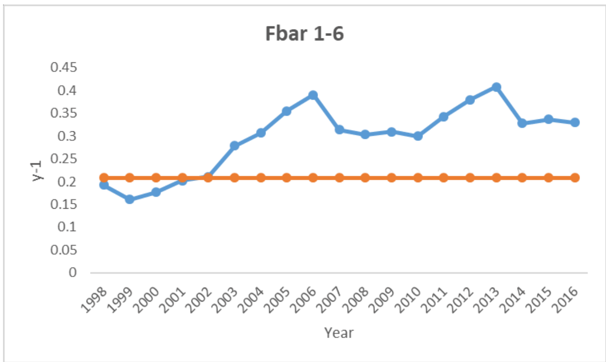


Figure 6.1.4.17 Result – Fbar(1-6)

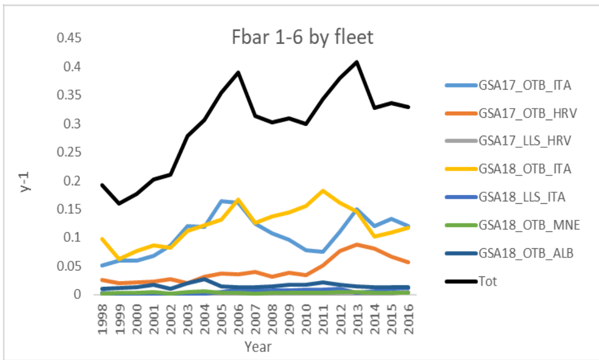


Figure 6.1.4.18 Result – F by fleet

State of exploitation: exploitation shows an increasing trend over the years reaching a peak of 0.408 in 2013, in 2016 the value of F is equal to 0.33 whereas the mean value of the last three years is 0.331. Italian bottom trawlers are the principal cause of fishing mortality for hake. Specifically, the Italian bottom trawler of GSA 17 shows an increasing trend from 1998 to 2005 (F_{1-6} = 0.16) followed by a reduction in F to 2011 (F_{1-6} = 0.07), the last years show a new increasing trend reaching a new peak in 2013 (F_{1-6} = 0.15). The Italian bottom trawlers of GSA 18 and the Croatian bottom trawler present a generally continuous increasing trend respectively to 2011 (F_{1-6} = 0.18) and to 2013 (F_{1-6} = 0.09), whereas in the last years the trend is generally decreasing. The longlines fisheries and Albanian and Montenegrinian fleets account for lowest values.

State of the juveniles (recruits): recruitment show a fluctuating decreasing trend. The highest value has been estimated in 2004 (343,427 thousands), followed by a generally decreasing trend to 2016. The lowest value has been accounted in 2008 (63,061 thousands).

State of the adult biomass: the spawning stock biomass (SSB) showed a continuous decreasing trend all over the year. For the last years estimates are more precise since different information are available. Thus suggests the decreasing trend is less negative that it appears, moreover hake of big sizes and old are absent both in the catches and surveys estimates.

6.1.5 Robustness analysis

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

The SS3.3 framework allows to carry on the retrospective analysis, the results are showed in the figures below (Fig. XXX SSSB and Fig. XXX Recruitments). The retrospective analysis was carried out considering the removals of three years and considering the results the model appears stable, with more fluctuations for the recruitments.

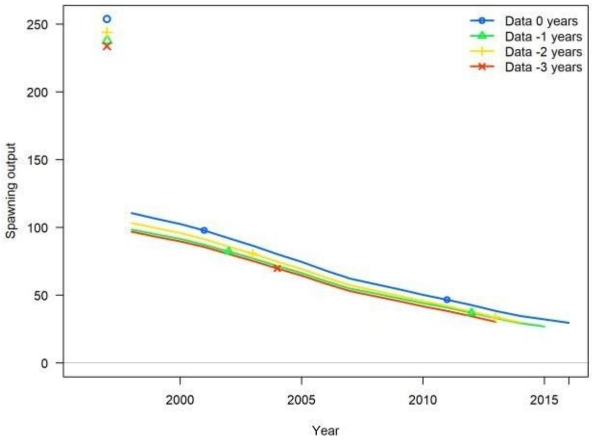


Figure 6.1.6.1 Spawning stock biomass (SSB) – result retrospective analysis

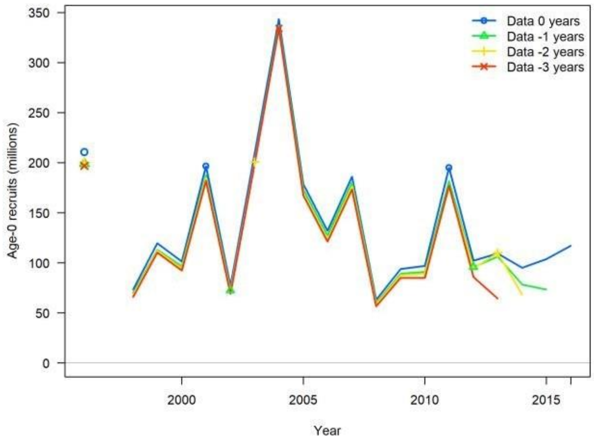


Figure 6.1.6.2 Recruitment - result retrospective analysis

6.1.7 Assessment quality

This assessment represents an updated stock assessment of the work carried out in 2016.

A two sex model was also tested this year, but considering the discussion we had during the working group it was decided to validate the sex combined model. The results of the two models presented some differences, that was particularly true for the estimated total and spawning stock biomass, whereas recruitment estimations were really similar. The estimated fishing mortality was also quite similar between the two model, $F_{bar(1-6)}$ for the sex combined model is equal to 0.33 whereas the $F_{bar(1-6)}$ for the two sex model is equal to 0.39. Considering these differences and the fact that the retrospective analysis show the sex combined model more stable, it was chosen to accept the sex combined model.

However, some concerns were expressed during the discussion of this work. These are reported hereunder and most of them will be investigate for the next year assessment.

- As suggested by the expert and to avoid inconsistency within the model, the growth parameters were estimated by the model taking into account a scalar value of natural mortality equal to 0.2. The resulting growth parameters suggest a slow growth. An investigation about the gain in terms of quality of the assessment derived from the use of a growth pattern differentiated by sex should be made; moreover, a comparison between the use of a natural mortality by age and sex and a scalar value is needed to explore the appropriateness of the constant natural mortality hypothesis.
- The time series of the survey indexes suggest the need of a standardisation of these information. Also, the use of a time varying catchability to fit these data can be helpful.

- A revision of the data for the survey indexes is needed. Specifically, the Medits data for the Italian GSA 17 used in the stock assessment models cover Italy and Slovenia; however, for some years only Italian data are included in the assessment. This inaccuracy has a negligible effect since only two hauls are foreseen in Slovenia water and also hake is not present in this area. However, for the future elaborations it will be useful to harmonize also this point. Also, the length frequency distributions for the Croatian Medits in 2016 have to be revised.

7 Stock predictions

The biological reference point estimated last year were agreed also for this year assessment. They have been estimated using the Yield per Recruits approach (Yield per Recruit Version 3.3 – NOAA Fisheries Toolbox), where $F_{0.1}$ is considered a proxy of F_{MSY}. RPs suggest an overfishing situation for the hake stock.

Table 7.1 - Yield per Recruit outputs for SCAA.

	Current F ($F_{BAR\ 1-6}$)	Reference Points	Harvest	Yield/R	SSB/R	Total biomass/R
SCAA	0.33	$F_{0.1}$	0.208	0.094	0.978	1.113
		F_{max}	0.459	0.075	0.122	0.251

7.1 Short term predictions

7.2 Medium term predictions

7.3 Long term predictions

8 Draft scientific advice

Considering the results of SCAA analyses, it can be concluded that the resource is subjected to overfishing. A reduction of fishing mortality is recommended. SSB shows a clear decreasing trend. The SS3 model allows the assumption of a dome-shaped population selection curve, which determines more reliable values of SSB if compared with the historical yields. However, we have to consider that the most reliable estimates were obtained for the last years of the time series considered, for which different data sets are available.

According to SCAA results, recruitment shows a fluctuating decreasing trend, accounting for the lowest value in 2008 and a peak in 2004.

Based on the SCAA estimates, in 2016 the fishing mortality appears higher than the respective estimates of $F_{0.1}$ and, hence, it can be concluded that the resource is in overexploitation. In this regard it must be kept in mind the different contribution of the fleets to the total F, since Italian bottom trawlers are the most influent factor.

It was agreed to maintain the reference point calculated for the last year assessment and equal to

0.21. Given the results of the present analysis ($F_{current}$ is 0.33), the stock appears to be subject to overfishing. A reduction is necessary to approach the reference point.

Considering the overexploited situation and the low values of SSB and biomass of the hake stock in GSA 17 and 18 a reduction of fishing mortality and an improvement in exploitation pattern is advisable, especially for bottom trawlers, which mainly exploit juveniles. Moreover, it will be important to verify the effectiveness of the restrictive fishing area established in the Pomo pit area since 2015 and also other spatial restrictions can be considered, e.g. the persistent areas of potential spawners observed in the eastern part of the Adriatic Sea by the Mediseh project.

Based on	Indicator	Analytical reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	$F_{0.1}$, = 0.21 F_{max}= 0.46	0.33		I	IO_I
	Fishing effort					
	Catch					
Stock abundance	Biomass					
	SSB	100,271 (33rd percentile) 159,352 (66th percentile)	59,335 (Spawning biomass 2015)		D	O_L
Recruitment						
Final Diagnosis		***The stock is overexploited and in overfishing.***				

The total F estimated by SS3 in the Adriatic Sea (GSA 17 and 18) for the 2016 is split in 37% exerted by Italian trawlers in GSA 17, 17% by Croatian trawlers, 36% by Italian trawlers in GSA 18, 4% by Albanian trawlers, 4% by Italian longlines in GSA 18, 1.1% by Montenegrin trawlers and 1.53% by Croatian longlines.

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)*