Stock Assessment Form

Demersal species

Reference year: 2015

Reporting year: 2016

The assessment of this species in the Adriatic has never been performed during the GFCM stock assessment demersal species working groups. For the assessment of the deep water pink shrimp in the whole Adriatic (GSA 17 and GSA 18) different sources of data (fishery dependent and fishery independent) have been used. A first attempt to apply SS3 model from 1998 to 2015, taking into account the different fleets exploiting the stock has been carried out. The model implemented allows time-varying length selectivity to take into account the change in availability and vulnerability of the stock along the years. Given the results from this analysis, based on the whole information from the area, the stock is over exploited (F0.1=0.9; Fcurrent=2.26) and it is recommended to reduce the fishing mortality to reach F0.1 level. The total F estimated by SS3 in Adriatic (GSA 17 and GSA 18) is split in 37 % exerted by Italian trawlers in GSA 18, 30% by Croatian trawlers, 16% by Albanian trawlers, 15% by Italian trawlers in GSA 17 and 2% by Montenegrin trawlers.

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Maria Teresa FACCHINI*

Stock assessment form

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Parapenaeus longirostris	Deep-water pink shrimp	45
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	Montenegro
4th Country	**5th Country**	**6th Country**
Albania		
Stock assessment method: (direct, indirect, combined, none)		
Combined (Trawl survey, SS3)		
Authors:		
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The ISSCAAP code is assigned according to the FAO 'International Standard Statistical Classification for Aquatic Animals and Plants' (ISSCAAP) which divides commercial species into 50 groups on the basis of their taxonomic, ecological and economic characteristics. This can be provided by the GFCM secretariat if needed. A list of groups can be found here:

http://www.fao.org/fishery/collection/asfis/en

Direct methods (you can choose more than one):

- Acoustics survey
- Egg production survey
- Trawl survey
- SURBA
- Other (please specify)

Indirect method (you can choose more than one):

- 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 present assessment will investigate the state of the deep-water rose shrimp stock in GSAs 17 and 18, (Figure 2-1). For the thermophilic and halophilic preference of deep water rose shrimp, the GSA 17 component of the joint stock is considered an expansion of the southern grounds thus the life history traits were assumed to be the same as those of GSA 18.

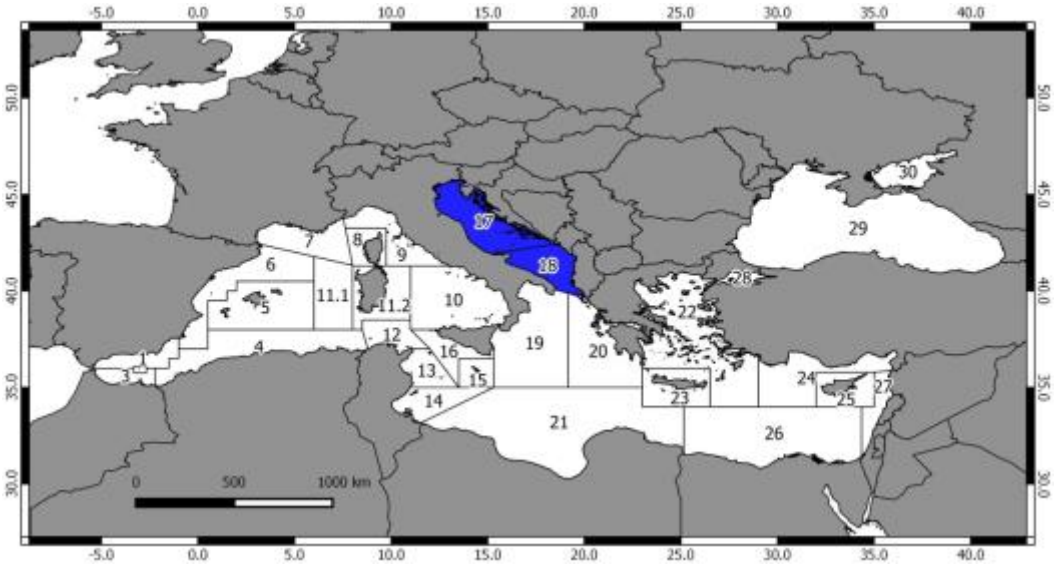


Figure 2-1 Geographical boundaries of the deep-water pink shrimp stock in GSA 17 (North and Central Adriatic Sea) and 18 (Southern Adriatic Sea).

The Northen and Central (NC) Adriatic Sea is a semi-enclosed basin located in the northern-most part of the central Mediterranean. This region of the Adriatic Sea is mostly characterized by the presence of the muddy and sandy bottoms (Brambati et al., 1983). The Adriatic Sea can be divided into three main water types: surface water, deep water and the Modified Levantine IntermediateWater (MLIW) (Artegiani et al., 1997a). In addition, the general circulation is baroclinic (Artegiani et al., 1997b). The primary production varies from a productive (potentially eutrophic) shallow northern basin to an oligotrophic deeper central basin (Zavatarelli et al., 2000). This production is influenced by a large number of rivers discharging into the basin, particularly the Po River in the northern basin (Artegiani et al., 1997a; Zavatarelli et al., 1998). The northern and middle regions of the Adriatic Sea are characterized by a high diversity of the environmental conditions that translates to high biodiversity (Ott, 1992). The NC Adriatic Sea total area is approximately 55,500 km2 ,an average depth of 75m, with maximum depths (in the "Pomo pit") at about 273 m. This area includes Italian territorial waters and international waters from the 12miles off the coast of Italy to 12miles from Croatia and Slovenia.

The Southern Adriatic Sea extends from the line between Gargano and Lastovo to the boundary with the Ionian Sea at the latitude of Otranto (Artegiani et al., 1997a). This southern section of the entire Adriatic Sea is characterised by the presence of a deep central depression known as the "South Adriatic Pit" (or Bari Pit). The seabed reaches a depth of 1,233 m in this area. 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 (Cataudella S. & Spagnolo M., 2011).

The deep-water pink shrimp, is one of the target species of the central and southern Adriatic multispecies trawl catches and is an epibenthic short-lived species, inhabiting preferably muddy sediments (Karlovac, 1949). In the southern Adriatic it is distributed mostly between 30 and 600 m depth although it is more abundant between 200 and 400 m depth (Pastorelli et al., 1996). Larger specimens are caught mainly in deeper waters. According to previous studies (Abellò et al., 2002; Mannini et al., 2004), the eastern part the south Adriatic is characterised by high occurrence and abundance of the species, given the characteristics of the water masses (warmer and saltier) and the lower fishing pressure; in particular an higher abundance of the juvenile component of the population was reported (Ungaro et al., 2006). However according to MEDITS time series the abundance of the species was growing even on the western side since 2002.

Spawning time is considered extended almost all the year around, as for other Mediterranean areas (Relini, 1999) and sex ratio, as estimated from trawl-survey data, is approximately 0.5. The abundance of this shrimp was steadily growing from 1996 to 2005 (Ungaro *et al.*, 2006).

Below are reported the maps from STOCKMED[1] project (Figure 2-2Figure 2-3) showing the distribution of the species.

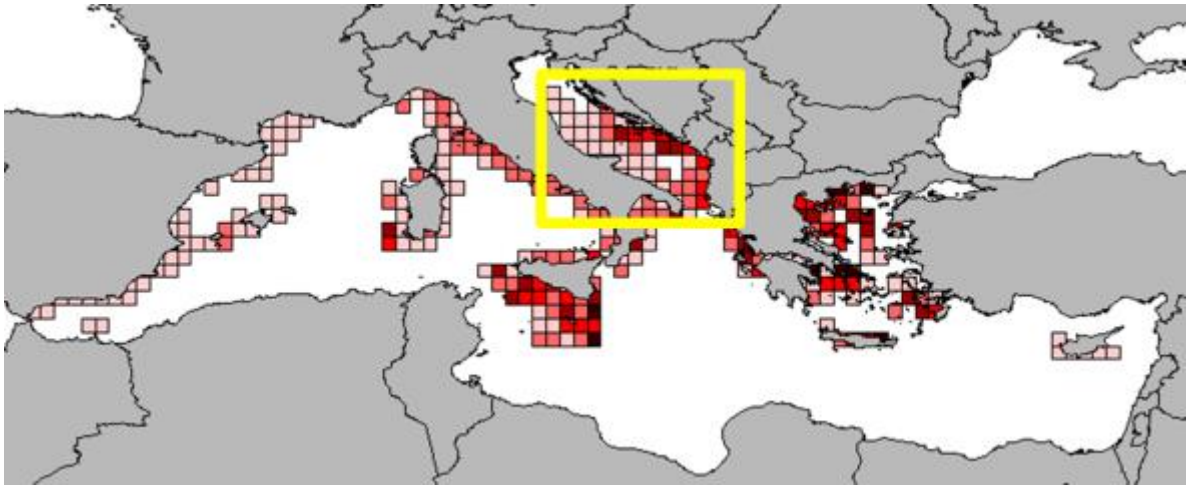


Figure 2-2 Geographical distribution of deep-water pink shrimp stock in terms of biomass (kg/km^2) calculated as average on the last 10 years (MEDITS survey data) in the GFCM Statistical grid.

[1] Fiorentino F., E. Massutì, F. Tinti, S. Somarakis, G. Garofalo, T. Russo, M.T. Facchini, P.Carbonara, K. Kapiris, P. Tugores, R. Cannas, C. Tsigenopoulos, B. Patti, F. Colloca, M. Sbrana, R. Mifsud, V. Valavanis, and M.T. Spedicato, 2014. Stock units: Identification of distinct biological units (stock units) for different fish and shellfish species and among different GFCM-GSA. STOCKMED Deliverable 03: FINAL REPORT. September 2014, 215 p.

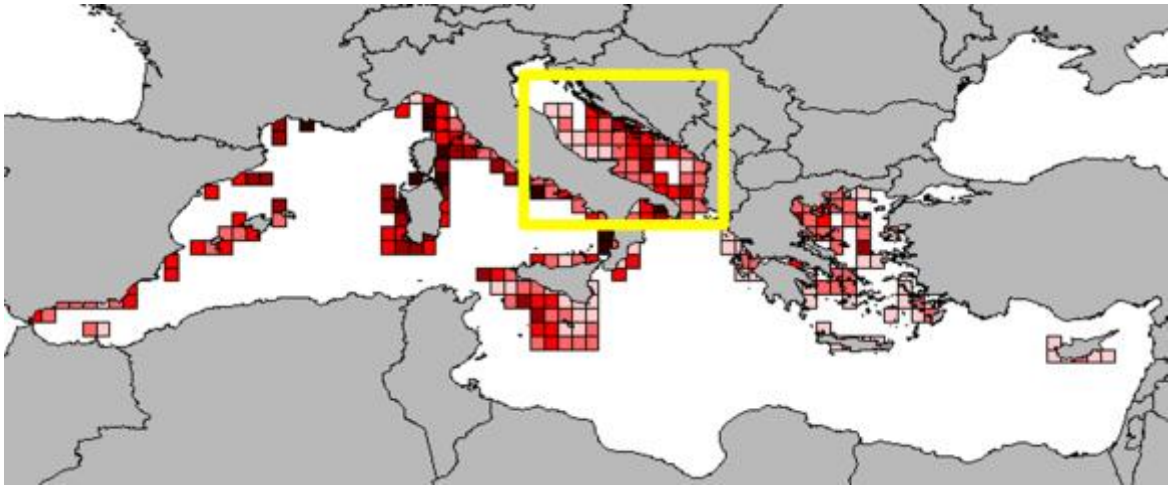


Figure 2-3 Geographical distribution of deep-water pink shrimp stock in terms of mean individual weight (kg) calculated as average on the last 10 years (MEDITS survey data) in the GFCM Statistical grid.

2.1 Stock unit

2.2 Growth and maturity

According to historical information on growth in the Adriatic area, *P. longirostris* can grow up to 16 cm (males) and 19 cm (females) total length. However, males are usually 8 to 14 cm and females from 12 to 16 cm total length. During the expedition "Hvar", the largest specimen caught was a female 17 cm in length (Karlovac, 1949). The growth rate of *P. longirostris* is high, but differs between sexes. Size distribution and growth parameters indicate a life cycle of 3-4 years (Froglia, 1982). Historical parameters of the length-weight relationship reported in the literature for carapace length expressed in mm and both sexes combined (Marano *et al.*, 1998) are *a*=0.0034, *b*=2.4364.

Estimates of growth parameters estimated within the DCF framework using the length frequency distribution analysis and von Bertalanffy model gave the following parameters : CL_∞=45.0 mm; K=0.6; t0= -0.20.

The parameters of the length-weight relationship estimated within the DCF for sexes combined and carapace length expressed in cm were: a=0.0019009, b=2.6064.

In the Mediterranean Sea, both sexes of *P. longirostris* reaches maturity in the first year of life (Froglia, 1982).

According to the data obtained in the Data Collection Framework (DCF), the maturity ogive (mature females were specimens belonging to the maturity stage 2 onwards) estimated by a maximum likelihood procedure indicates a Lm50% of about 18.5 mm (±0.026 mm) and a maturity range (MR; Lm75%-Lm25%) equal to 0.83 mm (±0.03 mm) of carapace length.

Information about maximum observed length, size at first maturity and recruitment size are reported in Table 2.2-1 and in Figure 2.2-1.

The sex ratio of commercial catches evidenced the prevalence of males in the size class from 16 to 18 mm and from 23 to 25 mm, while from 27 mm onwards the proportion of females was dominant.

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			45 mm	**Recruitment season**	March – December
Size at first maturity			18 mm	**Spawning area**	Offshore of eastern and western coast of the entire Adriatic Sea with a relatively higher probability on the eastern side both in GSA 17 and GSA 18.
Recruitment size to the fishery			=< 14 mm	**Nursery area**	Nuclei of recruit aggregations distributed in omogenous way in both GSA 17 and GSA 18, but more relevant along the eastern side.

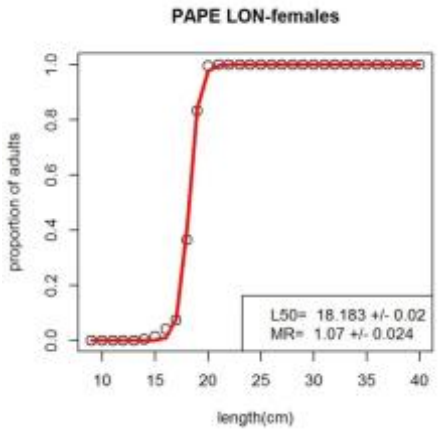


Figure 2.2-1 Maturity ogive for P. longirostris females, binomial GLM on 2014 DCF data.

For the assessment a vector natural mortality estimated by Chen & Watanabe method for sex combined. The vector of proportion of mature individuals by age has been derived slicing the maturity ogive by length with the von Bertalanffy coefficients for sex combined reported above. LFDA (FAO package) algorithm has been used for the age slicing.

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

Size/Age	Natural mortality	Proportion of matures*
0	*1.75*	0.69
1	*0.94*	1
2	*0.75*	1
3	*0.67*	1

**the proportion of mature individuals is calculated in the middle point of the age class (i.e. 0.5, 1.5, 2.5 and 3.5)*

Table 2.2-3 Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	**L_∞**	mm			45	
	K	$Year^{-1}$			0.6	
	t_0	Year			-0.2	
	Data source					
Length weight relationship	**a**	mm; g			0.0019009	
	b	mm; g			2.6064	
	M (scalar)					
	sex ratio (% females/total)	0.5				

3 Fisheries information

3.1 Description of the fleet

The Southern Adriatic sea makes a substantial contribution to national fishery production, with an input comparable to that of the Strait of Sicily, accounting for about 13% (Cataudella S. & Spagnolo M., 2011). The fleet data are referred to the whole GSA and are from the GFCM Task 1 Statistical Bulletin 2010.

Considered the species caught in terms of landings and incomes of the Italian bottom trawl fleet operating in GSA 17 on the muddy bottoms of continental shelf the *P. longirostris* is not among the most important target species (*M. merluccius*, *N. norvegicus*, *S. mantis*, *S. officinalis*, *P. kerathurus* and *Mullus spp.*)[2] (Figure 3.1-1).

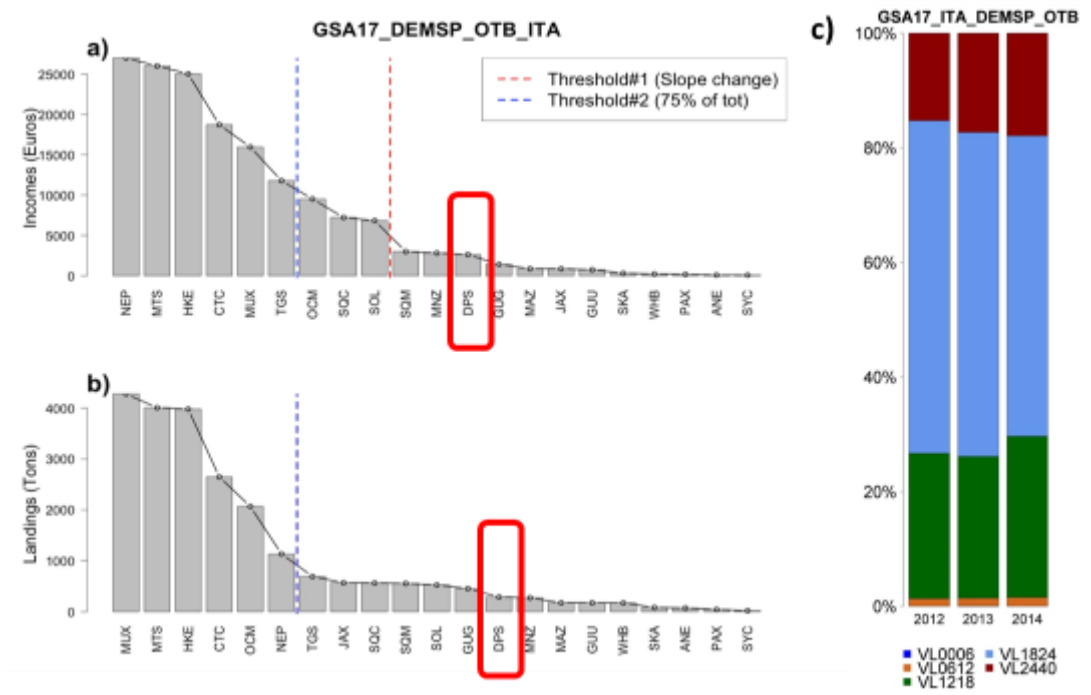


*Figure 3.1-1 Cumulative percentage for the GSA17_ITA_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line blue line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014) and the red line the slope change. Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.*

In the cumulative percentage in terms of landings and income of the bottom trawl fleet operating in GSA 17 in Croatian waters on the muddy bottoms of continental shelf the *P. longirostris* is one of the most important target species (*M. merluccius*, *P. longirostris*, *N. norvegicus*, *M. barbatus* and *Eledone spp*) (Figure 3.1-2).

[2] Scientific, Technical and Economic Committee for Fisheries (STECF) – Landing Obligation - Part 6 (Fisheries targeting demersal species in the Mediterranean Sea) (STECF-15-19) 2015.

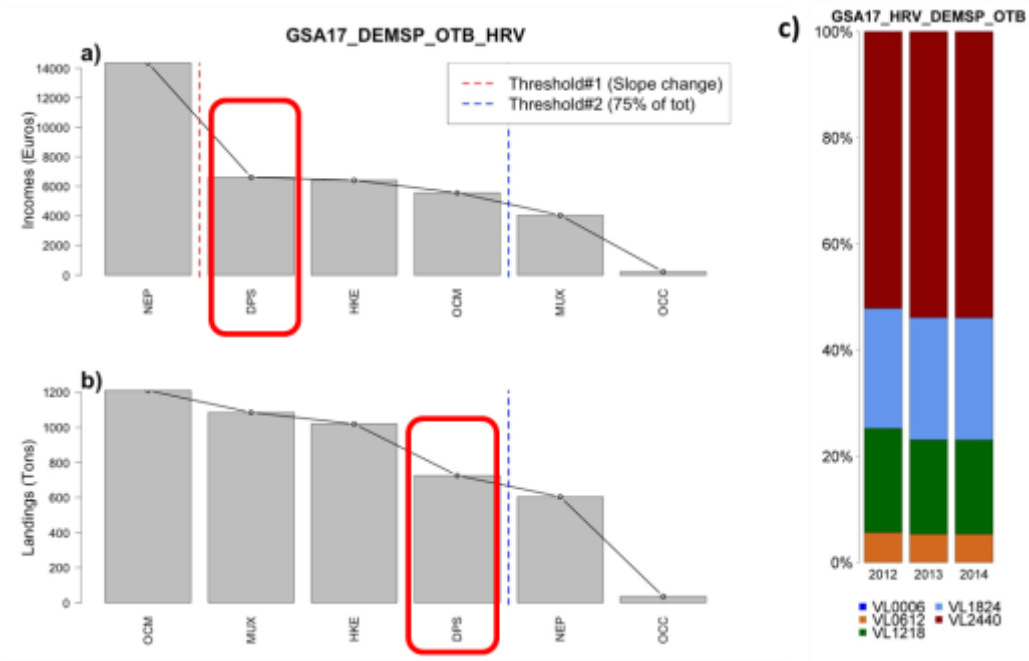


*Figure 3.1-2 Cumulative percentage for the GSA17_HRV_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014) and the red line the slope change. Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment*

Deep-water pink shrimp is also among the species characterizing bottom trawl fleets operating on the muddy bottoms of continental shelf in the Southern Adriatic (GSA 18), as it is among the 75% of the total, considering both landings and incomes of the fleet (Figure 3.1-3).

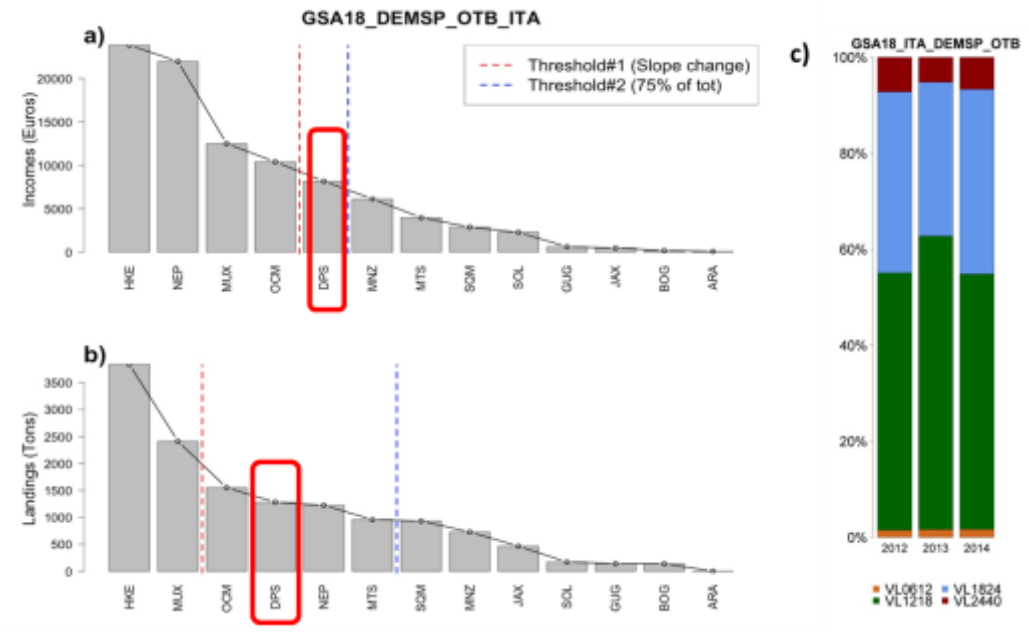


*Figure 3.1-3 Cumulative percentage for the GSA18_DEMSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014) and the red line the slope change. Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.*

For bottom trawl fleets operating on the muddy bottoms of continental shelf and slope in the Southern Adriatic (GSA 18) deep-water pink shrimp is one of the three species at the top of the list of species

characterizing the fishery (Figure 3.1-4).

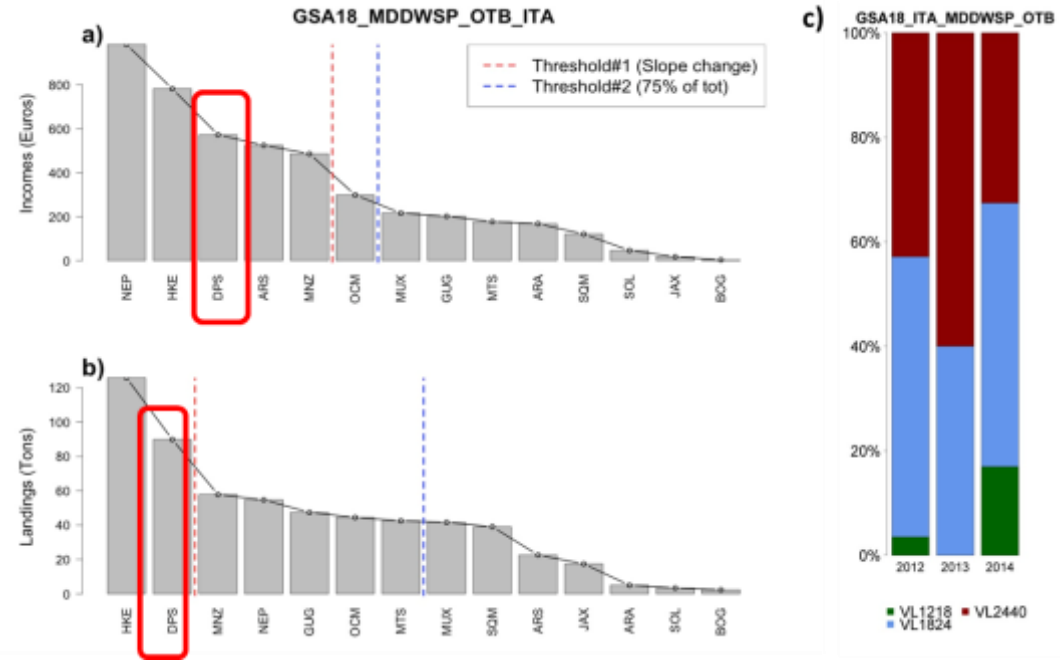


*Figure 3.1-4 Cumulative percentage for the GSA18_MDDWSP_OTB, in terms of value in Euros (a) and volume in kg (b), of the species landed. The vertical line represents the 75 % cumulative percentage (DCF data, average values of the years 2012-2014) and the red line the slope change. Percentage of GT*days at sea, proxy value of the fishing effort (c), by year and fleet segment.*

In the following table the description of the operational unit according to DCF classification is reported.

Table 3.1-1: Description of operational units exploiting the stock.

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1	ITA	18	D – Trawls (6-12 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 2	ITA	18	E – Trawls (12-24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 3	ITA	18	F – Trawls (>24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 4	MNE	18	D – Trawls (6-12 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 5	MNE	18	E – Trawls (12-24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 6	ALB	18	D – Trawls (6-12 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 7	ALB	18	E – Trawls (12-24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 8	ALB	18	F – Trawls (>24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 9	ITA	17	D – Trawls (6-12 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 10	ITA	17	E – Trawls (12-24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 11	ITA	17	F – Trawls (>24 m)	03 – Trawls	33 – Demersal shelf species	DPS
Operational Unit 12	HRV	17		03 – Trawls	33 – Demersal shelf species	DPS

Landings and discard data in the table 3.1-2 below reported are referred to the year 2015.

Table 3.1-2: Catch, bycatch, discards and effort by operational unit in the reference year (2015).

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)
ITA 18 Operational Units 1+2+3	472	651 T		14 T		
ALB Operational Units 6+7+8	187	291 T				
MNE Operational Units 4+3	20	31 T				
ITA 17 Operational Units 9+10+11		279 T		37 T		
HRV Operational Units 12		421 T		55 T		
Total		1673 T		106 T		

Figure 3.1-5 Effort data (nominal effort) for western side in GSA 17 (DCF data).

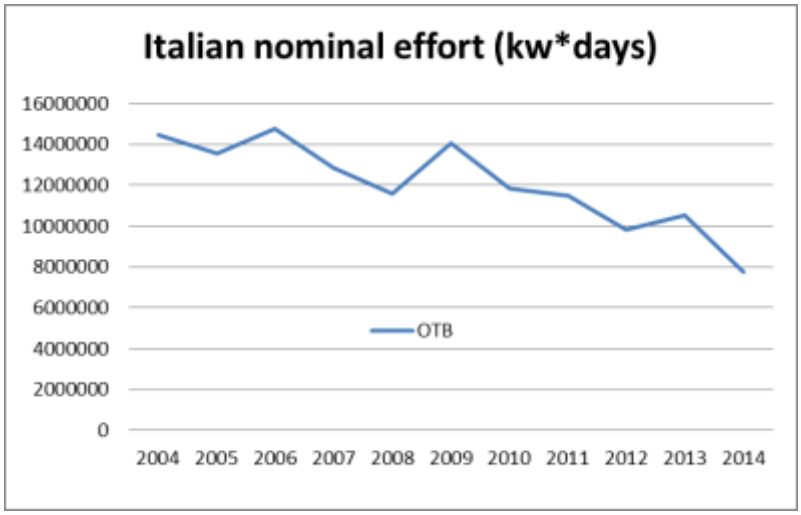


Figure 3.1-6 Effort data (nominal effort) for western side in GSA 18 (DCF data).

3.2 Historical trends

Available time series for the deep-water pink shrimp landings for the study area (Table 3.2-1) consisting of 18 years (1998-2015), and not complete for all countries in question. However, several assumptions have been made in order to overcome these limits.

Production data are from DCF for Italy and Croatia and from a pilot study within a framework of the AdriaMed project and the National Statistics Bureau for east side (Albania and Montenegro) and from official statistics FISHSTAT for the years not available in the DCF. Landings in Albania were based on export data, which was assumed to equal 64% of the total catch (FAO Yearbook of Fishery Statistics). In case of lack of data even in official statistics landings from 1998 to 2007 were assumed to be the average of the first earliest three available years in the time series (in case of Albania, Montenegro and Croatia).

The landing data for Montenegro 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.

The reduction of landings observed in 2011 continued, and was even more pronounced in 2012, marking the lowest point in the time series, together with the second lowest point in the time series in 1998. From 2013 there was an increase in landings with a positive trend until the last years (2015) (Figure 3.2-1).

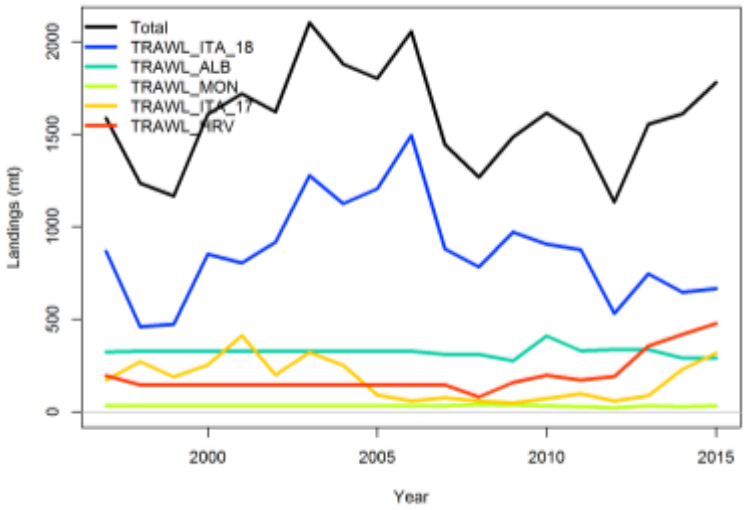


Figure 3.2-1 *Landing data by year and country.*

Table 3.2-1. Landing data for GSA 17 and GSA 18 by year and country.

	ITA 18 Operational Units 1+2+3	ALB Operational Units 6+7+8	MNE Operational Units 4+3	ITA 17 Operational Units 9+10+11	HRV Operational Units 12	Total
1998	450	326	33	251	128	1188
1999	464	326	33	175	128	1126
2000	835	326	33	234	128	1555
2001	788	326	33	381	128	1655
2002	903	326	33	185	128	1575
2003	1253	326	33	297	128	2037
2004	1104	326	33	231	128	1822
2005	1181	326	33	84	128	1752
2006	1465	326	33	54	128	2006
2007	863	309	33	70	128	1403
2008	766	309	39	54	71	1239
2009	939	275	36	44	138	1433
2010	888	409	32	65	174	1568
2011	870	328	27	92	151	1468
2012	523	335	22	53	169	1101
2013	734	335	31	84	315	1499
2014	638	291	28	202	369	1528
2015	651	291	31	279	421	1673

3.3 Management regulations

In Italy management regulations are based on technical measures, closed number of fishing licenses for the fleet and area limitation (distance from the coast and depth). In order to limit the over-capacity of fishing fleet, the Italian fishing licenses have been fixed since the late eighties and the fishing capacity has been gradually reduced. Other measures on which the management regulations are based regards technical measures (mesh size), minimum landing sizes (EC 1967/06) and seasonal fishing ban, that in southern Adriatic has been mandatory since the late eighties.

In 2008 a management plan was adopted, that foresaw the reduction of fleet capacity associated with a reduction of the time at sea. Two biological conservation zone (ZTB) were permanently established in 2009 (Decree of Ministry of Agriculture, Food and Forestry Policy of 22.01.2009; GU n. 37 of 14.02.2009) along the mainland, offshore Bari (180 km^2, between about 100 and 180 m depth), and in the vicinity of Tremiti Islands (115 km^2 along the bathymetry of 100 m) on the northern border of the GSA where a marine protected area (MPA) had been established in 1989. In the former only the professional small scale fishery using fixed nets and long-lines is allowed, from January 1st to June 30th, while in the latter the trawling fishery is allowed from November 1st to March 31 and the small scale fishery all year round. Recreational fishery using no more than 5 hooks is allowed in both the areas. Since June 2010 the rules implemented in the EU regulation (EC 1967/06) regarding the cod-end mesh size and the operative distance of fishing from the coasts are enforced.

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.

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					
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 MEDITS trawl survey in GSA 17

The sampling design is random stratified with number of haul by stratum proportional to stratum surface.
Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Hauls noted as valid were used only, including stations with no catches (zero catches are included).
The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). The variation of the stratified mean is then expressed as coefficient of variation respect to the mean.

4.1.1 Brief description of the direct method used

The sampling design is random stratified with number of haul by stratum proportional to stratum surface.

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Hauls noted as valid were used only, including stations with no catches (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). The variation of the stratified mean is then expressed as coefficient of variation respect to the mean.

Direct methods: trawl based abundance indices

Table 4.1.1-1: Trawl survey basic information

Survey	MEDITS	**Trawler/RV**	AND and BIO
Sampling season	Summer		
Sampling design	random stratified design with strata identified according to depth and number of haul by stratum proportional to stratum surface		
Sampler (gear used)	GOC 73		
Cod –end mesh size as opening in mm	20 mm		
Investigated depth range (m)	10-500 m		

Table 4.1.1-2: Trawl survey sampling area and number of hauls

Stratum	Total surface (km²)	Trawlable surface (km²)	Swept area (km²)	Number of hauls
10 – 50 m	29308			71
50 – 100 m	33335			85
100 – 200 m	22175			69
200 – 500 m	6309			18
500 – 800 m	0			0
Total (10 – 800 m)	91123			243

The haul positions are represented in the maps below.

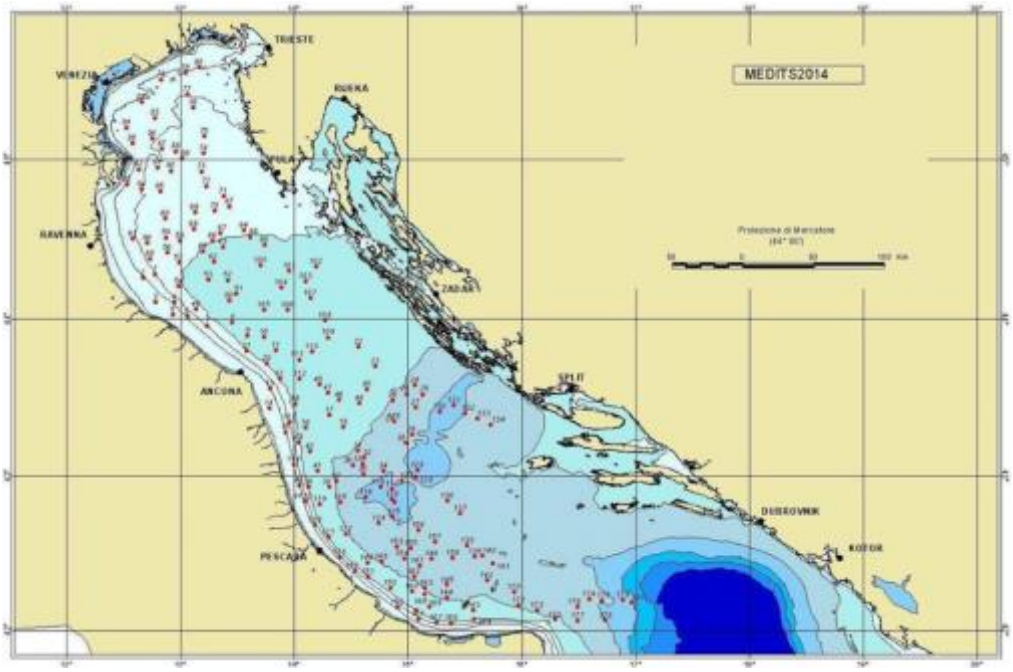


Figure 4.1.1-1 Map of MEDITS haul positions in the GSA 17 of Italian and international waters.

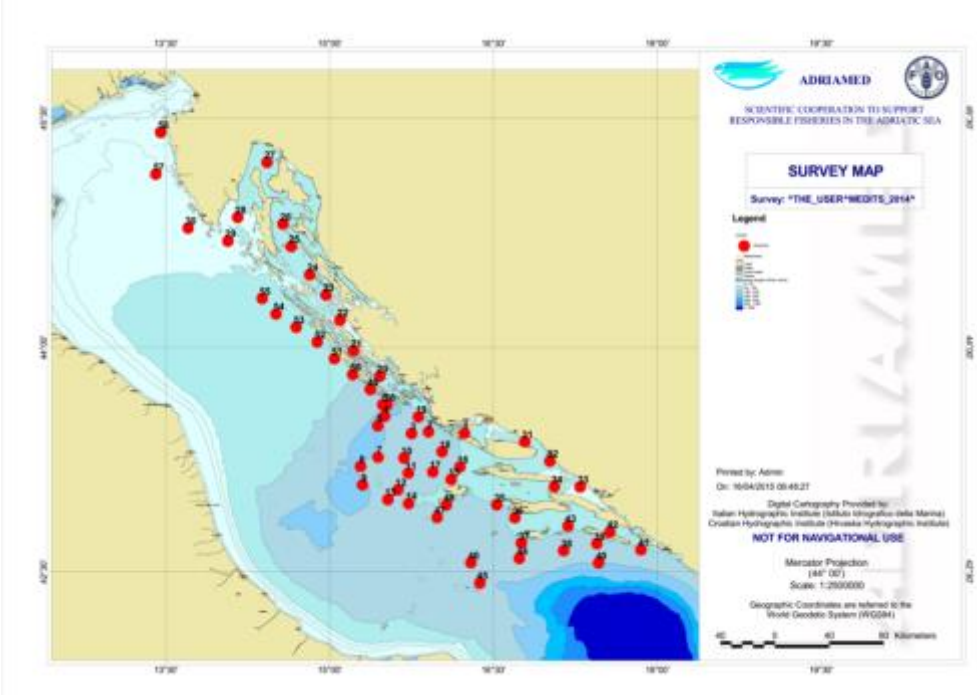


Figure 4.1.1-2 Map of MEDITS haul positions in the GSA 17 of Croatian territorial waters.

The abundance indices and the associated coefficient of variation for 2015 are reported in the table below.

Table 4.1.1-3: Trawl survey abundance and biomass results

Depth Stratum	Years	kg per km^2	CV or other	N per km^2	CV or other
10 – 50 m	2015	0		0	
50 – 100 m	2015	0.39	21.53	77.14	20.78
100 – 200 m	2015	8.13	14.17	1745.38	18.2
200 – 500 m	2015	12.07	18.89	1567.88	17.33
Total (10 –500 m)	2015	2.96	10.93	561.49	14.21

The number are standardised to the square km but not raised to the overall area assuming the same catchability.

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

Slicing method

The maturity scale used for the maturity stages of this species is MEDITS scale (Medits Handbook 2013, version 7).

Table 4.1.1-4: Trawl survey results by length class

N/km2 (sex combined) by Length class [mm]	Year													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.2	0.1	0.2	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
8	0.4	0.4	0.3	2.7	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.3
9	0.4	3.9	2.6	4.3	0.2	0.4	0.1	0.0	0.3	0.1	1.9	0.0	0.0	1.8
10	0.7	5.9	3.2	6.2	1.4	1.2	0.2	0.2	0.4	0.2	1.8	0.1	0.2	3.6
11	3.0	8.4	6.0	6.4	0.5	2.0	0.3	0.4	1.4	1.3	2.7	0.2	0.8	6.2
12	4.4	13.7	4.2	8.1	1.7	4.6	0.9	0.5	1.9	0.8	3.0	0.5	1.7	12.1
13	7.2	13.9	4.4	5.3	2.0	4.4	0.8	0.7	1.7	1.1	2.5	0.5	2.6	17.0
14	11.9	21.2	4.1	6.2	3.2	6.1	3.9	2.1	1.6	1.0	3.0	1.9	5.7	31.2
15	16.7	16.4	2.9	5.1	1.8	5.2	3.2	1.5	0.6	1.2	2.8	2.0	9.0	34.4
16	13.9	23.0	4.5	6.7	5.6	5.7	5.7	3.0	0.6	0.7	5.0	2.7	13.8	33.6
17	12.0	20.1	3.9	9.1	9.1	3.2	5.9	2.2	0.6	0.6	7.3	3.6	20.1	47.0
18	10.1	19.8	6.9	12.6	18.9	1.5	4.6	1.6	0.6	0.4	5.1	2.4	19.2	42.1
19	14.1	17.1	10.3	10.9	18.3	2.5	5.0	1.3	0.4	0.0	5.0	2.7	18.7	35.1
20	23.6	21.5	17.7	13.7	19.1	3.0	5.9	2.6	0.4	0.6	1.6	3.5	13.5	25.5
21	35.0	19.4	11.3	14.2	15.8	5.2	9.9	2.4	1.1	2.4	1.3	4.3	15.2	21.9
22	39.4	23.9	11.4	20.7	27.1	8.3	12.2	3.3	5.2	5.6	3.3	6.8	19.2	25.2
23	27.0	19.3	10.0	14.1	22.1	7.6	13.7	3.0	7.1	6.1	1.9	6.7	21.1	28.1
24	24.2	26.1	13.5	21.0	35.5	12.4	7.8	3.3	12.4	5.0	2.6	8.8	16.2	28.8
25	25.4	20.6	15.8	24.5	30.2	14.7	6.7	3.3	8.3	4.2	5.0	5.2	14.4	29.7
26	23.6	30.9	17.9	26.9	30.5	19.0	9.7	4.2	8.6	5.5	8.6	5.7	9.9	22.2
27	16.6	19.3	18.4	22.5	29.1	18.4	10.7	5.1	9.3	4.3	6.2	6.2	9.3	29.8
28	17.5	24.0	16.0	17.8	26.1	15.2	9.4	4.9	6.6	5.1	7.1	6.3	6.7	28.1
29	11.1	15.2	11.8	10.8	19.3	9.2	8.8	3.4	4.7	1.9	4.2	5.3	5.6	20.3
30	6.7	21.1	17.4	13.6	16.7	13.3	4.6	2.9	2.9	1.6	2.6	4.4	4.9	15.3
31	4.4	21.9	13.9	14.4	17.7	11.4	3.5	2.4	2.5	1.1	2.6	2.1	3.5	7.5
32	5.7	22.2	14.0	10.5	12.1	11.0	3.4	3.1	1.7	1.2	2.3	1.1	3.7	6.3
33	3.5	9.9	10.6	11.2	7.1	4.7	2.8	1.9	1.1	1.0	1.4	1.7	1.1	2.8
34	1.9	10.2	12.5	9.3	5.9	5.6	2.6	2.7	1.9	0.9	0.4	0.9	1.5	2.6
35	0.8	7.2	13.1	7.0	4.5	6.8	1.7	2.0	0.8	0.2	0.4	1.1	0.6	0.7
36	0.5	4.9	9.0	6.0	4.4	3.8	0.9	1.2	0.4	0.5	0.7	0.4	0.0	1.0
37	0.7	2.3	8.0	4.7	5.7	6.0	0.1	1.9	0.2	0.0	0.8	0.2	0.3	1.0
38	1.8	1.8	5.7	1.7	2.4	4.1	0.1	1.1	0.1	0.2	0.3	0.2	0.1	0.3
39	0.2	1.1	4.5	2.1	2.8	2.6	0.1	0.2	0.1	0.0	0.2	0.0	0.2	0.1
40	0.0	0.9	3.9	1.2	2.5	0.9	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.1
41	0.0	0.2	1.2	0.3	1.1	0.1	0.1	0.3	0.0	0.0	0.2	0.0	0.0	0.0
42	0.0	0.7	1.0	0.7	0.2	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.4	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.3	0.4	0.1	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	364.6	489.2	314.0	353.4	402.0	220.3	145.3	69.1	85.6	55.0	94.0	87.3	238.8	561.5

Sex ratio by Length or Age class	Year		
	….	….	…..
Total			

The number are standardised to the square km but not raised to the overall area assuming the same catchability (=1).

Direct methods: trawl based Recruitment analysis

Table 4.1.1-5: Trawl surveys; recruitment analysis summary

Survey	**MEDITS**	**Trawler/RV**	**AND and BIO**
Survey season		Summer	
Cod –end mesh size as opening in mm		20	
Investigated depth range (m)		10-500 m	
Recruitment season and peak (months)			
Age at fishing-grounds recruitment			
Length at fishing-grounds recruitment			

Table 4.1.1-6: Trawl surveys; recruitment analysis results

Years	Area in km²	N of recruit per km²	CV or other
2002	91127	28.17	20.1
2003	91127	67.86	17.34
2004	91127	25.84	18.4
2005	91127	39.78	17.28
2006	91127	9.35	24.16
2007	91127	18.98	30.66
2008	91127	6.27	19.61
2009	91127	3.87	40.03
2010	91127	7.82	26.95
2011	91127	4.46	37.87
2012	91127	15.77	25.21
2013	91127	3.11	23.31
2014	91127	11.53	18.91
2015	91127	72.28	13.07

Direct methods: trawl based Spawner analysis

Table 4.1.1-7: Trawl surveys; spawners analysis summary

Survey	MEDITS	Trawler/RV	AND and BIO
Survey season			Summer
Investigated depth range (m)			10-500 m
Spawning season and peak (months)			

Table 4.1.1-8: Trawl surveys; spawners analysis results

Surveys	Area in km²	N (N of individuals) of spawners per km²	CV or other
2002	911127	293.86	16.66
2003	911127	362.28	15.39
2004	911127	279.77	16.05
2005	911127	292.83	21.38
2006	911127	376.92	19.59
2007	911127	187.35	26.39
2008	911127	124.13	21.65
2009	911127	58.62	20.48
2010	911127	80.43	18.51
2011	911127	48.5	22.67
2012	911127	65.27	24.37
2013	911127	75.9	17.24
2014	911127	191.43	12.33
2015	911127	374.27	12.89

4.1.2 Spatial distribution of the resources

In the MEDISEH project (DG MARE Specific Contract SI2.600741, call for tenders MARE/2009/05), nursery areas and spawner aggregations have been detected, mainly in the eastern part of the Adriatic Sea, along the Croatia and Albania coasts, where persistent spawning grounda are localized.

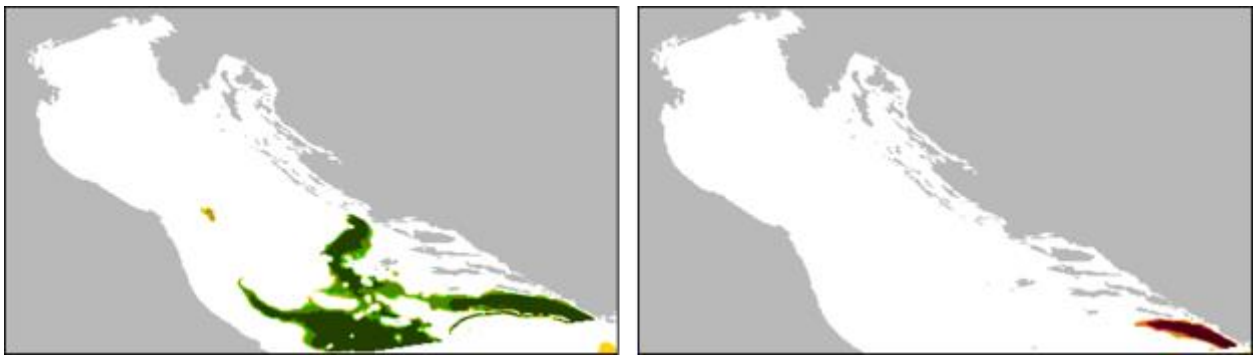


Figure 4.1.2-1 Position of persistent nursery (left) and spawning (right) areas of deep water pink shrimp in the GSA17.

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.

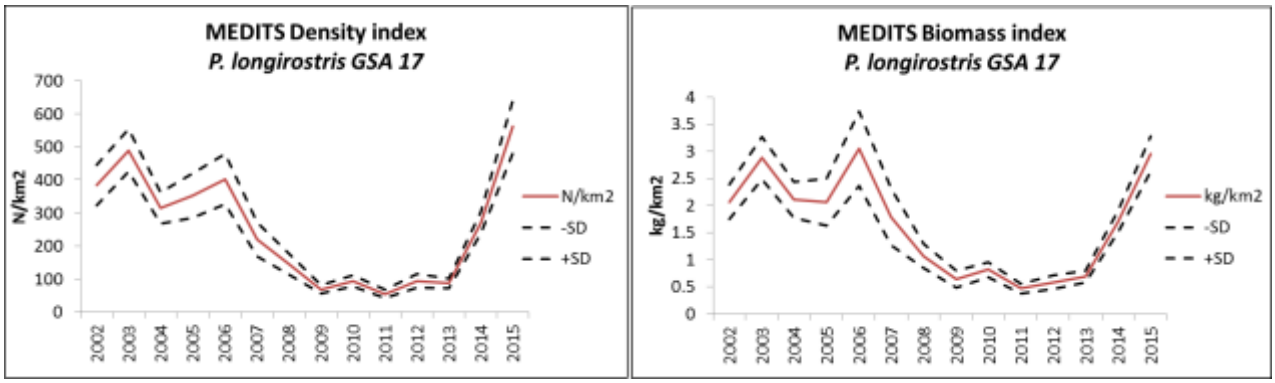


Figure 4.1.3-1Density and biomass MEDITS indices in GSA 17.

4.2 MEDITS trawl survey in GSA 18

The sampling design is random stratified with number of haul by stratum proportional to stratum surface.
Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Hauls noted as valid were used only, including stations with no catches (zero catches are included).
The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). The variation of the stratified mean is then expressed as coefficient of variation respect to the mean.

4.2.1 Brief description of the direct method used

The sampling design is random stratified with number of haul by stratum proportional to stratum surface.

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Hauls noted as valid were used only, including stations with no catches (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). The variation of the stratified mean is then expressed as coefficient of variation respect to the mean.

Direct methods: trawl based abundance indices

Table 4.2.1-1: 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 mm		
Investigated depth range (m)	10 – 800 m		

Table 4.2.1-2: Trawl survey sampling area and number of hauls

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

The haul positions are represented in the map below.

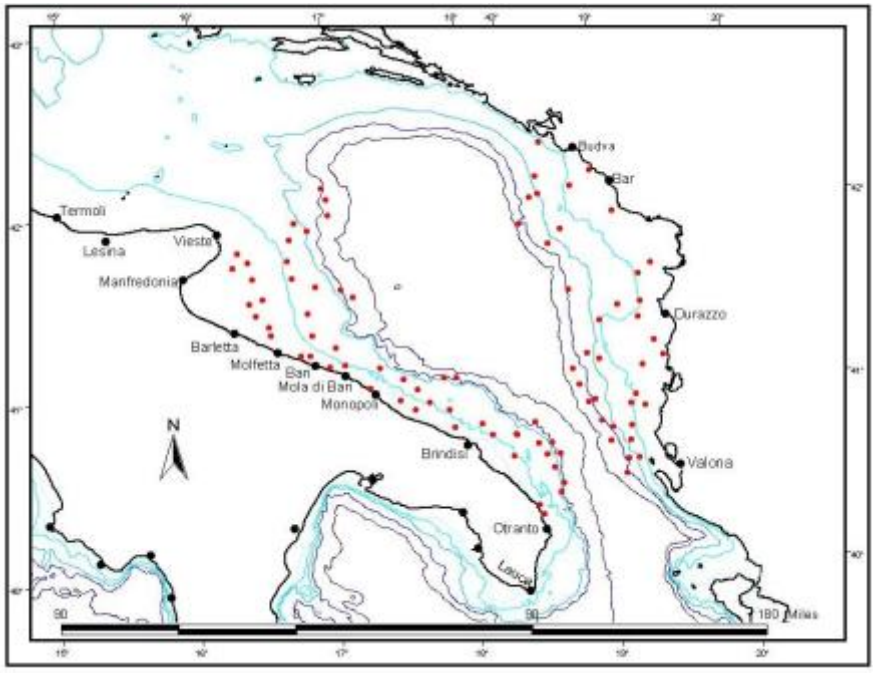


Figure 4.2.1-1 Map of MEDITS haul positions in the GSA 18.

The abundance indices and the associated coefficient of variation for 2015 are reported in the table below.

Table 4.2.1-3: Trawl survey abundance and biomass results

Depth Stratum	Years	kg per km²	CV or other	N per km²	CV or other
10 – 50 m	2015	0.12	85.15	14.00	86.79
50 – 100 m	2015	0.84	22.05	140.41	21.22
100 – 200 m	2015	0.36	33.02	50.14	25.65
200 – 500 m	2015	10.27	28.63	1348.68	30.39
500 – 800 m	2015	0.95	43.98	73.87	46.03
Total (10 – 800 m)	2015	2.16	22.70	282.88	24.03

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

Slicing method

The maturity scale used for the maturity stages of this species is MEDITS scale (Medits Handbook 2013, version 7).

Table 4.2.1-4: Trawl survey results by length class

N/km2 (sex combined) by Length class [mm]	Year																	
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.0
7	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.9	0.9	0.6	1.4	0.7
8	0.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.1	2.6	6.6	2.9	1.2	5.2	0.8
9	1.5	0.1	0.3	0.2	0.5	0.3	0.7	0.9	0.0	0.3	0.0	7.9	10.2	9.3	5.2	0.6	8.8	1.4
10	6.6	0.4	1.0	1.5	0.5	2.3	0.5	1.9	0.0	0.0	0.0	13.6	13.5	14.0	10.3	3.3	11.3	2.4
11	9.0	0.4	5.5	2.8	2.0	5.0	3.0	3.1	0.5	0.0	1.1	25.8	18.1	16.9	17.6	4.1	12.3	3.7
12	9.3	0.5	6.0	10.6	6.5	6.5	5.3	9.1	1.7	0.3	1.1	32.2	22.8	21.2	18.1	9.6	18.5	4.2
13	9.2	0.8	10.8	28.4	8.7	32.5	12.7	24.1	2.0	0.7	2.5	43.8	26.2	22.5	22.4	13.5	34.7	5.8
14	9.0	3.4	10.4	41.4	19.9	50.8	17.8	48.6	10.1	1.5	3.2	45.4	27.9	27.0	32.2	20.9	55.4	7.7
15	10.8	3.9	11.9	50.8	33.0	49.1	42.3	69.8	15.2	5.1	6.8	63.5	35.4	42.4	30.9	32.6	69.5	12.1
16	15.1	4.1	11.8	37.7	33.9	54.9	57.8	91.0	21.0	4.2	4.4	83.3	35.3	41.9	33.1	34.6	77.1	10.5
17	14.0	4.6	12.8	23.7	34.7	40.4	51.2	93.2	25.8	6.5	9.9	86.3	31.0	32.5	24.9	31.7	70.8	11.8
18	14.1	3.4	15.1	34.2	38.8	70.0	74.5	119.3	22.3	12.7	20.0	64.0	17.2	24.2	19.5	23.4	52.0	11.1
19	12.0	9.5	31.9	36.9	20.1	50.6	60.6	128.1	25.9	12.6	22.5	48.1	27.3	35.9	27.6	21.8	56.2	12.5
20	21.9	14.5	54.9	56.3	33.0	54.7	75.8	106.2	45.7	23.4	42.2	70.4	56.1	50.6	58.3	15.9	83.6	15.6
21	37.3	19.0	37.3	58.4	36.6	52.9	71.4	136.1	41.6	17.8	31.7	67.1	80.1	61.1	72.7	16.0	84.7	16.3
22	62.9	15.2	19.6	49.5	50.2	51.3	65.1	116.3	62.3	18.8	28.9	54.6	67.3	47.3	73.6	10.5	57.2	21.6
23	47.8	11.6	17.9	39.8	41.6	55.8	68.0	102.3	57.1	15.7	16.5	51.4	47.8	32.1	52.5	9.2	41.3	17.6
24	31.6	14.8	21.3	26.9	39.9	42.0	42.8	75.6	60.0	14.2	59.5	48.1	48.3	35.2	46.7	10.7	34.7	19.6
25	35.0	16.2	20.4	35.9	28.4	45.2	52.7	73.5	71.1	15.9	46.2	41.6	48.0	42.2	49.4	11.4	32.1	19.2
26	32.9	20.8	12.8	26.9	39.9	38.8	55.0	83.1	47.2	12.2	62.8	42.3	39.3	36.7	52.4	12.9	31.6	17.5
27	40.9	15.8	11.1	16.9	29.6	25.5	44.0	88.0	57.6	16.4	41.9	39.9	32.4	27.5	43.5	13.4	32.5	19.0
28	32.0	16.2	7.4	19.5	27.9	22.8	53.0	42.1	55.6	16.4	38.5	36.4	26.7	16.6	30.9	8.8	21.0	14.7
29	23.2	7.8	7.6	10.7	19.9	21.5	34.0	29.8	43.3	19.8	41.3	25.0	26.3	15.2	17.9	6.6	20.2	10.5
30	15.8	6.6	5.5	12.5	23.7	14.1	30.9	26.0	39.1	25.2	84.6	23.1	15.1	9.4	12.2	6.0	11.7	7.2
31	7.6	5.1	3.8	7.8	9.0	9.3	15.4	27.7	26.3	10.2	59.9	18.7	13.6	7.7	11.7	4.8	9.2	5.1
32	4.8	4.9	3.3	3.6	10.3	6.9	12.7	19.4	13.6	11.8	49.2	14.5	9.7	6.4	9.9	5.1	7.6	4.6
33	3.9	3.2	2.8	1.2	6.5	9.7	6.7	6.1	10.3	8.7	33.5	9.3	6.8	6.2	4.5	4.8	2.2	3.1
34	3.2	2.8	1.3	0.8	2.0	5.2	3.1	5.8	11.4	5.1	31.9	7.5	5.8	5.9	2.2	2.2	2.9	2.7
35	3.2	2.0	0.1	0.9	2.2	3.2	0.5	5.2	6.8	9.3	29.8	4.5	5.5	2.2	1.1	2.2	2.3	2.1
36	1.4	0.2	0.7	0.1	0.3	2.1	1.2	3.1	4.3	9.2	52.9	1.7	3.8	0.9	0.6	1.2	1.0	1.1
37	0.7	0.9	0.8	0.0	0.4	0.2	0.2	2.2	4.2	5.8	16.8	1.7	2.0	0.2	0.2	0.4	0.9	0.5
38	0.7	0.2	0.0	0.6	1.4	1.2	1.2	2.9	0.3	2.0	5.8	0.6	1.7	0.5	0.1	0.2	1.4	0.0
39	0.1	0.1	0.2	0.0	0.1	0.7	0.0	0.0	1.8	1.1	5.3	0.9	1.4	0.2	0.0	0.0	0.1	0.2
40	0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.5	1.9	14.5	0.0	0.9	0.1	0.0	0.1	0.1	0.0
41	0.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.9	1.3	0.2	0.3	0.0	0.0	0.1	0.0	0.0
42	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	1.9	0.2	0.6	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.8	0.2	0.1	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.9	0.0	0.3	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	519	209	346	637	602	826	960	1540	785	316	881	1075	808	704	786	340	952	283

Sex ratio by Length or Age class	Year		
	….	….	…..
Total			

The number are standardised to the square km but not raised to the overall area assuming the same catchability (=1).

Direct methods: trawl based Recruitment analysis

Table 4.2.1-5: Trawl surveys; recruitment analysis summary

Survey	**MEDITS**	**Trawler/RV**	**PEC**
Survey season		summer	
Cod –end mesh size as opening in mm		20	
Investigated depth range (m)		10-800	
Recruitment season and peak (months)		All year round (autumn-spring)	
Age at fishing-grounds recruitment		0	
Length at fishing-grounds recruitment		~7 mm CL	

Table 4.2.1-6: Trawl surveys; recruitment analysis results (<=14 mm)

Years	**Area in km²**	**N of recruit per km²**	**CV or other**
1996	29008	63	33.4
1997	29008	13	35.3
1998	29008	45	67.1
1999	29008	6	28.1
2000	29008	34	25.3
2001	29008	85	16.3
2002	29008	38	24.7
2003	29008	98	27.9
2004	29008	40	21.6
2005	29008	88	18.5
2006	29008	14	31.6
2007	29008	3	38.3
2008	29008	8	40.6
2009	29008	170	38.2
2010	29008	122	26.7
2011	29008	123	25.3
2012	29008	109	23.7
2013	29008	54	32.7
2014	29008	148	32.6
2015	29008	27	33.3

Recruitment follows a quasi-continuous pattern with main peaks in spring and autumn. Recruits mainly occur between 100 and 200 m depth. Size of recruits ranged between 14 mm and 19 mm CL.

The threshold size (14.5 mm) to extract recruitment indices has been derived by the separation of length frequency distribution (Batthacharya method) applied to the years when the first mode was well detectable. The abundance indices of individuals <=14 mm has been considered has recruitment index.

Indices are related to the total area (N/Km^2, not raised to the total area).

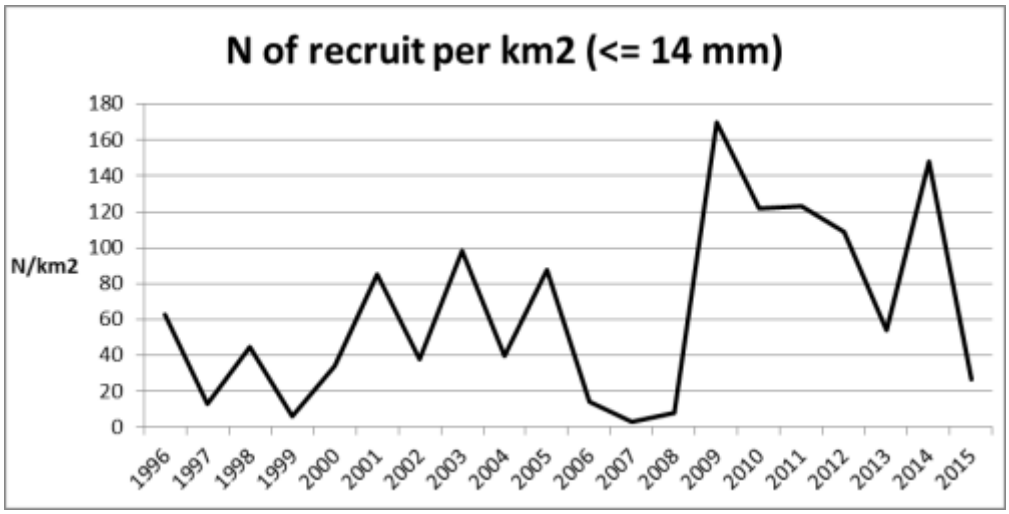


Figure 4.2.1-2 Abundance indices (N/Km2) of individuals <=14 mm.

Direct methods: trawl based Spawner analysis

Table 4.2.1-7: Trawl surveys; spawners analysis summary

Survey	**MEDITS**	**Trawler/RV**	**PEC**
Survey season			summer
Investigated depth range (m)			10-800
Spawning season and peak (months)			All year round (April-May; September-October)

Table 4.2.1-8: Trawl surveys; spawners analysis results

Years	**Area in km²**	**N of spawners per km²**	**CV or other**
1996	29008	705	23.5
1997	29008	229	18.8
1998	29008	434	19.5
1999	29008	191	15.3
2000	29008	276	18.6
2001	29008	439	15.6
2002	29008	462	12.8
2003	29008	584	18.0
2004	29008	769	21.8
2005	29008	1199	15.7
2006	29008	709	15.4
2007	29008	297	23.6
2008	29008	853	21.5
2009	29008	672	18.3
2010	29008	584	18.9
2011	29008	464	18.9
2012	29008	588	21.1
2013	29008	188	21.8
2014	29008	586	22.5
2015	29008	222	24.2

P. longirostris is a sequential spawners, spawning all year round with peaks in April-May and September-October. Adult aggregations of females are mainly located in the eastern part of the GSA18, along the Albania coast.

Indices are related to the total area (N/km^2, not raised to the total area).

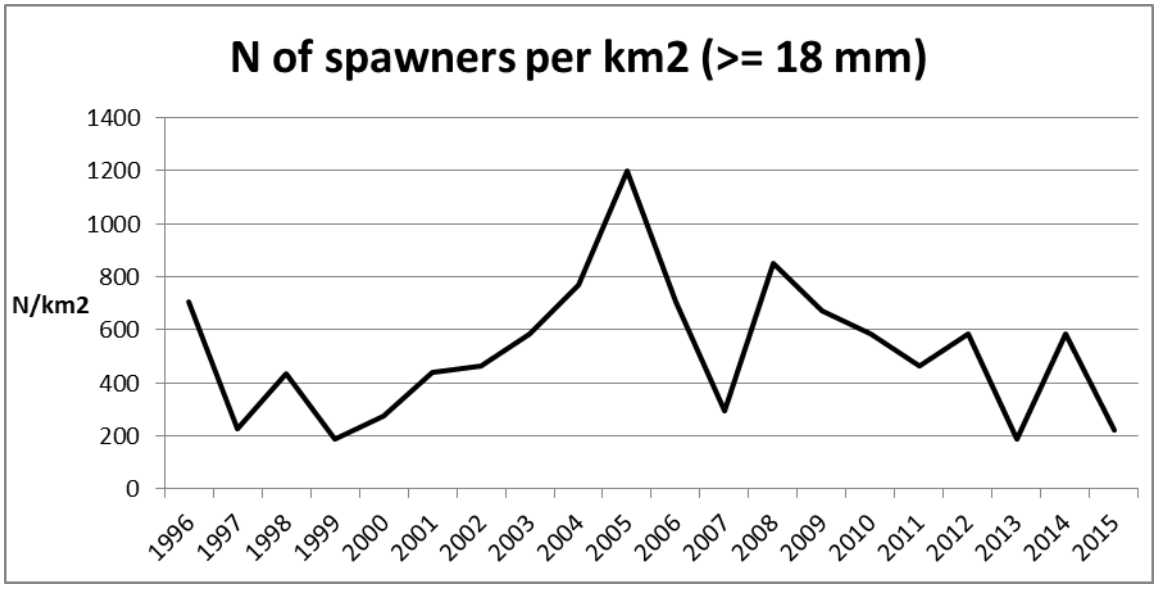


Figure 4.2.1-3 Abundance indices (N/Km2) of individuals >=18 mm.

4.2.2 Spatial distribution of the resources

In the MEDISEH project (DG MARE Specific Contract SI2.600741, call for tenders MARE/2009/05), nursery areas and spawner aggregations have been detected, mainly in the eastern part of the Adriatic Sea, along the Croatia and Albania coasts, where persistent spawning grounds are localized.

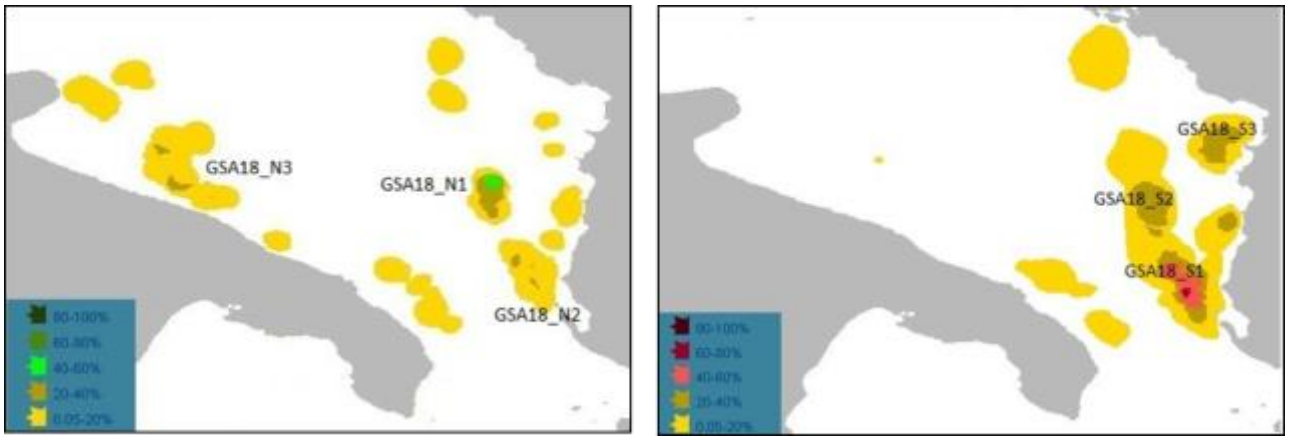


Figure 4.2.2-1 Position of persistent nursery (left) and spawning (right) areas of deep water pink shrimp in the GSA18.

4.2.3 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.

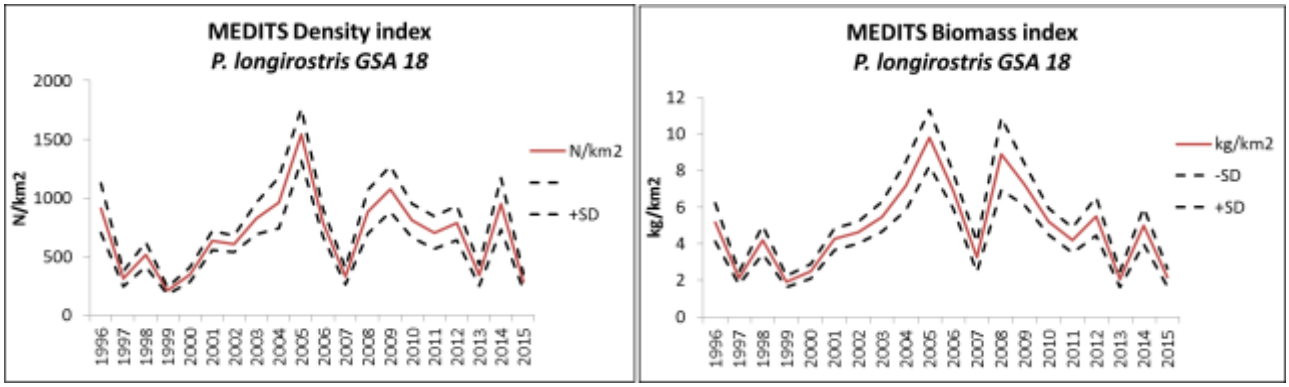


Figure 4.2.3-1 Density and biomass MEDITS indices in GSA 18.

5 Ecological information

5.1 Protected species potentially affected by the fisheries

This analysis has not been carried out.

5.2 Environmental indexes

None environmental index used.

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 Stock Synthesis 3 (SS3)

An attempt to carry out the assessment by means of SS3 model has been done to explore the exploitation of each fishery targeting the stock, not possible with XSA model.

The Stock Synthesis (SS3, Method and Wetzel, 2013) assessment program provides a statistical framework for calibration of a population dynamics model using a multi-fleet approach. It is designed to include different information from fishery and survey data, as well as to consider different subareas within the same stock. The model allows to work by length or by age and to assume different selectivity patterns for the different fleet exploiting the stock. In the model the selectivity is a combination of availability and vulnerability.

SS3 is based on ADMB C++ software, allowing to easily work with large databases, as well as to simultaneously estimate a number of parameters. A wide number of options are available for modelling the selectivity patterns of the different fishing gears. Moreover, time varying selectivity can be defined in order to take into account annual changes in vulnerability and availability of the stock.

6.1.1 Model assumptions

The model built in SS3 for this stock has the following features:

- Length based;
- Discard included in catch data;
- sex combined;
- 1 area;
- annual time step;
- 5 commercial fleets: Italian trawlers in GSA18, Italian trawlers in GSA17, Albanian trawlers, Montenegrin trawlers and Croatian trawlers
- 2 survey fleets: MEDITS whole GSA 18 (ITA, ALB, MON) and MEDITS whole GSA 17 (ITA and HRV)
- time-varying selectivity for all the commercial fleets and for the survey;
- logistic selectivity for the two survey sand all commercial fleets;
- Albanian trawlers with the same selectivity of Italian trawlers;
- no stock-recruitment relationship (annual scalar recruitment).

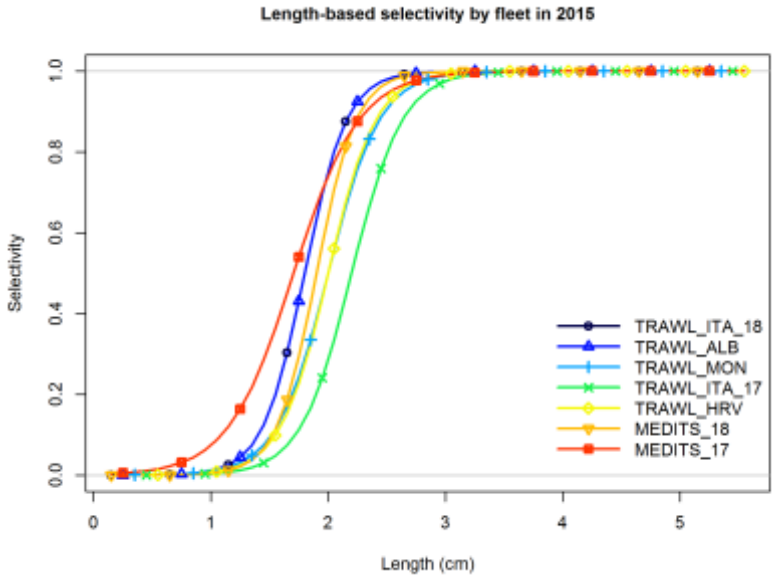
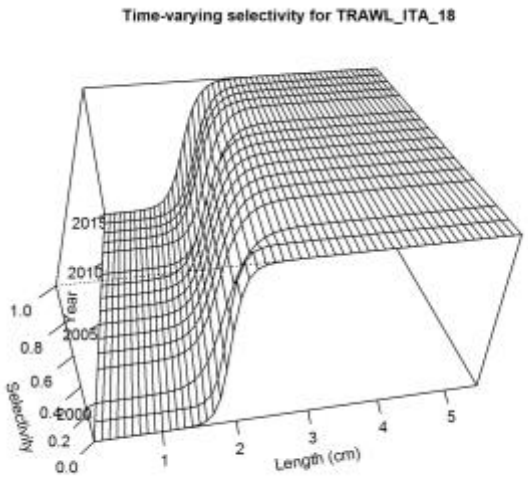
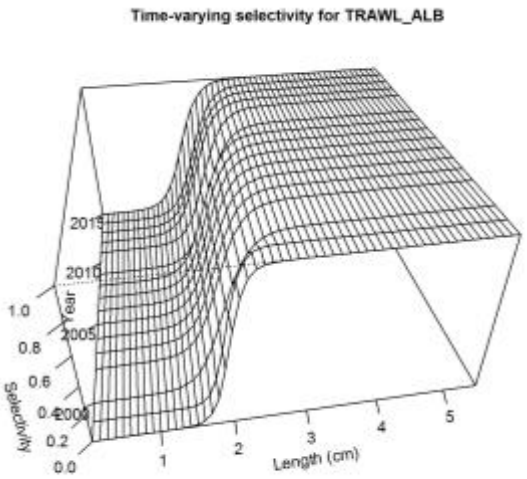
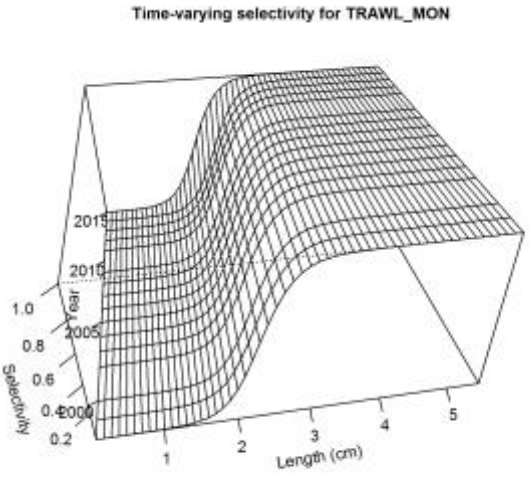
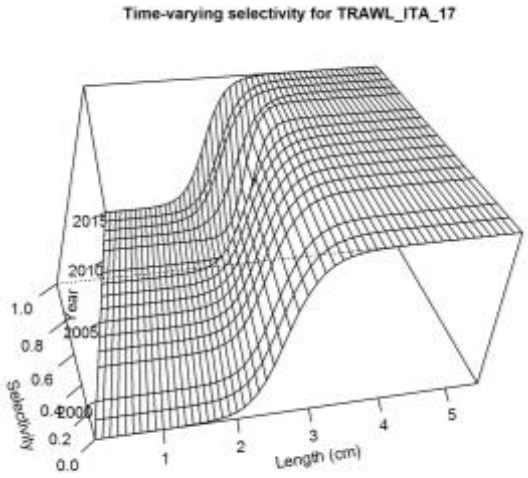


Figure 6.1.1-1 Length selectivity estimated by SS3 in 2015.









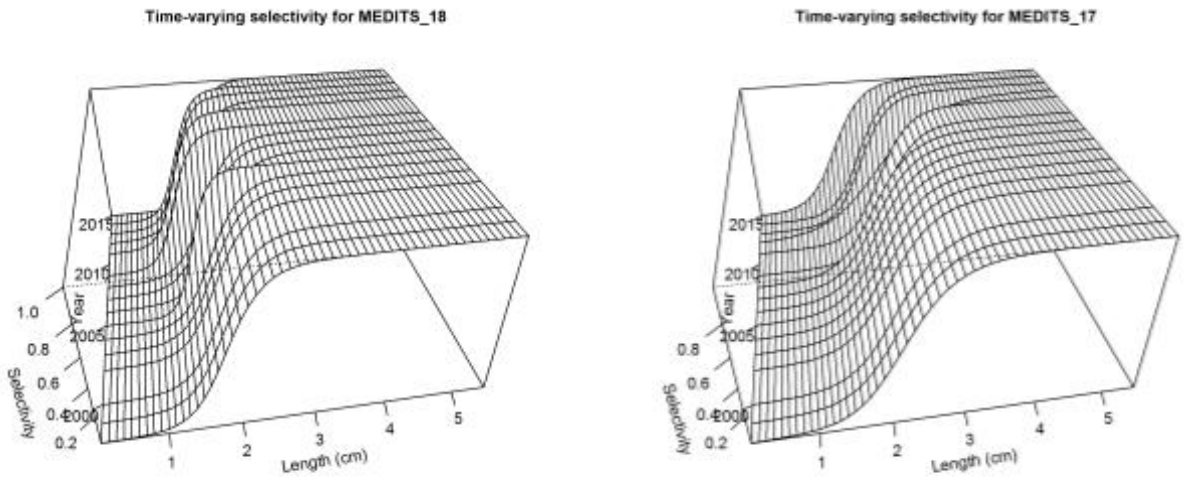


Fig. 6.1.1-2 Time varying length selectivity estimated by SS3 by fleet.

For Italian trawlers in GSA 18 the size at which selectivity is 1, ranges between 1.8 and 2.1 cm along the years, for Montenegrin trawlers between 2 and 2.3 cm, for Italian trawlers in GSA 17 between 2.2 and 2.8 cm and for Croatian trawlers between 2 and 2.4 cm. The size at which selectivity is 1 for MEDITS in GSA 18 ranges between 1.4 and 2 cm along the years and in GSA 17 between 1.7 and 2.4 cm.

6.1.2 Scripts

The version 3 of Stock Synthesis has been used to carry out the assessment (SS3safe_Win64.exe). The input and files of the final run have been uploaded on the GFCM Extranet.

6.1.3 Input data and Parameters

For GSA 18 (Italy) discards data of 2009, 2010, 2011, 2012, 2013, 2014 and 2015 were available and have been included in the assessment. The proportion of the discards of deep water pink shrimp in the GSA 18 (Italy) ranged from about 0.6% (2011) to about 3.2% (2009). Discard data not available (from 1998 to 2008) have been estimated on the basis of the average discard ratio in 2009-2011.

For GSA 17 (Italy) discards data of 2011, 2013, 2014 and 2015 were available and have been included in the assessment. The proportion of the discards of deep water pink shrimp in the GSA 18 (Italy) ranged from about 1.8 % (2013) to about 12.2% (2014). Discard data not available (from 1998 to 2010 and 2012) have been estimated on the basis of the average discard ratio in 2011 and 2013-2015. For Croatian side discards data available and included in the assessment are only related to 2015. The proportion of the discards of deep water pink shrimp in Croatia was estimated as 11.5 % (2015). Discard data not available (from 1998 to 2014) have been estimated on the basis of the available discard ratio in 2015.

Sensitivity analysis with different hypothesis of natural mortality (Prodbiom, Chen and Watanabe and Gislason methods) has been carried out.

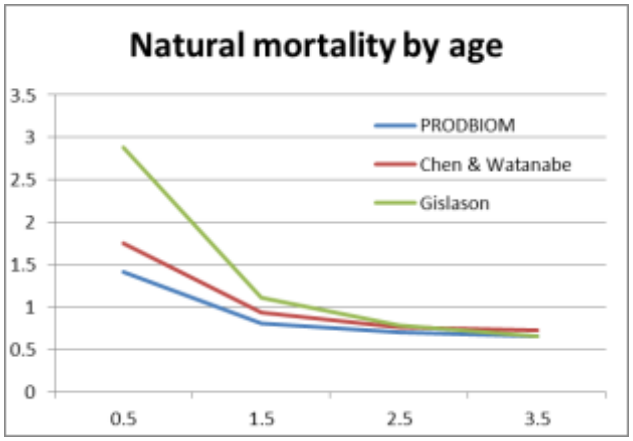


Fig. 6.1.3-1 Natural mortality by age and method.

Tab. 6.1.3-1 Italian trawlers catch (landing and discard) in GSA 18 LFDs.

Thousands (sex combined) by Length class [mm]	Year								
	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.1	-	0.0	0.0	0.4	0.0	3.8	0.0	0.9
8	0.0	-	0.0	0.0	0.0	0.0	4.7	0.0	3.5
9	10.9	-	8.3	0.0	33.8	13.6	27.8	4.6	15.0
10	25.6	-	12.2	0.0	70.7	15.8	73.1	31.9	93.8
11	42.3	-	33.0	5.1	113.6	85.9	263.5	80.4	218.4
12	104.7	-	81.1	34.0	258.8	86.8	376.2	202.1	506.5
13	156.2	-	189.8	111.1	327.1	123.1	555.9	551.8	962.6
14	350.3	-	599.1	293.0	625.5	324.9	1112.4	1314.3	1885.3
15	903.7	-	1217.3	902.6	777.4	973.9	2975.4	3210.5	3531.7
16	3788.8	-	2458.9	1815.7	1249.4	2259.7	6508.1	5717.8	5879.5
17	6159.2	-	4085.9	3223.4	1559.7	3533.0	8552.0	6951.9	6971.1
18	7192.7	-	5422.1	4100.2	2396.1	4679.8	8896.6	6863.8	7639.6
19	6866.7	-	6970.2	5782.3	3633.7	5346.4	7297.7	6318.3	8823.0
20	7529.4	-	8981.0	7775.1	5730.3	6760.0	8940.1	7454.7	9700.1
21	9122.5	-	12300.8	10302.4	7024.6	6517.3	10130.6	10593.2	9728.3
22	12936.7	-	13045.6	10508.9	6551.5	6092.5	9636.9	9668.7	8595.4
23	12577.1	-	12106.2	10267.0	7564.4	5238.5	7438.0	6816.9	6941.0
24	9207.6	-	10392.3	8866.0	8877.1	4600.5	6264.5	4235.5	6441.4
25	8085.4	-	10415.9	8538.0	9589.9	3895.7	5483.5	3409.1	5494.5
26	4809.3	-	8649.2	7538.4	8187.4	3449.9	4367.5	2969.7	4824.2
27	4193.8	-	6492.6	6230.4	6294.8	3022.9	4031.1	3238.1	3589.8
28	4222.8	-	5159.9	5119.1	4919.9	2583.0	2728.3	3366.5	2899.0
29	3911.1	-	3723.8	4208.4	4361.1	2131.9	2341.0	3288.9	2261.4
30	2789.8	-	3249.4	3773.2	4743.0	1683.4	1853.9	2551.9	1921.6
31	2070.4	-	2158.6	2825.3	3141.4	1154.7	1497.2	1867.4	1297.7
32	1128.8	-	1371.4	1863.2	2121.4	873.7	1094.6	1042.9	737.8
33	1331.4	-	1080.0	1310.6	1395.3	619.1	660.8	586.3	439.4
34	667.0	-	825.0	914.2	803.2	388.7	409.2	261.1	196.6
35	1063.3	-	395.4	637.0	455.1	217.3	179.9	227.7	151.9
36	405.2	-	284.4	342.0	347.5	152.1	122.7	101.4	59.0
37	281.6	-	163.1	339.5	237.8	75.8	53.7	50.3	19.4
38	127.5	-	101.3	109.7	121.6	36.3	11.8	30.8	8.4
39	53.1	-	29.7	33.6	50.4	2.8	14.9	5.3	0.3
40	0.0	-	1.4	23.6	19.3	0.0	5.6	0.1	0.0
41	0.0	-	22.2	26.7	30.7	4.7	0.5	0.0	0.0
42	0.0	-	0.0	8.9	9.1	0.0	0.0	0.0	0.0
43	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	112115	-	122027	107828	93623	66944	103914	93014	101838

Tab. 6.1.3-2 Italian trawlers catch (landing and discard) in GSA 17 LFDs.

Thousands (sex combined) by Length class [mm]	Year				
	2011	2012	2013	2014	2015
1	0.0	-	0.0	0.0	0.0
2	0.0	-	0.0	0.0	0.0
3	0.0	-	0.0	0.0	0.0
4	0.0	-	0.0	0.0	0.0
5	0.0	-	0.0	0.0	75.4
6	0.0	-	0.0	0.0	113.2
7	0.0	-	0.0	0.0	163.5
8	0.0	-	0.0	0.0	113.2
9	0.0	-	0.0	0.0	112.8
10	0.0	-	0.0	0.0	64.4
11	0.0	-	0.0	0.0	149.4
12	0.0	-	0.0	0.0	250.9
13	0.0	-	0.0	0.0	85.0
14	6.6	-	0.0	0.0	18.5
15	13.2	-	0.0	5.3	136.2
16	0.0	-	41.9	0.0	1042.2
17	0.0	-	0.0	14.8	1065.6
18	0.0	-	89.1	208.4	2966.9
19	34.8	-	345.5	206.0	3035.9
20	19.8	-	646.8	594.0	3045.0
21	63.0	-	520.6	966.2	3201.0
22	79.1	-	604.4	925.7	4796.7
23	89.2	-	760.1	1811.4	4094.6
24	161.9	-	689.4	1656.0	3445.2
25	178.1	-	723.1	2103.6	3456.5
26	276.3	-	662.6	1976.6	2593.0
27	908.5	-	661.9	1796.9	1595.5
28	831.0	-	787.2	1977.5	1441.6
29	1051.7	-	325.1	1558.2	1328.7
30	534.9	-	635.5	1519.7	1205.5
31	455.3	-	402.0	1070.6	969.3
32	502.4	-	41.9	730.7	666.2
33	506.1	-	67.6	275.6	615.5
34	388.7	-	111.2	334.8	334.2
35	383.8	-	180.4	172.7	145.9
36	217.5	-	65.9	16.6	191.3
37	18.3	-	63.6	57.7	42.0
38	34.8	-	5.6	0.0	33.5
39	87.1	-	11.1	4.4	60.4
40	16.4	-	73.1	0.0	10.2
41	0.0	-	5.6	0.0	0.0
42	0.0	-	0.0	0.0	0.0
43	0.0	-	0.0	0.0	0.0
44	0.0	-	0.0	0.0	0.0
45	0.0	-	0.0	0.0	0.0
46	0.0	-	0.0	0.0	0.0
47	0.0	-	0.0	0.0	0.0
48	0.0	-	0.0	0.0	0.0
49	0.0	-	0.0	0.0	0.0
50	0.0	-	0.0	0.0	0.0
Total	6859	-	8521	19984	42665

Tab. 6.1.3-3 Montenegrin trawlers landing LFDs.

Thousands (sex combined) by Length class [mm]	Year							
	2008	2009	2010	2011	2012	2013	2014	2015
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	69.5	34.8	0.0	56.6	0.0	0.0	0.0	0.0
15	54.8	33.5	12.1	43.1	18.5	31.4	18.5	96.7
16	102.0	56.8	11.5	43.3	21.8	48.3	21.8	227.1
17	176.5	101.0	25.5	115.1	56.4	103.1	56.4	376.3
18	197.2	155.4	113.6	58.7	174.4	309.4	174.4	434.0
19	162.1	130.3	98.4	71.2	128.8	243.6	128.8	776.5
20	253.4	163.6	73.7	111.4	164.9	355.3	164.9	576.3
21	284.8	238.6	192.3	225.1	115.6	283.8	115.6	599.5
22	198.6	232.7	266.9	137.5	114.7	269.0	114.7	390.1
23	312.3	248.1	183.8	330.3	227.0	371.0	227.0	546.3
24	337.6	329.3	321.1	211.0	218.4	362.0	218.4	356.4
25	355.8	300.4	245.0	173.8	112.3	299.4	112.3	443.7
26	326.7	290.3	254.0	85.4	22.2	165.8	22.2	492.9
27	174.8	219.0	263.3	35.9	104.2	218.6	104.2	384.4
28	195.0	238.4	281.9	32.0	147.3	229.8	147.3	213.9
29	84.1	186.7	289.3	26.3	248.1	268.1	248.1	175.0
30	66.1	136.1	206.1	15.3	164.6	242.0	164.6	0.0
31	57.9	126.2	194.5	10.7	127.9	175.4	127.9	0.0
32	85.7	112.8	139.8	11.9	127.9	170.1	127.9	104.3
33	53.0	88.1	123.1	4.9	31.3	50.2	31.3	92.3
34	38.4	48.1	57.8	6.1	53.5	46.6	53.5	0.0
35	5.7	12.8	19.8	7.4	3.3	12.6	3.3	0.0
36	0.0	6.5	13.1	2.4	3.3	2.9	3.3	0.0
37	3.5	5.2	6.9	2.5	3.3	11.0	3.3	0.0
38	0.0	0.0	0.0	0.0	3.3	11.0	3.3	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3595	3494	3393	1818	2393	4280	2393	6286

Tab. 6.1.3-4 Croatian trawlers catch (landing and discard) LFDs.

Thousands (sex combined) by Length class [mm]	Year	
	2014	2015
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	3.7	4.2
9	22.3	25.5
10	55.5	63.3
11	162.4	185.3
12	392.9	448.4
13	532.4	538.0
14	1231.3	1567.1
15	1946.1	2590.8
16	2408.2	3270.2
17	4832.0	5261.3
18	4239.4	4692.1
19	4439.2	4107.3
20	5798.3	7337.8
21	5649.5	5970.6
22	7920.3	7042.2
23	6369.2	7372.4
24	7642.1	8547.1
25	6603.9	7691.1
26	3860.9	5555.9
27	5236.2	5775.6
28	4369.6	4537.2
29	5161.0	3570.0
30	3811.7	3314.2
31	3180.1	1954.5
32	2885.1	1323.0
33	1029.6	857.2
34	1127.9	480.4
35	395.8	189.9
36	331.0	125.0
37	637.7	202.0
38	8.4	82.0
39	0.0	20.6
40	95.0	16.1
41	0.0	15.1
42	0.0	5.0
43	0.0	0.0
44	0.0	1.5
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
Total	92379	94740

6.1.4 Tuning data

The survey LFDs used in SS3 are the ones reported in Table 4.1.1-3 Table 4.2.1-3.

Fishing mortality (F) shows the minimum value of 0.99 ($\bar{F}$ or Fbar) in 2005, and a maximum of 3.35 in 2000. Average F for the period of last three years (2013-2015) was 2.26.

The F0.1 value estimated by FLBRP package was 0.9.

The summary of the best run (Chen and Watanabe natural mortality), chosen for the advice is reported below in Figure 6.1.4-1.

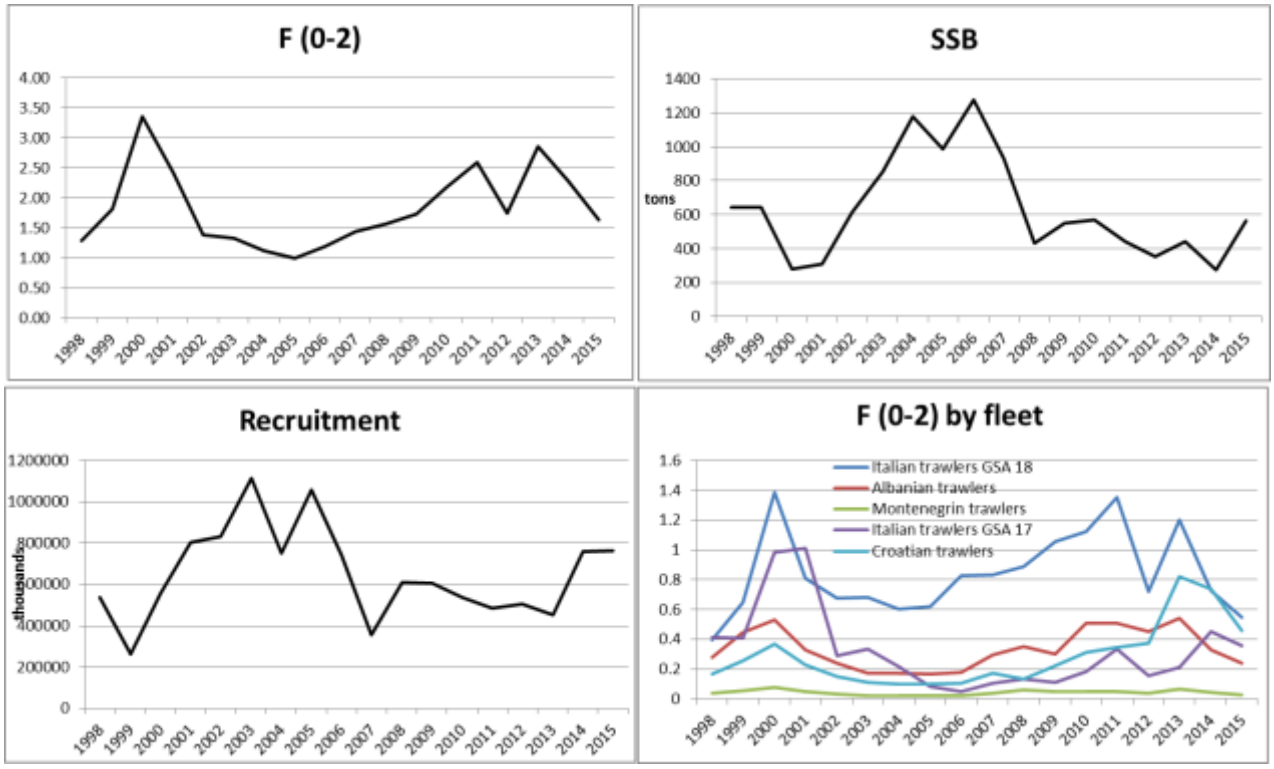


Figure. 6.1.4-1 Results of the best run (Chen and Watanabe natural mortality hypothesis).

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.

6.1.6 Robustness analysis

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

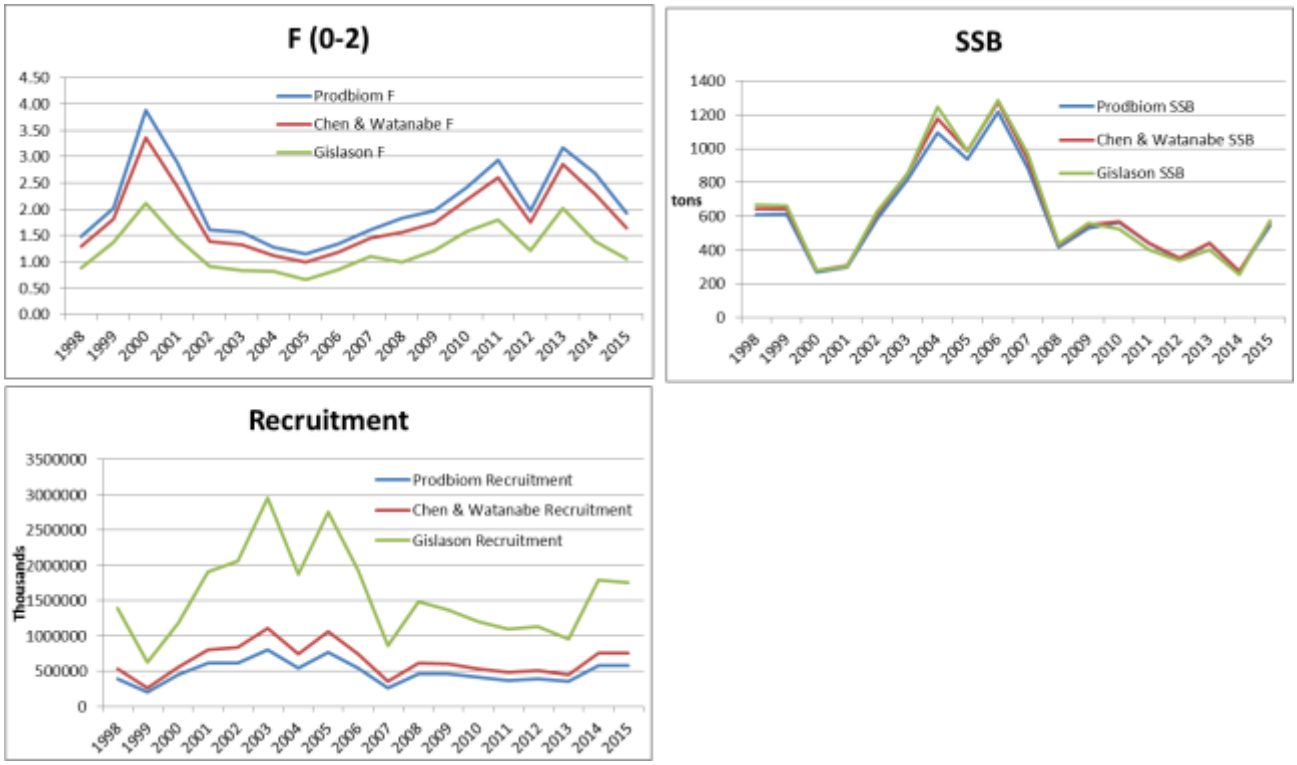


Fig. 6.1.7-1. Sensitivity analysis results on natural mortality.

The Gislason run has been excluded, because the recruitment seemed to reach an extreme value, being very different from the recruitment estimated by Prodbiom and Chen and Watanabe runs.

From the inspection of the likelihood for the three runs, Prodbiom run seems slightly worse than Gislason, not well performing as well, while Chen and Watanabe is in the middle. For this reason the Chen and Watanabe run was retained.

Table 6.1.7-1 Likelihood (precisely –log (likelihood)) table: in the first row is the total likelihood that is the sum of the single likelihoods in the other rows. The red coloured cells are the maximum values among the three runs for each likelihood, the green ones are the minimum value and the yellow one is the intermediate value. The best performance is given by the minimum value.

values	Prodbiom	Chen e Watanabe	Gislason
TOTAL	300.8	303.9	319.9
Catch	5.6149E-07	1.74799E-08	8.17025E-09
Equil_catch	0.00050806	0.000173583	3.56433E-05
Survey	-23.2824	-23.8425	-24.9
Length_comp	317.6	320.7	336.1
Recruitment	6.4	6.9	8.7

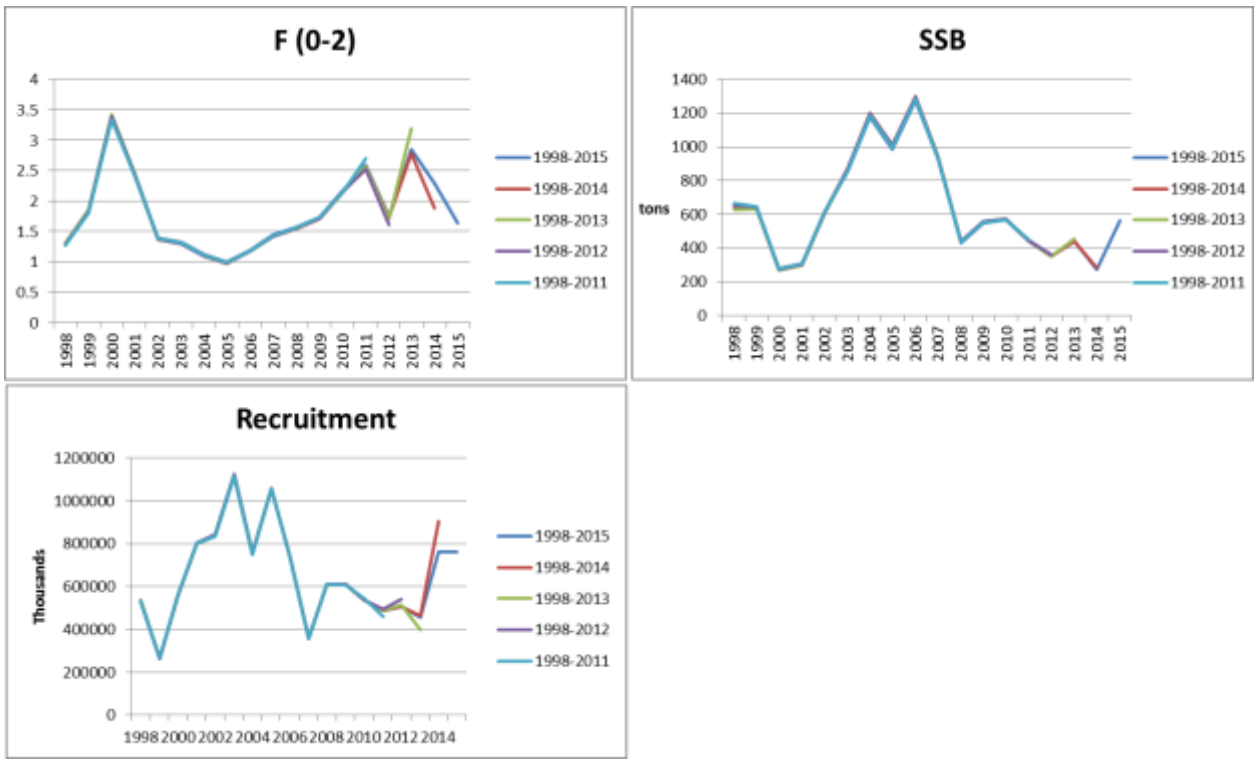
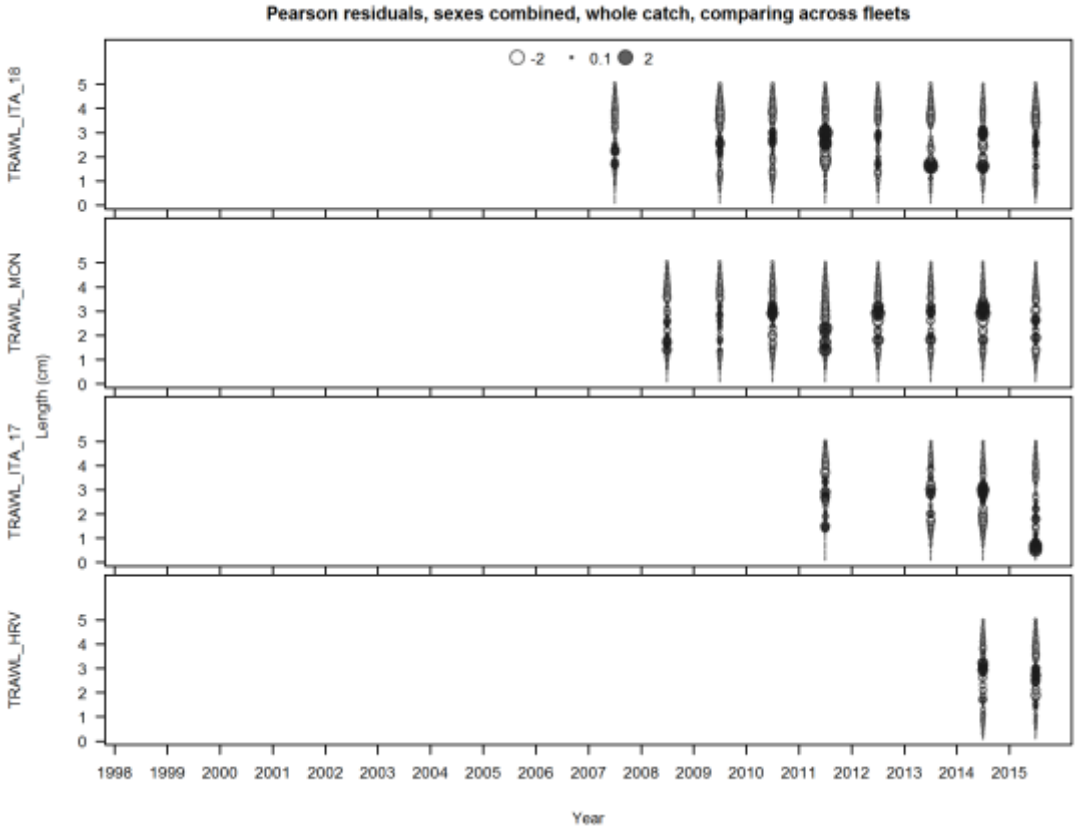


Fig. 6.1.7-2. Retrospective analysis results.



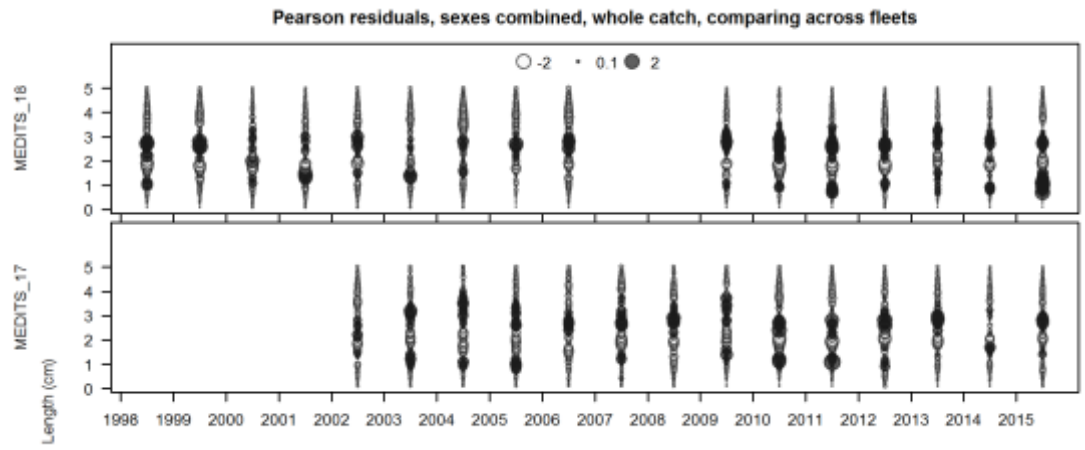


Fig. 6.1.7-3. Pearson residuals by fleet.

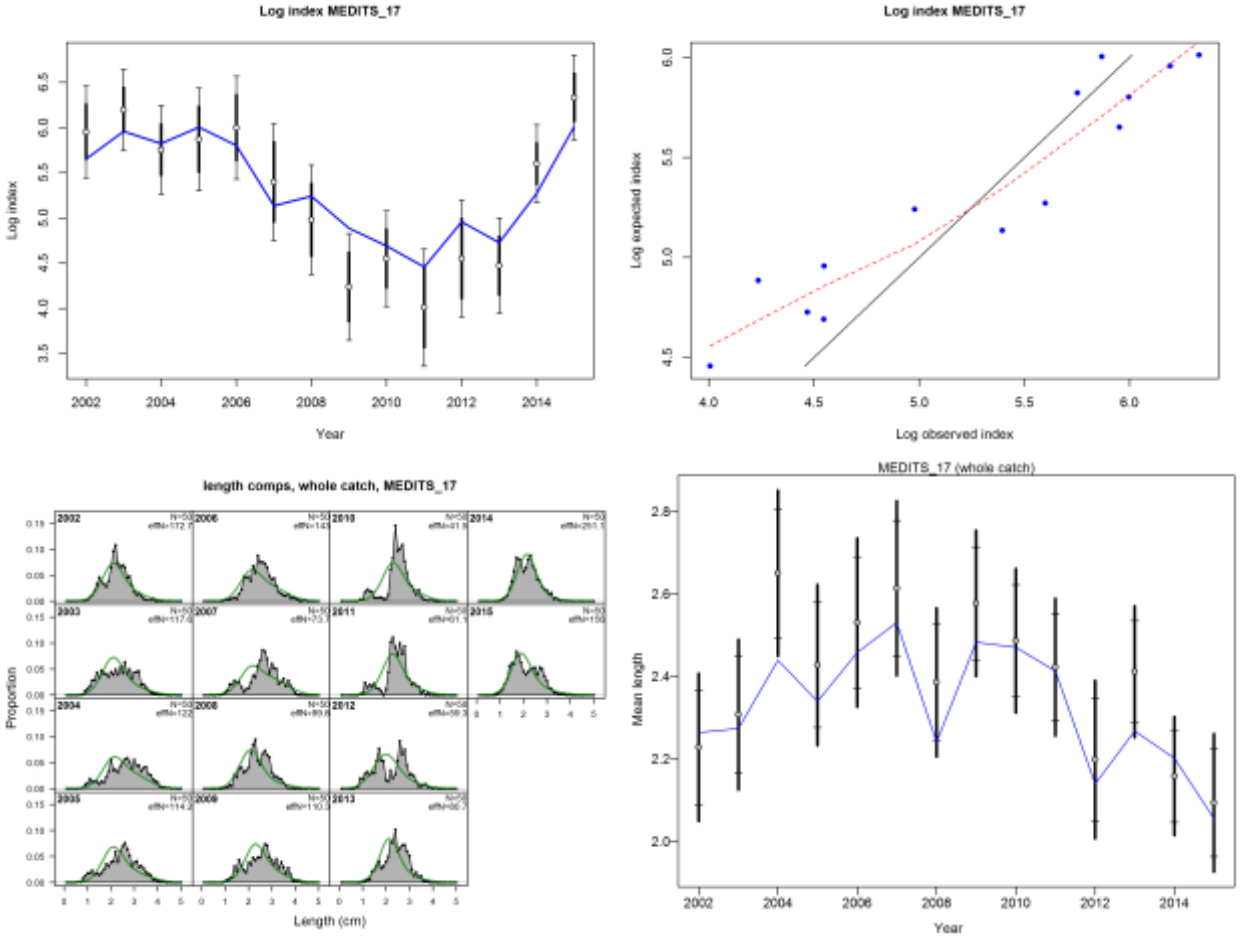


Fig. 6.1.7-4 Comparison between observed and estimated MEDITS GSA 17 log index, mean length, LFDs and between theoretical and empirical quantiles.

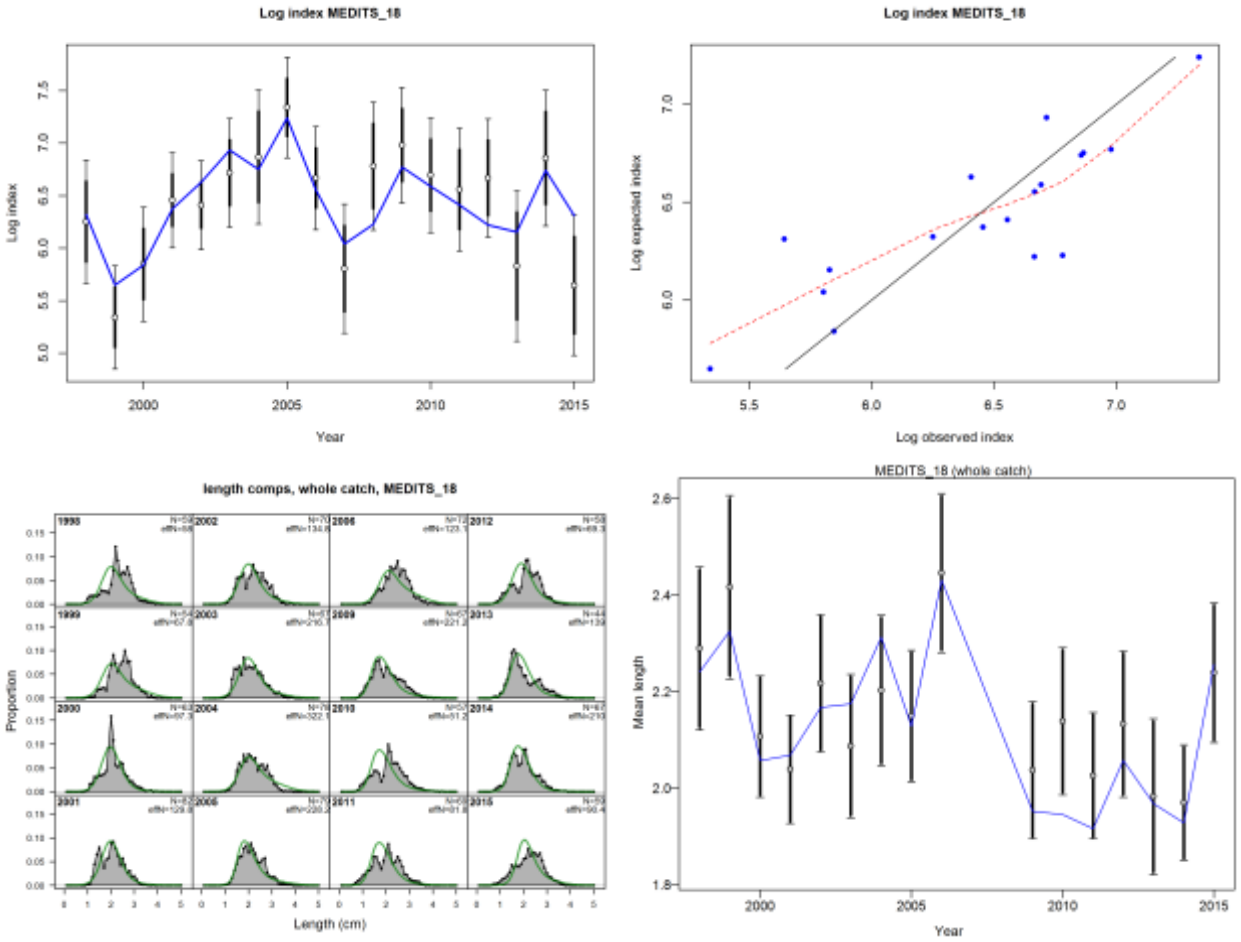
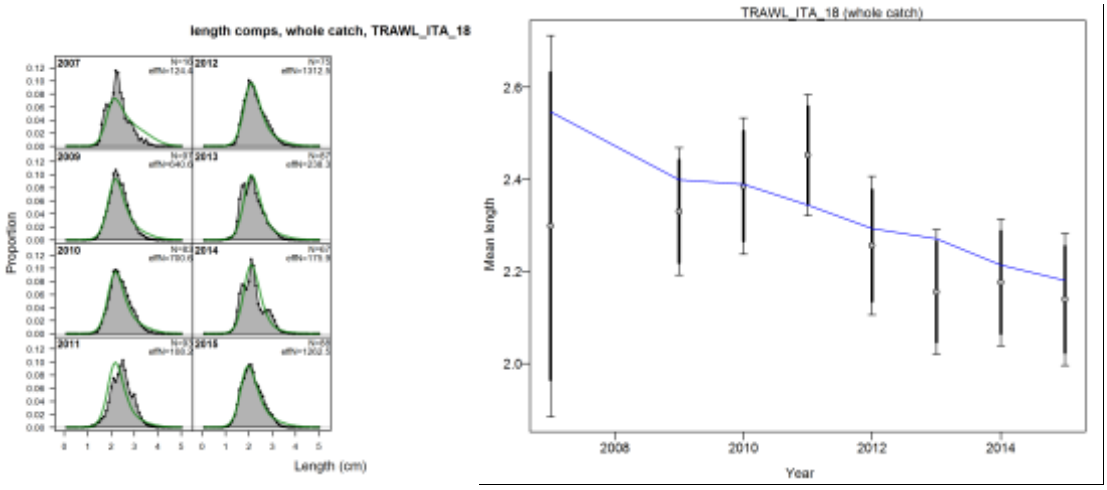


Fig. 6.1.7-5 Comparison between observed and estimated MEDITS GSA 18 log index, mean length, LFDs and between theoretical and empirical quantiles.



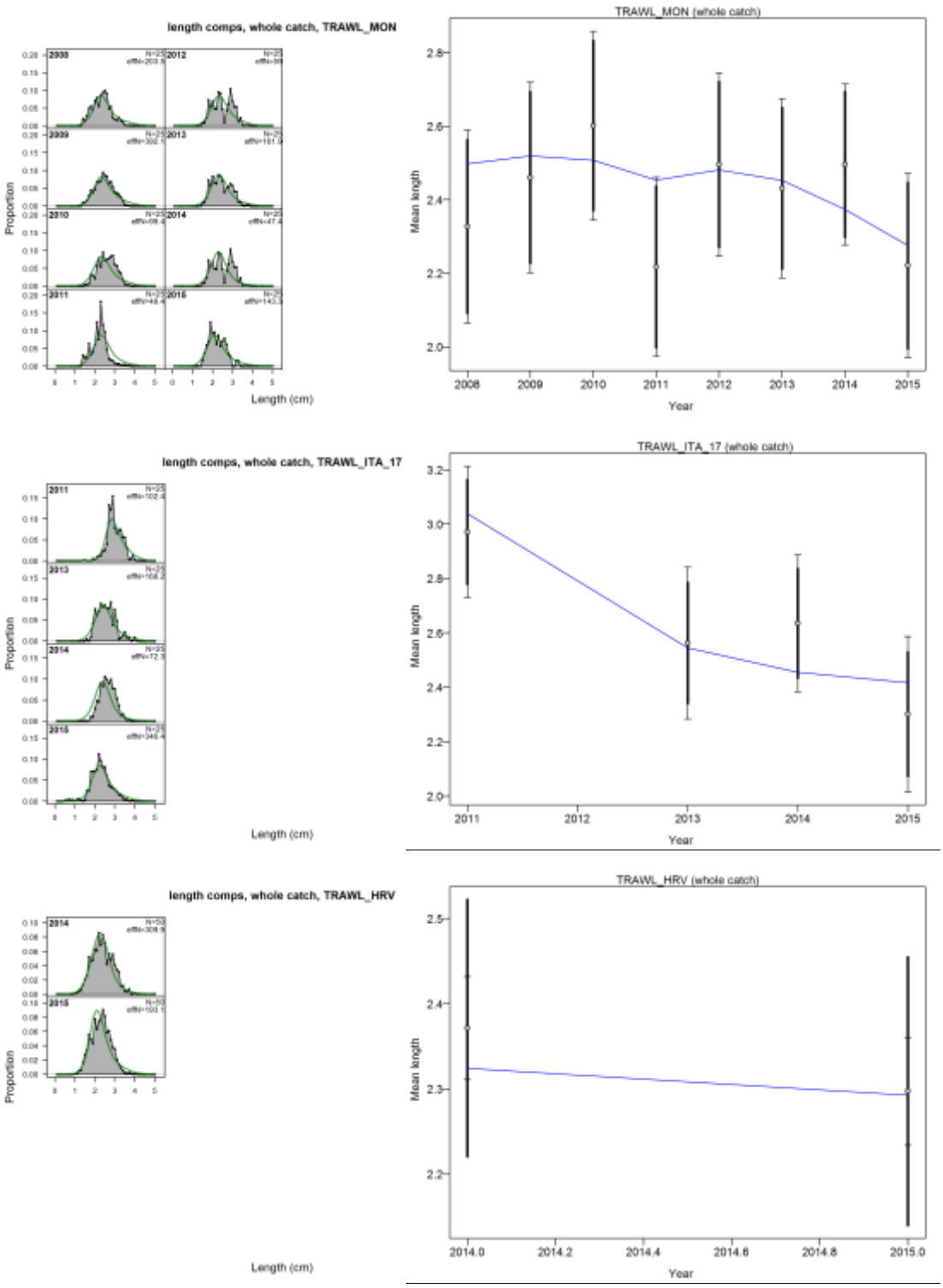


Fig. 6.1.7-6 Comparison between observed and estimated commercial mean length and LFDs.

6.1.8 Assessment quality

The residuals do not shows any particular trend and the retrospective analysis seems to be consistent. The comparison between observed and estimated commercial LFDs and mean length along the years as well as between observed and estimated MEDITS mean length, log index and LFDs seems quite satisfactory.

7 Stock predictions

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)	Stock Status
Fishing mortality	Fishing mortality	$F_{0.1}$ = 0.9	F_{curr} = 2.26		D	IO_H
	Fishing effort				D	
	Catch					
Stock abundance	Biomass					O_L
	SSB			Percentiles SSB (tons): 33rd : 440 66th : 641 Current: 426		
Recruitment						
Final Diagnosis		$\frac{F_{curr}}{F_{0.1}} = 2.5$				

The total F estimated by SS3 in Adriatic Sea (GSA 17 and GSA 18) is split in 37 % exerted by Italian trawlers in GSA 18, 30% by Croatian trawlers, 16% by Albanian trawlers, 15% by Italian trawlers in GSA 17 and 2% by Montenegrin trawlers.

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)*

9 References

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