Stock Assessment Form

Demersal species

Parapenaeus longirostris in GSA 17, 18 & 19

Reference year: 2017

Reporting year: 2018

Estimating higher than reported catches by a factor close to two. If this is incorrect, and catches are nearer reported catch, then F in the final year will be lower than the F shown in the assessment. However, F will still be aboveF_{msy}.

Stock Assessment Form version 1.0 (January 2014)

Uploader: STECF EWG18-16

Stock assessment form

1. Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
	Deep-water rose shrimp	
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
[GSA_17]	[GSA_18]	[GSA_19]
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
1st Country	2nd Country	3rd Country
Italy		
4th Country	5th Country	6th Country
Stock assessment method: (direct, indirect, combined, none)		
Indirect		
Authors:		
STECF-18-16		
Affiliation:		
For more details please refer to https://stecf.jrc.ec.europa.eu/reports/medbs		

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:

Direct methods (you can choose more than one):

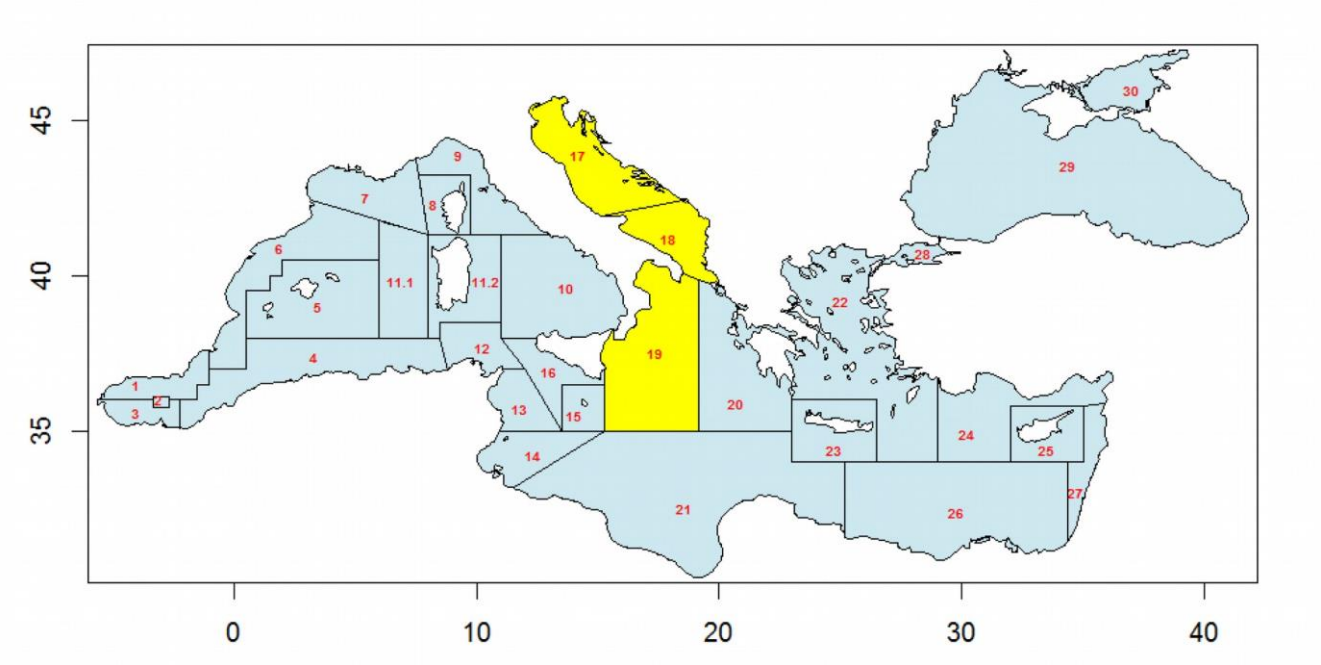
- Acoustics survey
- Egg production survey
- Trawl survey
- SURBA
- Other (please specify)

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



2.1 Stock unit

2.2 Growth and maturity

Table 2-1.-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				**Recruitment season**	
Size at first maturity				**Spawning area**	
Recruitment size				**Nursery area**	
to the fishery					

For *P. longirostris*, males and females are known to have different growth profiles, with males growing slower and reaching smaller size than females. The DCF data include information on the growth parameters by sex of in GSA 18-19, but not in GSA 17. However, since the sex ratio in the catches was not available in the DCF, was not possible to use it for the purposes of the DPS assessment. Growth parameter and length-weight relationship parameters for sex combined from DCF were used in the assessment as it was done in previous meetings.

The same vector of proportion of mature individuals by age used in STECF EWG 17-09 was utilized by EWG 18-16.

A vector of natural mortality was estimated by the Chen and Watanabe (1989) function using growth and length-weight relationship parameters for sex combined.

Maturity is taken from DCF data

Table Deep-water rose shrimp in GSA 17-19. Maturity and Natural mortality parameters used in the assessment

Age	0	1	2	3+
Maturity	0.519	0.939	0.977	1
Natural mortality	1.75	0.938	0.748	0.673

Studies carried out in the Mediterranean indicate a variable reproductive strategy for this species. Some authors found that in the South Ionian the spawning of the deepwater rose shrimp females' is carried out during summer and that is more protracted in Montenegrin waters compared to Ionian waters (K. Kapiris et al., 2013). From other authors spawning is considered to occur through the year (D' Onghia et al., 1998). Then for the purposes of this assessment the spawning time was set at the mid-point of the year with 50% F and M occurring before spawning.

Table 2-5: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**				45	
	K				0.6	
	t_0				-0.2	
	Data source					
Length weight relationship	**a**				0.0024	
	b				2.5372	
	M (scalar)					
	sex ratio (% females/total)					

3. Fisheries information

3.1 Description of the fleet

Deep-water rose shrimp is targeted mainly by bottom trawlers in these areas. Deep-water rose shrimp is commercially important in the Adriatic Sea: it is targeted by trawlers (Italy, Croatia, Albania and Montenegro). The Southern Adriatic Sea makes a substantial contribution to the Italian Deep-water rose shrimp national fishery production, with an input comparable to that of the Strait of Sicily, accounting for about 13% of total production (Cataudella and Spagnolo, 2011).

In the northwestern Ionian Sea, fishing occurs from coastal waters to 700–750 m. The most important demersal resources in the northwestern Ionian Sea are represented by the red mullet (*Mullus barbatus*) on the continental shelf, hake (*Merluccius merluccius*), deep-water rose shrimp (*Parapenaeus longirostris*) and Norway lobster (*Nephrops norvegicus*) over a wide bathymetric range and the deep- water red shrimps (*Aristeus antennatus and Aristaeomorpha foliacea*) on the slope.

Fishing effort data were reported to STECF EWG 18-12 through DCF. Some effort reported in some year by France and Malta is removed to better see the effort ripartion among countries in the area studied. Nominal effort expressed as engine power (kW) per fishing days is reported in following tables.

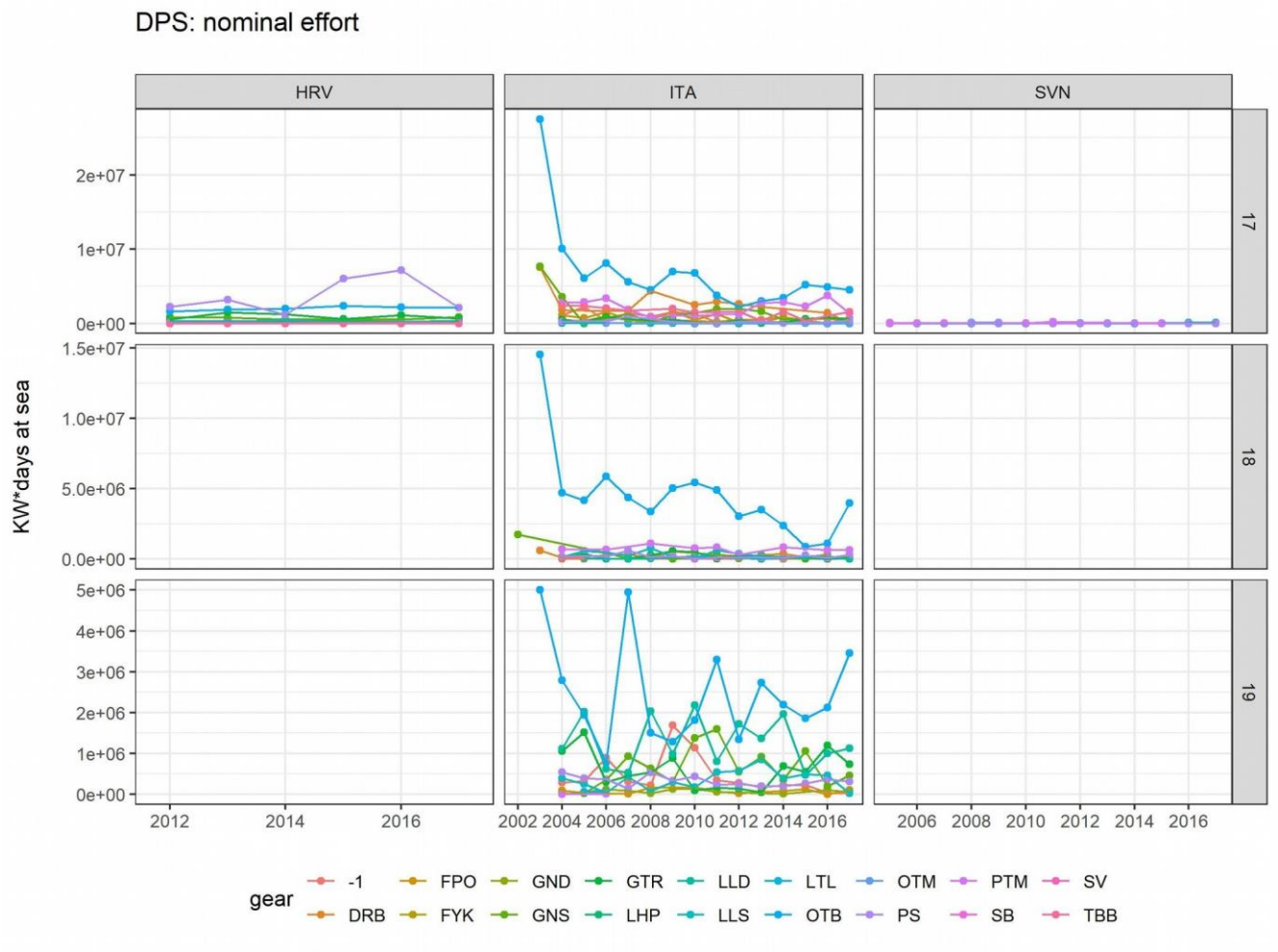


Figure Deep-water rose shrimp in GSA 17-19. Nominal effort by fleet, year, country and area.

Nominal effort by fleet that report catches of some DPS is almost exclusively related to bottom trawl gears.

Table Deep-water rose shrimp in GSA 17-19. Fishing effort in nominal effort, GT*Days at sea and Days at sea by year and fishing gear.

gsa	country	gear	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17	HRV	OTB	0	0	0	0	0	0	0	0	0	1630587	1859634	1984391	2389646	2181732	2123555
17	ITA	OTB	27486393	10071569	6081576	8136671	5598424	4522733	6997610	6776081	3768980	2267947	3017774	3423905	5238809	4917122	4497771
17	SVN	OTB	0	0	36869.4	27457	41472.8	127226.5	107464.8	58005.88	112440.9	47885.6	12023	7638	51341.7	30268.4	27445.3
18	ITA	OTB	14530793	4709285	4159165	5850066	4351301	3345982	5017395	5419689	4902562	3043563	3482955	2372921	874759	1085514	3946224
19	ITA	OTB	5002396	2787749	1945416	772266	4942437	1505117	1281958	1816764	3290819	1344209	2733581	2194448	1863294	2128423	3452780
all	all	OTB	47019582	17568603	12223026	14786460	14933635	9501059	13404428	14070540	12074802	8334191	11105967	9983303.2	10417850	10343060	14047775

Figure Deep-water rose shrimp in GSA 17-19. Nominal effort by OTB and year in the three GSAs.

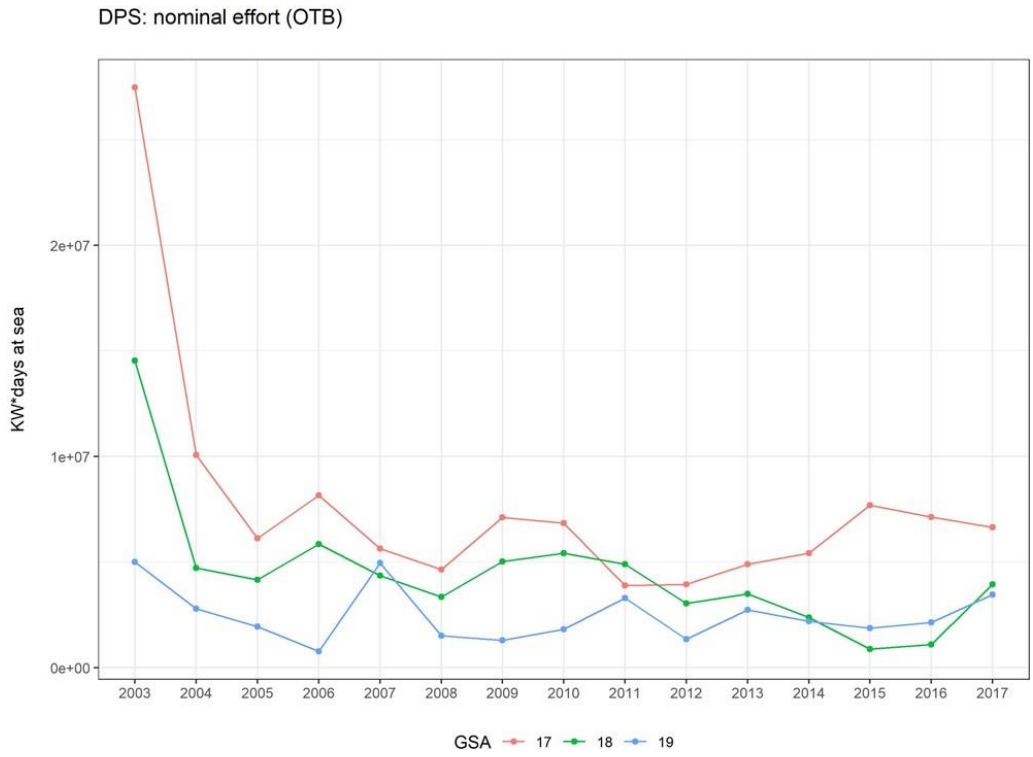


Figure Deep-water rose shrimp in GSA 17-19.: Nominal effort by OTB and year in the three GSAs.

Table 3-2: Description of operational units exploiting the stock

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*					[ISCAAP Group]	

Table 3.1-3: Catch, bycatch, discards and effort by operational unit in the reference year

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
[Operational Unit1]						
[Operational Unit2]						
[Operational Unit3]						
[Operational Unit4]						
[Operational Unit5]						
Total						

3.2 Historical trends

All data were taken from 2018 DCF data call.

3.2.1 Catch (landings and discards)

Catch data were reported to STECF EWG 18-16 through the DCF. In GSAs 17-18, and 19, most of the landings come from otter trawls. DCF data coming from other gear were considered sampled inconsistently and were not included in the stock assessment.

Table Deep-water rose shrimp stocks in GSAs 17-19. Landings and discards data in tonnes by fleet from DCF 2018.

Landings

area	country	gear	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17	HRV	OTB													363	536	655	833
17	ITA	OTB					54					92		84	202	279	471	520
17	MLT	OTB														0		
18	ITA	-1	244	496			9											
18	ITA	GNS		67	7													
18	ITA	GTR			1													
18	ITA	LLS			1													
18	ITA	OTB	903	1253	1848	1181	1465	863	766	939	888	870	523	734	638	651	996	1109
19	ITA	-1	365	745	0	0												
19	ITA	FPO			15													
19	ITA	GNS			7													0
19	ITA	GTR	3										0		2			
19	ITA	LLS			9													
19	ITA	OTB	738	646	1170	1243	1245	608	785	767	716	593	488	334	422	622	647	693
19	ITA	PS	20			1												
19	ITA	PTM					0											
19	ITA	SB			0	0												
19	ITA	SV			0	0												

Discards

area	country	gear	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17	HRV	OTB														0	2	11
17	ITA	OTB										3		2	28	37	207	73
18	ITA	OTB								31	18	5	7	12	8	14	21	42
19	ITA	OTB					19			55	36	13	8	20	9	12	25	45

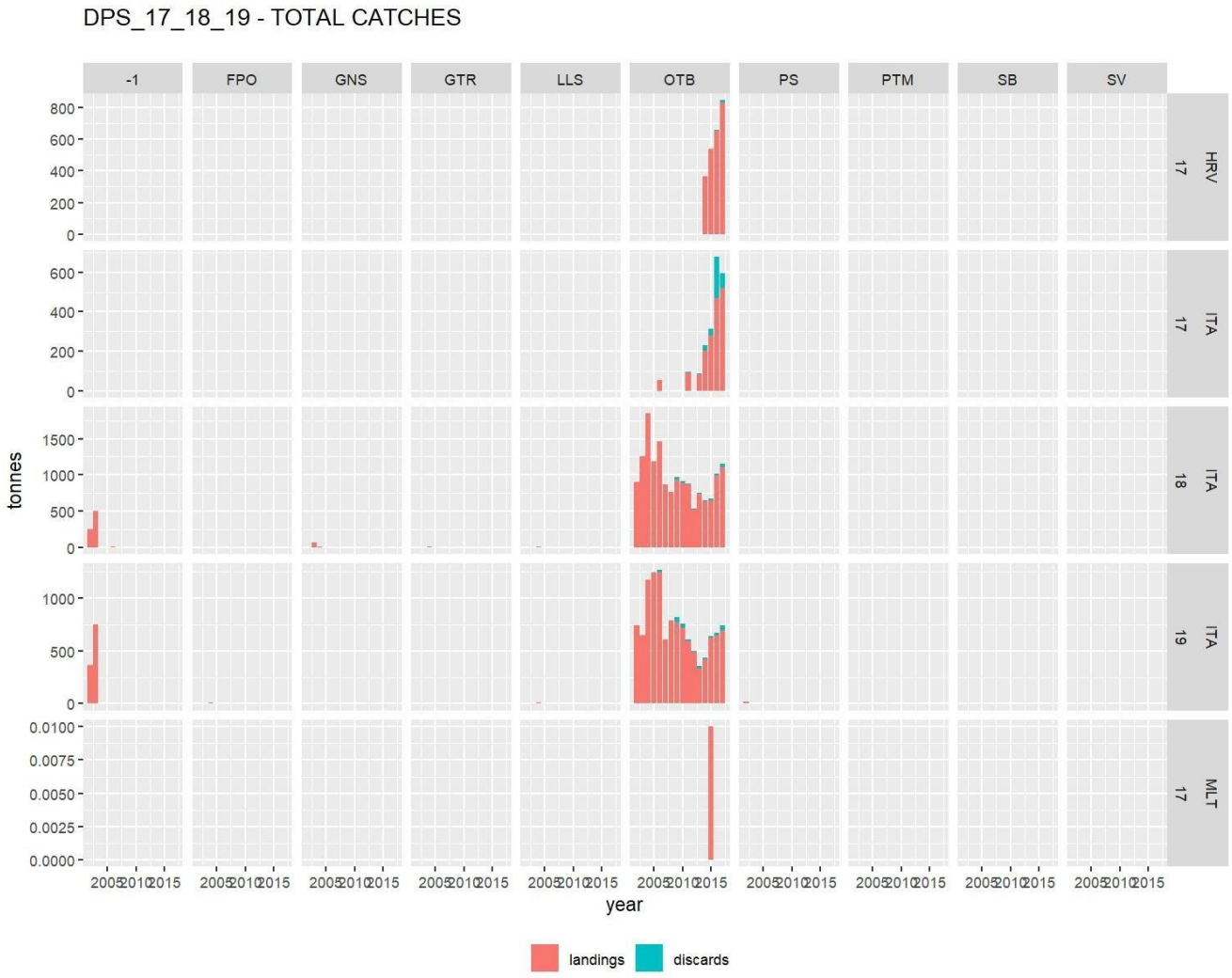


Figure Deep-water rose shrimp in GSA 17-19. Landings and discards data in tonnes by fleet. from DCF 2018.

In the rest of the report, we will refer to and present only data for otter trawl and we will not consider the data from Malta fleet that occurs only in 2015 and seems to be not consistent with the time series.

Landings data for GSA 17 were incomplete. Italian landings were present just for 2006, 2011, and from 2013 to 2017. Croatian landings were present just from 2014 to 2017 in the DCF database because previously there was no obligation to monitor that species. Landings data for GSA 18 were incomplete for Albania and Montenegro. Landings data for Albania were obtained from last report from 2007,2008 and 2009 and FISHSTAT from 2010 onward.Landing data from Albania were updated for the most recent five years. The Albanian landings update has been included, this gives a 3.5 to 5 fold increase in reported Albanian landings from 2012 to 2016, increasing total catches by all countries by +50% in 2012 (when catches were previously at their lowest) but by less (+25%) in 2016, as catches by most countries are seen to increase from 2012 onwards, as does the MEDITS index. The EWG discussed this and there did appear to be an increase in Albanian effort during this period, though the full extent of the catch increases and the validity of the landings values could not be verified. Data from Montenegro by last report (EWG 17-09) and originally derived from the GFCM assessment in 2017 were used. Landings data for GSA 19 were complete.

Discards were reported through DCF for GSA 18 and GSA 19 since 2010, for GSA 17in 2006, 2011 and 2013-2017 for Italy and since 2008 for Croatia; no information was available neither for Albania nor for Montenegro.

Table Deep-water rose shrimp in GSA 17-19. Landings and discards data in tonnes by OTB as reported in the JRC repository (from DCF 2018).

DCF 2018 (OTB)	area	country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Land	17	HRV													363	536	655	833
Land	17	ITA					54					92		84	202	279	471	520
Land	18	ITA	903	1253	1848	1181	1465	863	766	939	888	870	523	734	638	651	996	1109
Land	19	ITA	738	646	1170	1243	1245	608	785	767	716	593	488	334	422	622	647	693
Disc	17	HRV														0	2	11
Disc	17	ITA										3		2	28	37	207	73
Disc	18	ITA								31	18	5	7	12	8	14	21	42
disc	19	ITA					19			55	36	13	8	20	9	12	25	45

For the puproses of the assessment EWG 18-06 reconstructed missing data taking in to account all the available information to fill gaps by fleet (i.e. By GSA, country and gear).

Missing landing data were taken from the previous STECF EWG 17-09. When landings where not present neither in JRC database nor in the previous STECF EWG 17-09 report they were rebuilded as the average landing value of the closest 5 years.

Table Deep-water rose shrimp in GSA 17-19. Landings data in tonnes by OTB as recontstruct by EWG18-16. The landings data present in the DCF database are in white. Landing reconstructed based on the mean proportions between landings and discards in the time series of each fleet are highlighted. Landings taken from previous report are in bold.

area	country	gear	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17	HRV	OTB	141	141	141	141	141	141	**71**	**138**	**174**	**151**	**169**	**315**	363	536	655	833
17	ITA	OTB	57	57	57	57	**54**	**70**	**54**	**44**	**65**	92	**53**	84	202	279	471	520
18	ITA	OTB	903	1253	1848	1181	1465	863	766	939	888	870	523	734	638	651	996	1109
18	ALB	OTB	222	222	222	222	222	**309**	**309**	**275**	7	209	1170	1210	1430	1290	1460	1473
18	MNE	OTB	35	35	35	35	35	**39**	**39**	**36**	**32**	**27**	**22**	**31**	**28**	**31**	**32**	35
19	ITA	OTB	738	646	1170	1243	1245	608	785	767	716	593	488	334	422	622	647	693

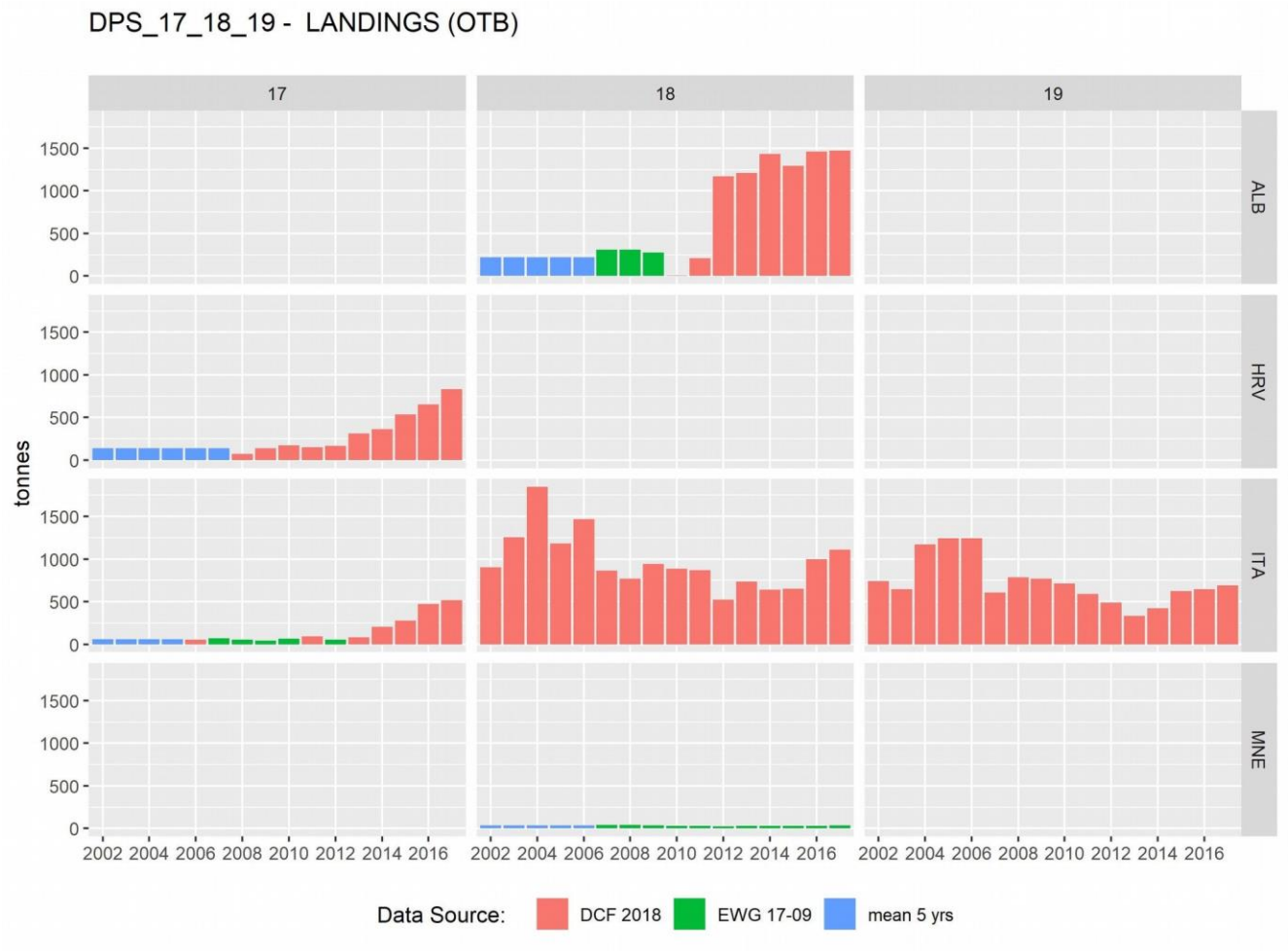


Figure Deep-water rose shrimp in GSA 17-19. Total landings in tonnes by fleet and data source.

To fill gap in discards by country and area in missing years EWG 18-16 first used the DCF db at fleet segment level by year. Missing data were reconstruct by applying to landings the mean proportions between discard and landings found in other fleet segment of the same year. When no discard information were available data were derived by the mean value of discards for the same GSA and country in the neighboroud five years.

Table Deep-water rose shrimp stocks in GSAs 17-19: Discards data in tonnes by OTB as recontstruct by EWG18-16. The discards data present in the DCF database are in white. Discards reconstructed based on the mean proportions between landings and discards for each fleet of the same year are in bold and red. Discards reconstructed based on the mean proportions between landings and discards of the available time series. Discards taken from previous report are in bold character.

area	country	gear	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17	HRV	OTB	0.8	0.8	0.8	0.8	0.8	0.8	0.4	0.8	1.0	0.8	0.9	1.7	2.0	0.1	1.9	11.2
17	ITA	OTB	4.3	4.3	4.3	4.3	8.2	**6.2**	**4.7**	**3.9**	**5.7**	3.2	**4.6**	1.6	28.1	36.9	206.9	73.0
18	ITA	OTB	**16.6**	**23.1**	**34.0**	**21.8**	**23.8**	**15.9**	**16.0**	31.0	17.7	5.3	7.2	12.3	7.7	13.9	20.8	42.3
19	ITA	OTB	**26.8**	**23.5**	**42.5**	**45.2**	**19.0**	**22.1**	**28.5**	54.6	36.1	13.5	8.0	20.4	8.9	12.0	25.5	44.7

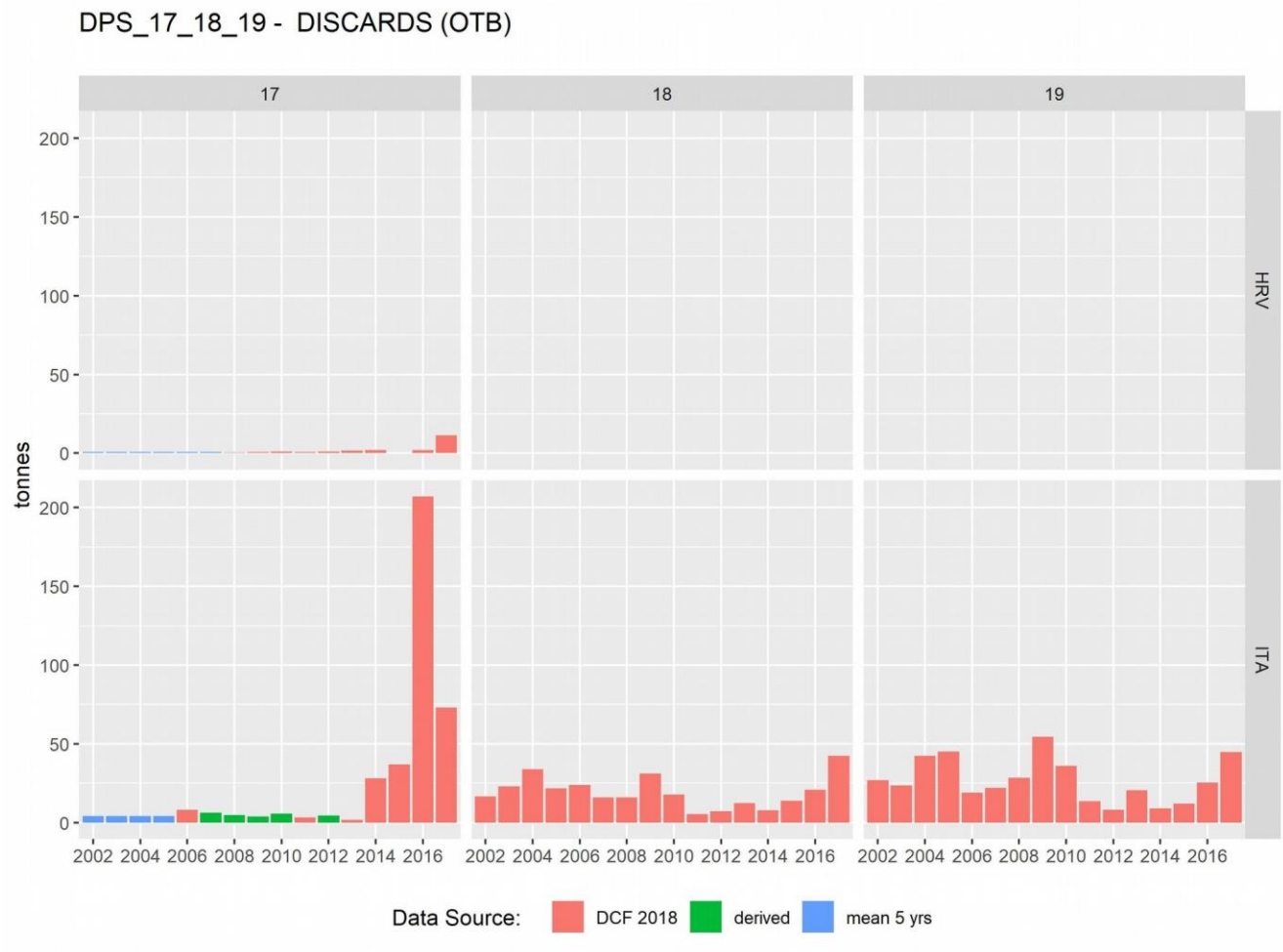


Figure Deep-water rose shrimp in GSA 17-19. Total discards in tonnes by fleet and data source.

Landings and discards data as reconstructed by fleet where then summarised by year to be used as input data for the assessment.

Table Deep-water rose shrimp in GSA 17-19. Total landing, discards and catch by year as reconstructed by EWG 18-16.

OTB	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
discards	48.5	51.7	81.6	72.1	51.8	45	49.6	90.3	60.5	22.8	20.7	36	46.7	62.9	255	171
landings	2096	2354	3472	2879	3160	2029	2024	2200	1881	1942	2424	2708	3082	3409	4262	4663
catch	2144	2406	3554	2951	3212	2074	2074	2290	1942	1965	2445	2744	3129	3472	4517	4835

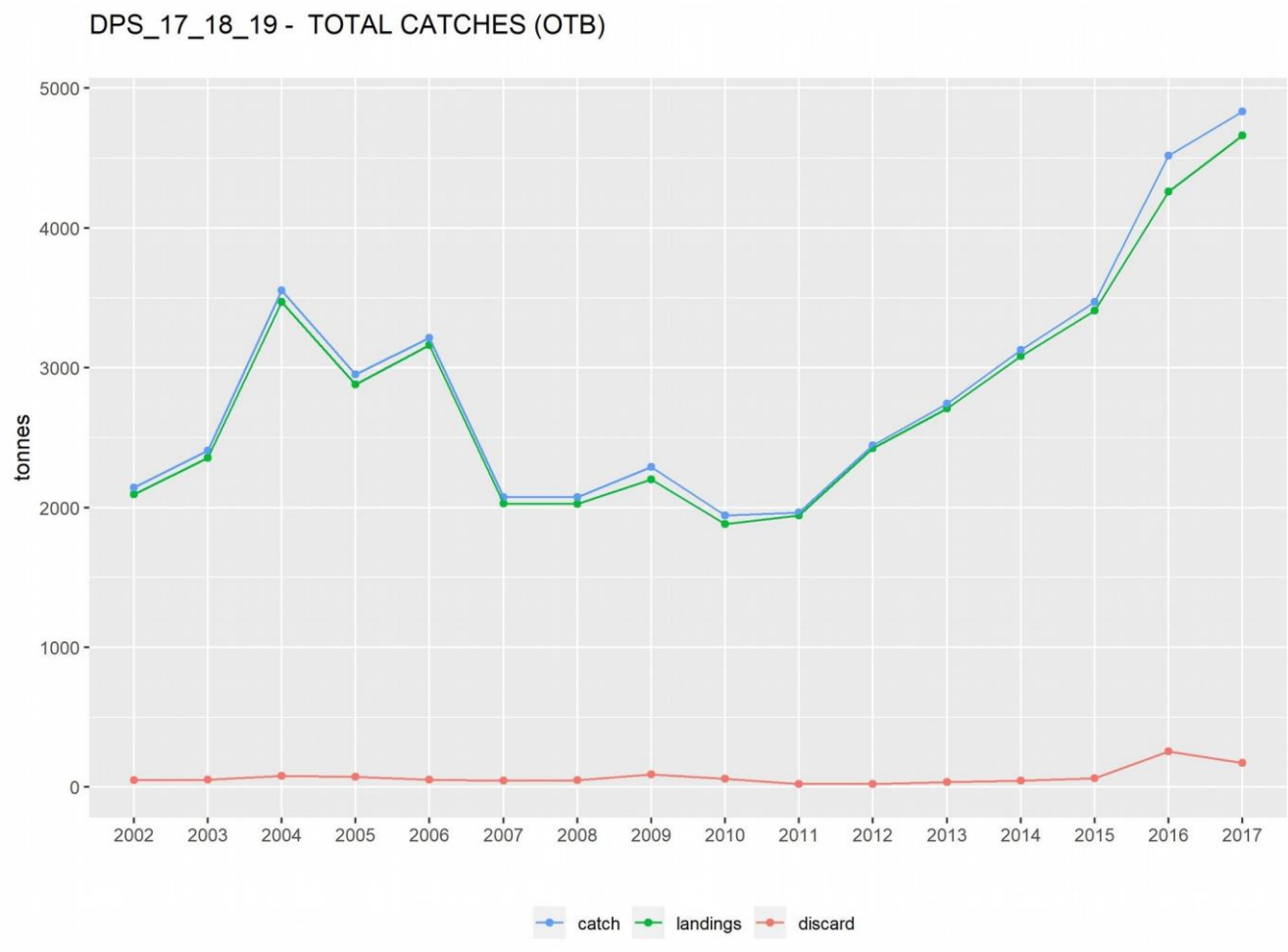


Figure Deep-water rose shrimp in GSA 17-19. Total landing, discards and catch by year as reconstructed by EWG 18-16.

Information on landings at length is available for the whole time series (2002-2017) for Italy in GSA 18-19. For GSA 17 is only available in 2006, 2011 and 2013-2017 for Italy and from 2014 onwards in Croatia

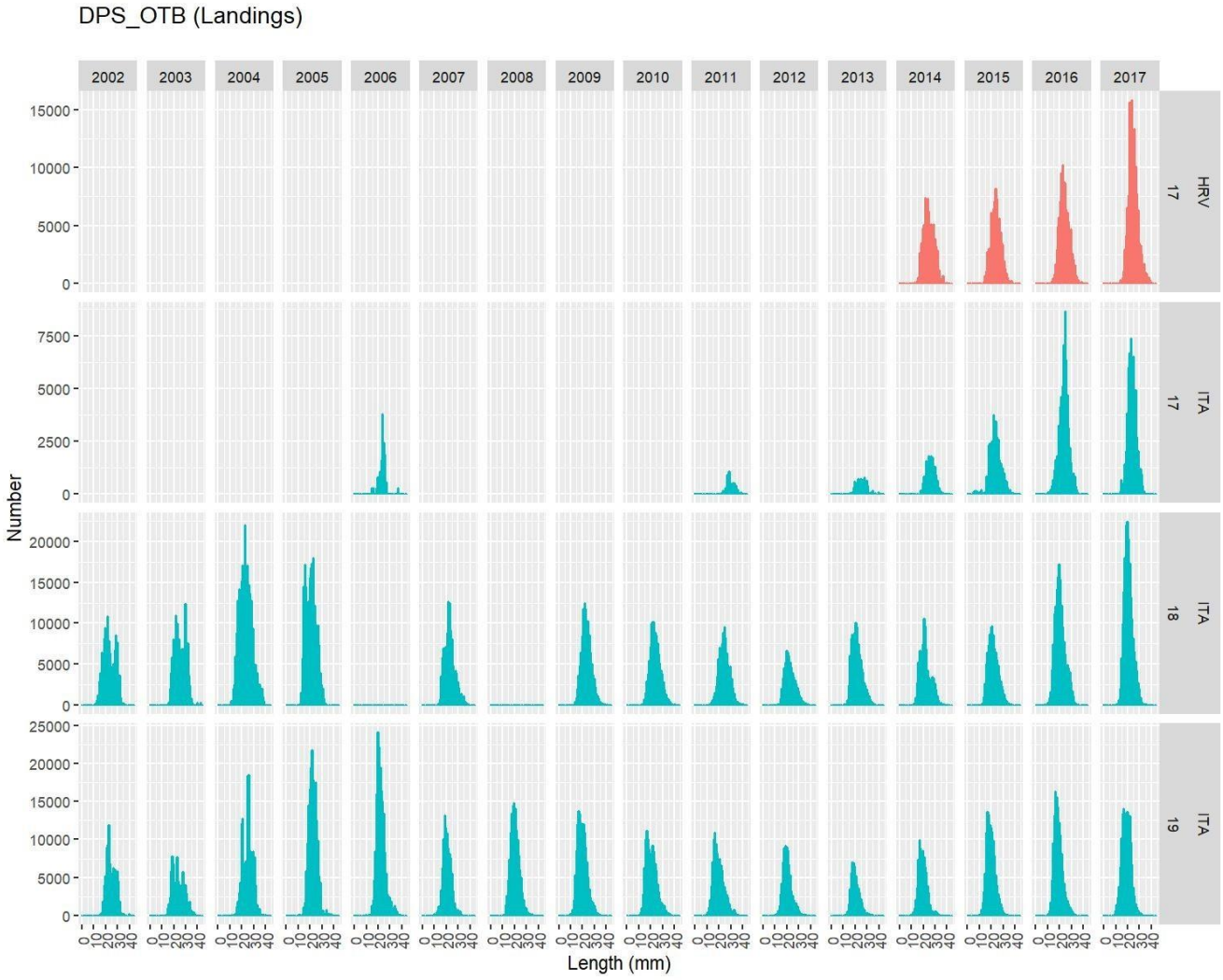


Figure Deep-water rose shrimp stocks in GSAs 17-19. Length frequency distribution of the landings by year and fleet.

Information on discards at length is available since 2009 for Italy in GSA 19 and GSA18. For GSA 19 length are present also for 2006. For GSA 17 data at length are available in 2011 and from 2013 onwards for Italy and from 2015 onwards for Croatia

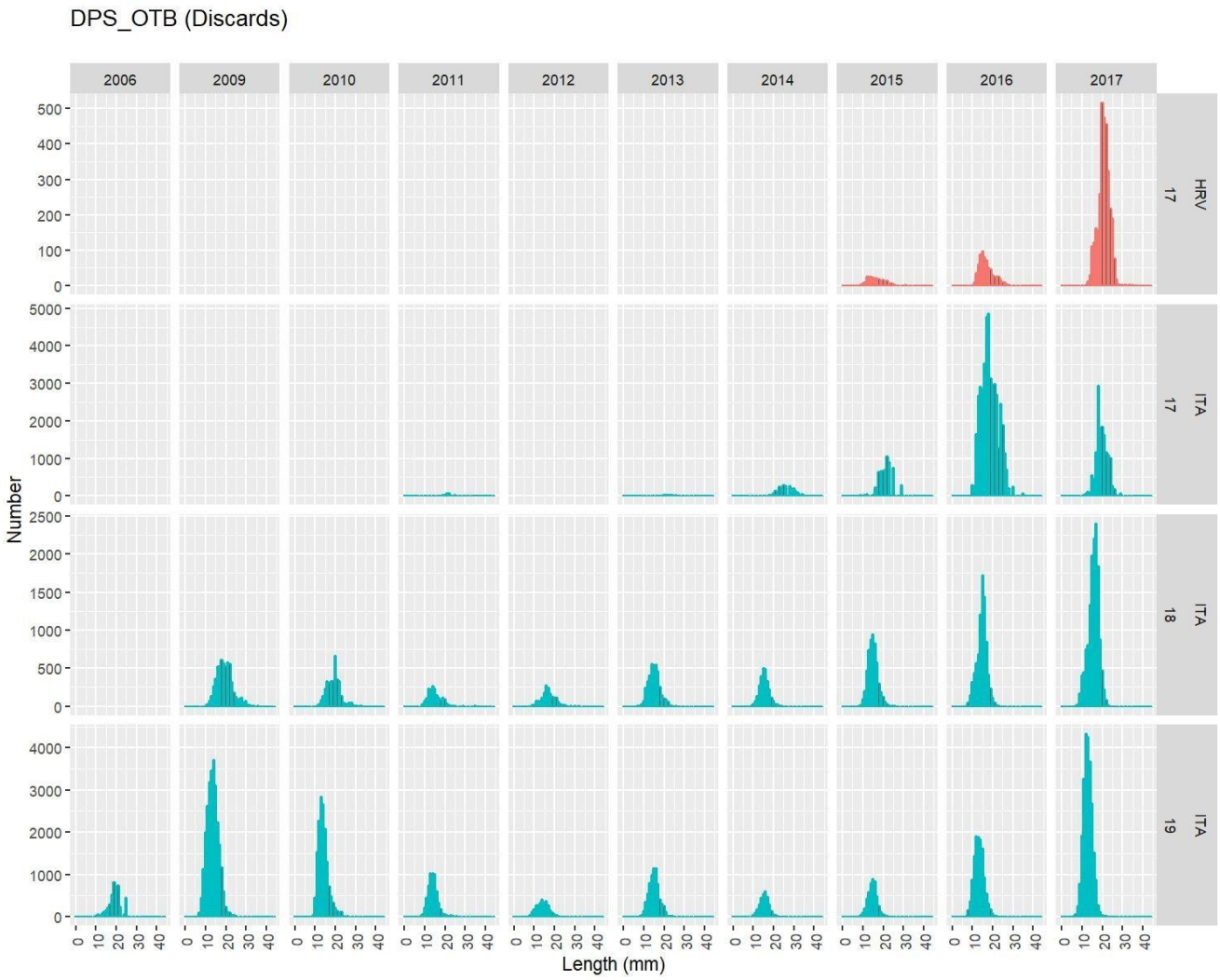


Figure Deep-water rose shrimp in GSA 17-19. Length frequency distribution of the discards by year and fleet.

Discards have been included in the total catches,the assessment is based on these catches.

3.3 Management regulations

In Italy management regulations are based on technical measures, a restricted number of fishing licenses for the fleet and an area limitation (distance from the coast and minimum fishing 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 the GSA 19 the fishing ban has not been mandatory at all times, and from one year to the other it was adopted on a voluntary basis by fishers, whilst in the last years it has been mandatory. Regarding small scale fishery management regulations are based on

technical measures related to the height and length of the gears as well as the mesh size opening, minimum landing sizes and number of fishing licenses for the fleet.

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 km2, between about 100 and 180 m depth), and in the vicinity of Tremiti Islands (115 km2 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. A 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. Also concerning conservation and management measures, minimum legal sizes and minimum mesh sizes are those proposed by EU 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.

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).

3.4 Reference points

Table 3.4-1: 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			$F_{0.1}$	0.65	STECF-18-16
Y					
CPUE					
Index of Biomass at sea					

4. Fisheries independent information

Since 1994, MEDITS trawl surveys has been regularly carried out each year during the spring season in GSAs 17-19 and MEDITS was conducted consistently from 2007 to the present.

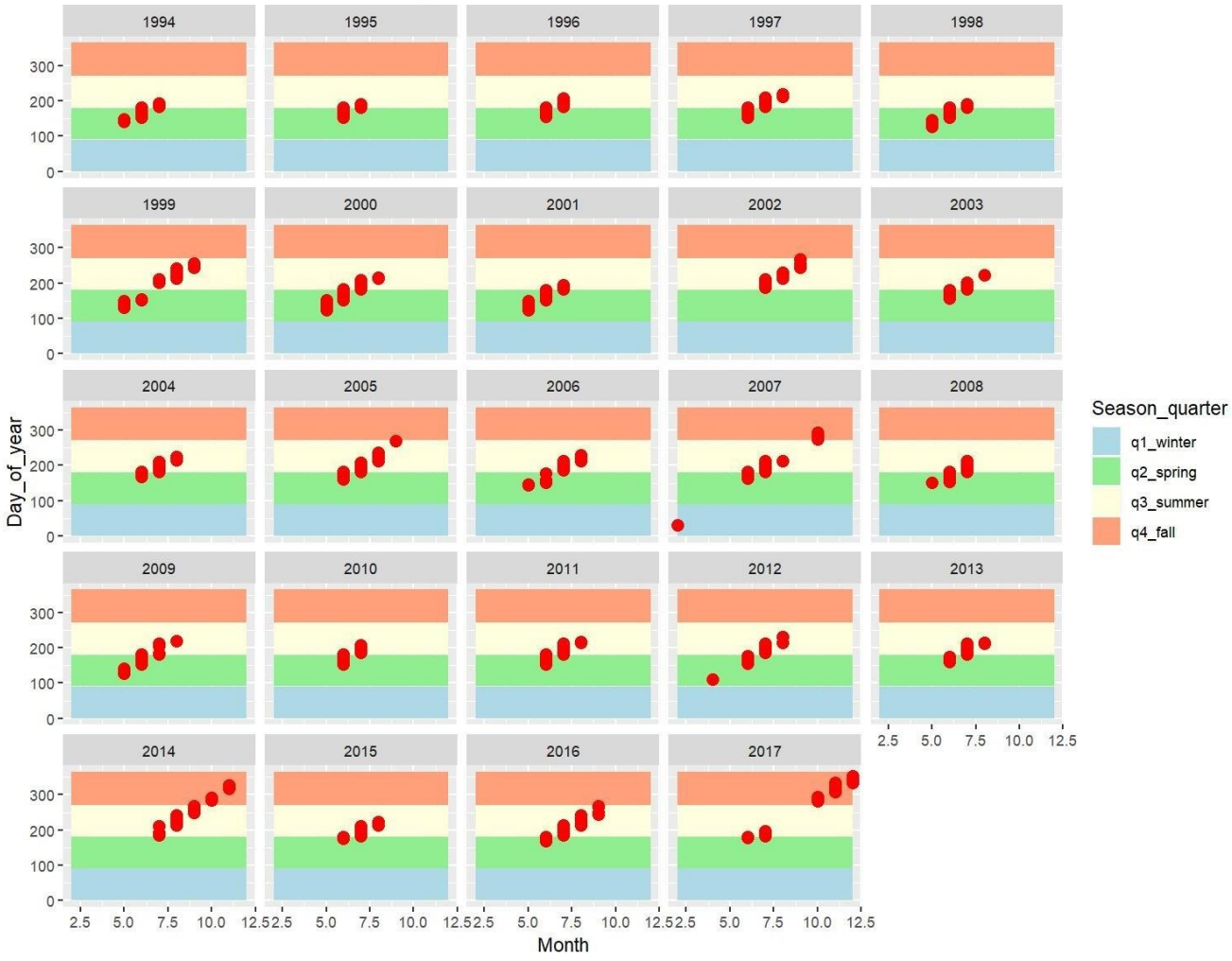


Figure Deep-water rose shrimp in GSA 17-19. Period of MEDITS survey in GSAs 17-18-19.

Table Deep-water rose shrimp in GSA 17-19. Total number of MEDITS hauls per year and country.

country	HRV	ITA	ITA	ITA	SVN
area	17	17	18	19	17
1994	0	86	72	73	0
1995	0	86	72	74	0
1996	0	85	112	74	2
1997	0	86	112	74	2
1998	0	86	112	74	2
1999	0	84	112	74	2
2000	0	86	112	74	2
2001	0	86	112	74	2
2002	59	119	90	70	2
2003	59	120	90	70	2
2004	61	118	90	70	2
2005	59	121	90	70	2
2006	59	120	90	70	0
2007	60	120	90	70	4
2008	59	121	90	70	2
2009	60	121	90	70	2
2010	60	120	90	70	2
2011	60	120	90	70	2
2012	60	119	90	70	2
2013	59	180	90	70	2
2014	56	180	90	70	2
2015	65	180	90	70	2
2016	56	180	90	70	2
2017	61	122	68	70	2

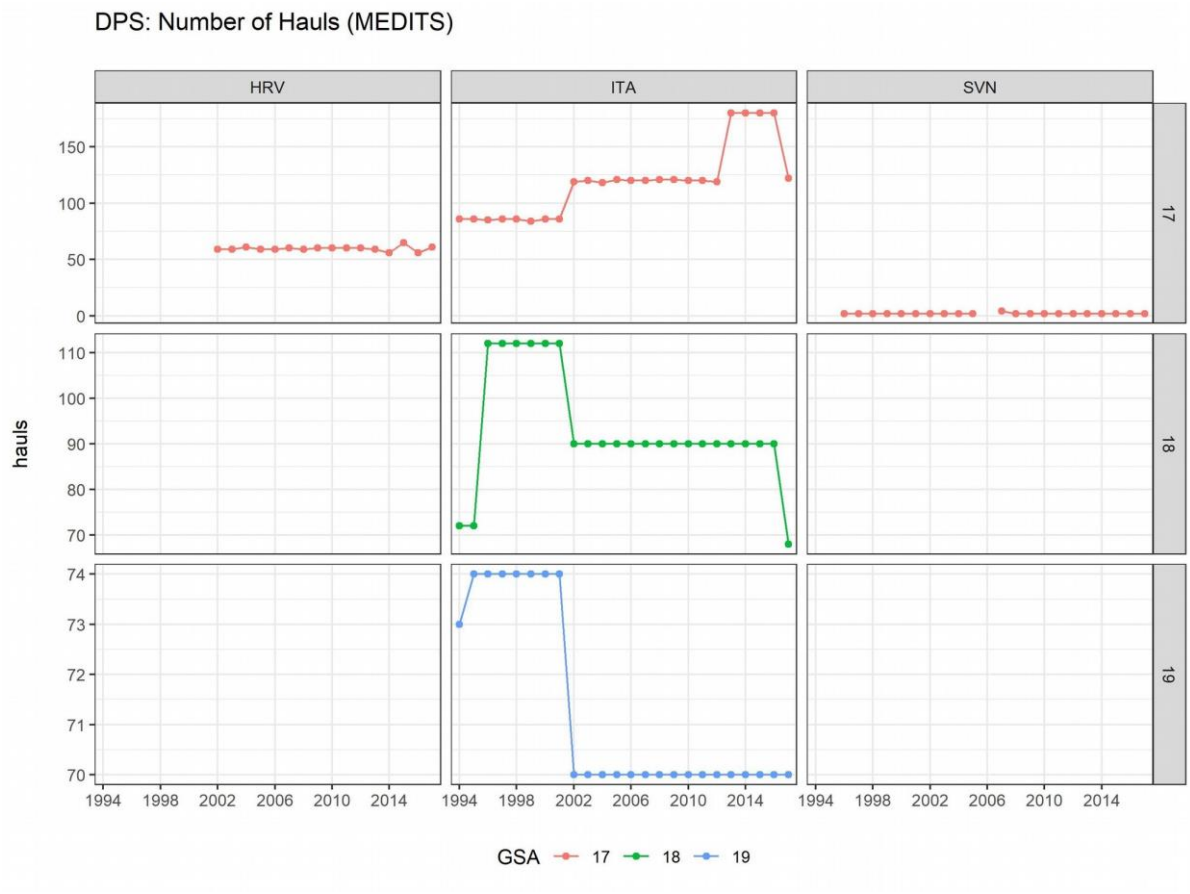


Figure Deep-water rose shrimp in GSA 17-19. Total number of MEDITS hauls per year and country.

Both estimated abundance and biomass indices show similar trends, with very high increas of value in last two years.

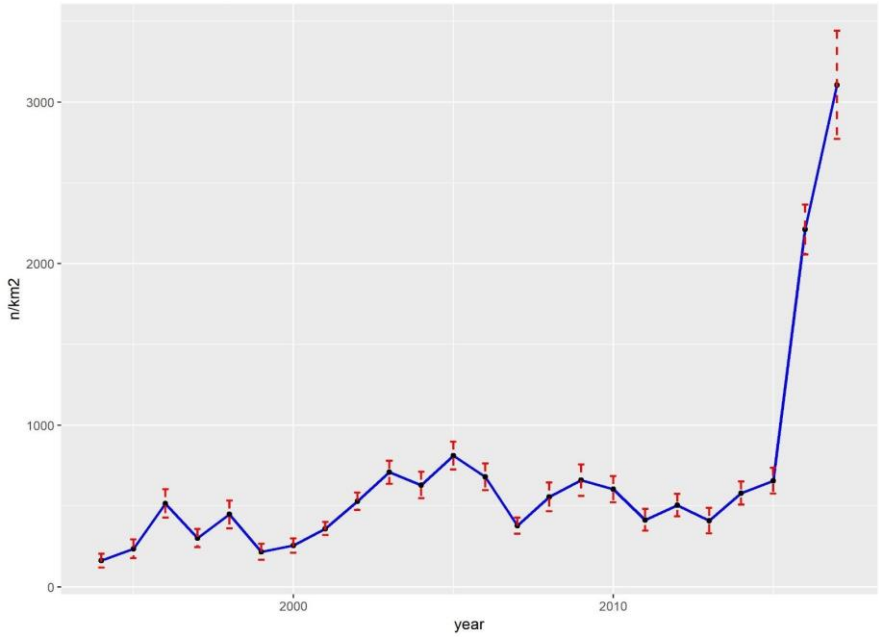


Figure Deep-water rose shrimp in GSA 17-19. Estimated abundance indices (N/km^2).

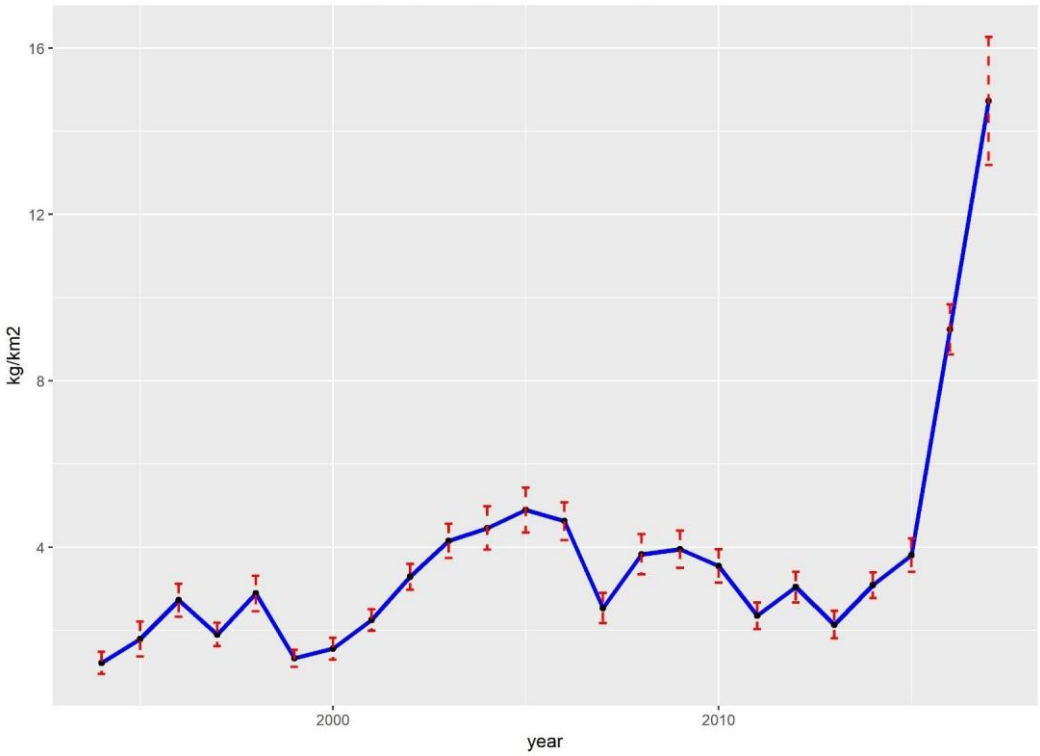


Figure Deep-water rose shrimp in GSA 17-19. Estimated biomass indices (kg/km^2)

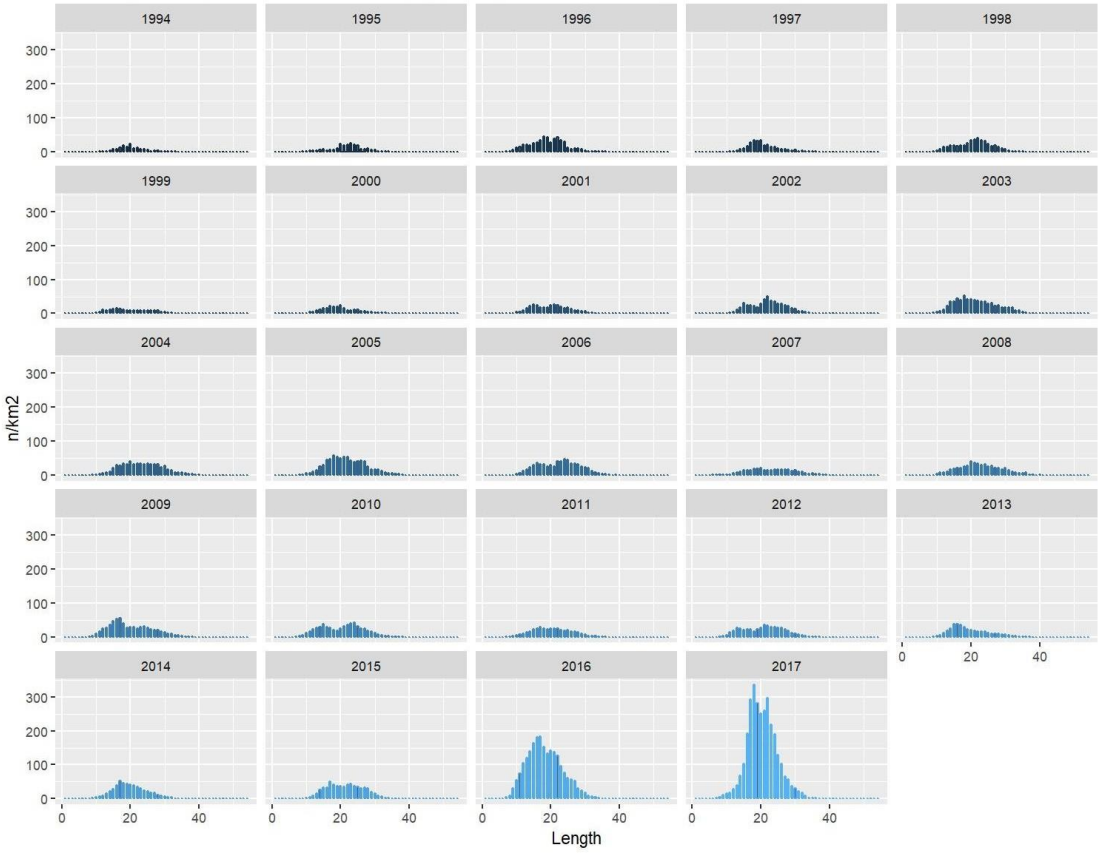


Figure Deep-water rose shrimp in GSA 17-19. Length frequency distribution by year of MEDITS.

The conclusion to the data investigation, is that only age disaggregated data is available from 2002 for the catch, so the assessment is run based on catches from 2002 to 2017. In addition data on discards at length are available only from 2009 and thus were reconstructed after the slicing procedure by by multiplying for the missing years the numbers of age at landings for the average ratio of discards and landings in the time series.

5. Ecological information

6. Stock Assessment

The statistical catch-at-age method Assessment for All (a4a) (Jardim et al., 2015) was used to estimate historical population size and fishing mortality.

Using the l2a routine in FLR catch at length and MEDITS abundaces were deterministically length sliced to numbers and mean weights at age for the assessment using the growth parameters and weight length relationship given in previous tables. These parameters were taken from the DCF data call and considered reasonable.

6.1 Input data

Table Deep-water rose shrimp stocks in GSAs 17-19: MEDITS tuning index of abundance by age and by year.

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	40.1	84.5	36.7	70.2	66.9	41.9	52.9	124.9	120.1	64.5	99.5	70.5	64.7	61.8	544.0	192.3
1	424.2	518.3	459.5	640.2	497.7	244.5	392.8	465.5	421.7	316.0	362.0	303.6	460.3	530.6	1597.2	2781.5
2	53.5	96.2	110.4	88.6	104.4	70.0	90.2	64.3	54.3	32.2	41.3	33.1	31.1	61.5	67.9	125.7
3	2.5	9.4	22.5	13.1	11.5	17.1	20.1	5.4	4.4	1.4	2.0	2.8	1.6	2.4	1.3	5.8

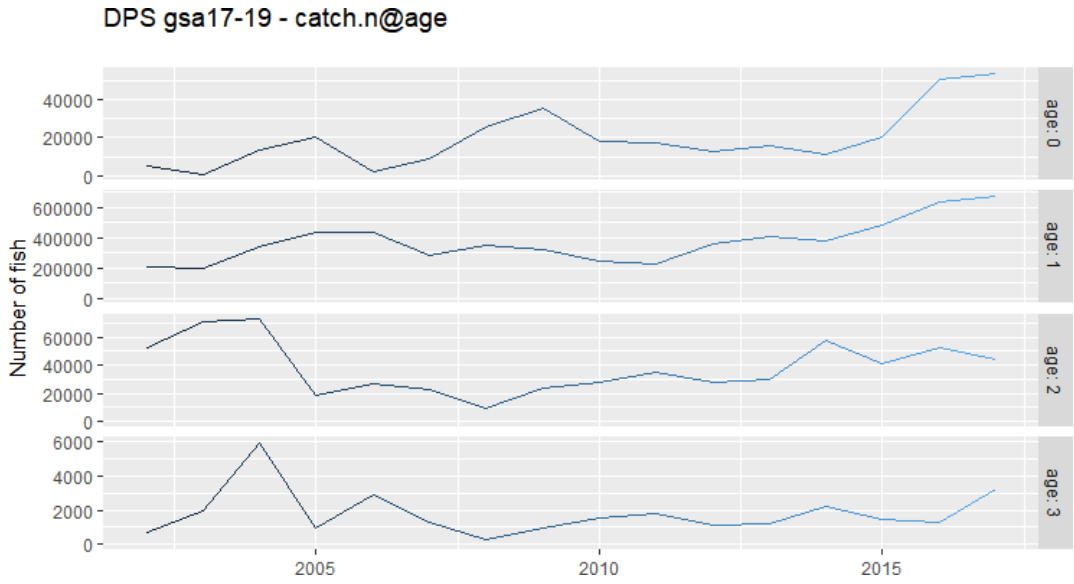


Figure Deep-water rose shrimp in GSA 17-19. MEDITS mean catch/rate at age by year derived from length by slicing.

Table Deep-water rose shrimp in GSA 17-19. Catch at age by year (sum of landings + discards after slicing).

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	4183	298	12705	17477	655	6124	9563	26433	14680	12627	4771	6035	6891	13033	35339	40689
1	166644	151596	320900	370576	176510	195693	130561	240280	198046	168589	132935	156592	232490	307434	438363	504583
2	41370	55305	68118	16260	10646	15764	3655	17736	22684	25694	10203	11415	35028	26318	36455	33478
3	560	1528	5555	821	1167	892	120	683	1250	1325	418	481	1378	947	906	2408

Differences on total catch and total of catch at age were checked and the sum of products correction (SOP) was needed.

The catches at age was raised to the total catch by applying the SOP. The corrected catch at age matrix and the applied SOP factors are reported below. The SOP factors represent not just numercial issues but include also the extent of 'fill-ins' where no sampling data is provided, but similar fleets have sampling data.

Table Deep-water rose shrimp in GSA 17-19. The new catch at age matrix SOP corrected.

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	5287	382	13569	20372	1630	8949	25610	35382	18048	16995	12791	15535	11253	20429	51116	54351
1	210617	194091	342715	431968	439382	285957	349647	321624	243477	226908	356371	403086	379629	481879	634060	674006
2	52287	70808	72748	18953	26501	23035	9789	23740	27887	34582	27353	29384	57197	41251	52729	44719
3	708	1956	5933	957	2905	1303	321	914	1537	1783	1120	1238	2250	1485	1310	3217

Table Deep-water rose shrimp in GSA 17-19. SOP corrections for years applied to raised catch at length/age used in the assessment.(SOP values include 'fill-ins' as well as numerical corrections)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SOP	1.26	1.28	1.07	1.17	2.49	1.46	2.68	1.34	1.23	1.35	2.68	2.57	1.63	1.57	1.45	1.34

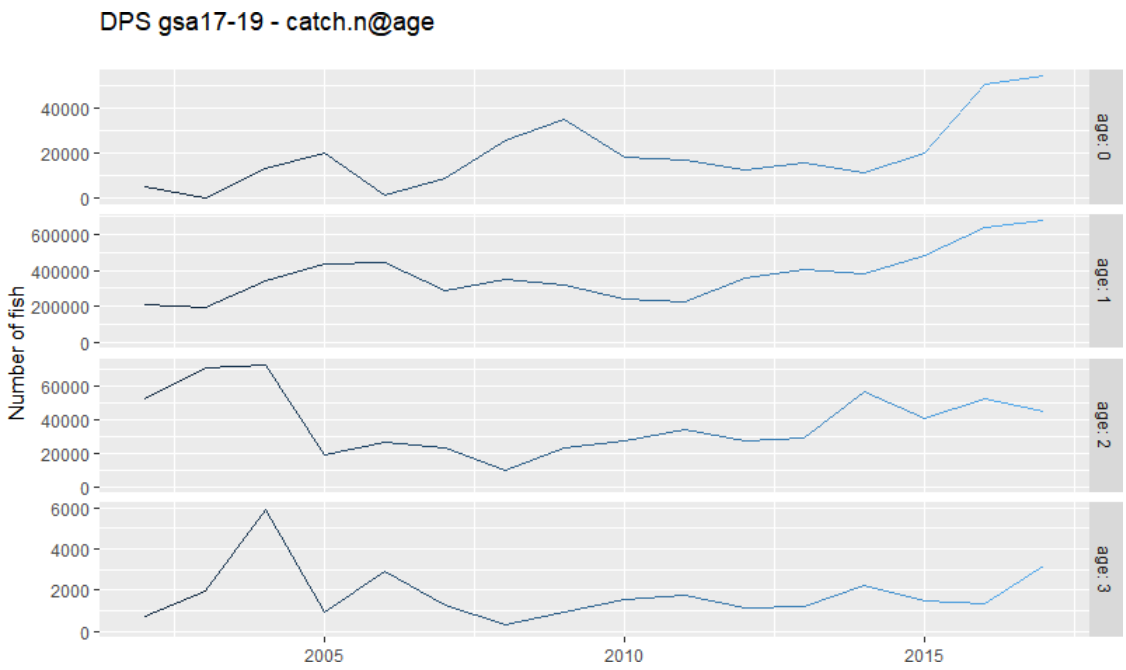
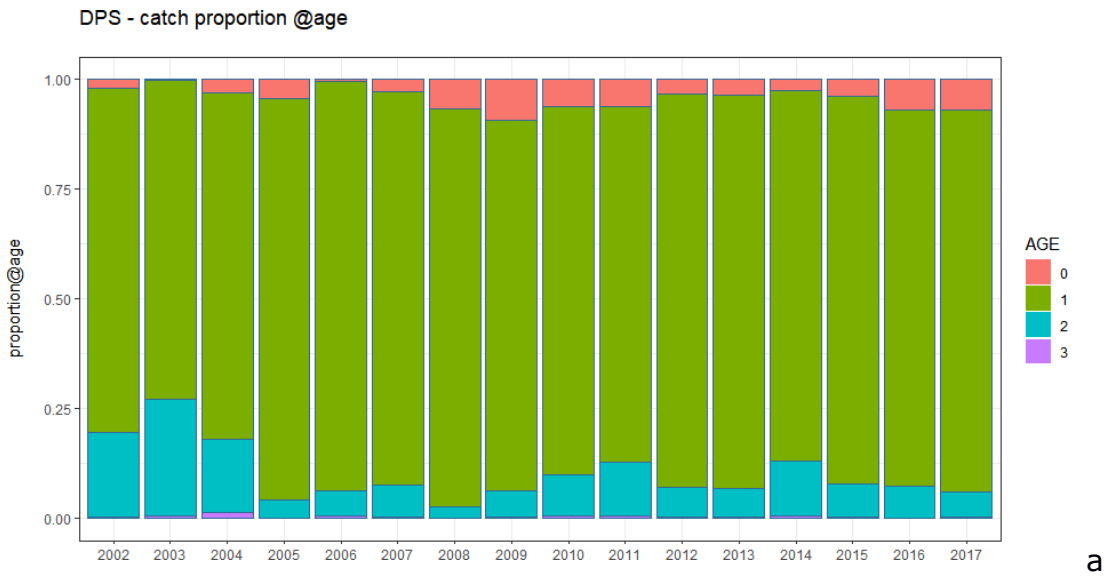
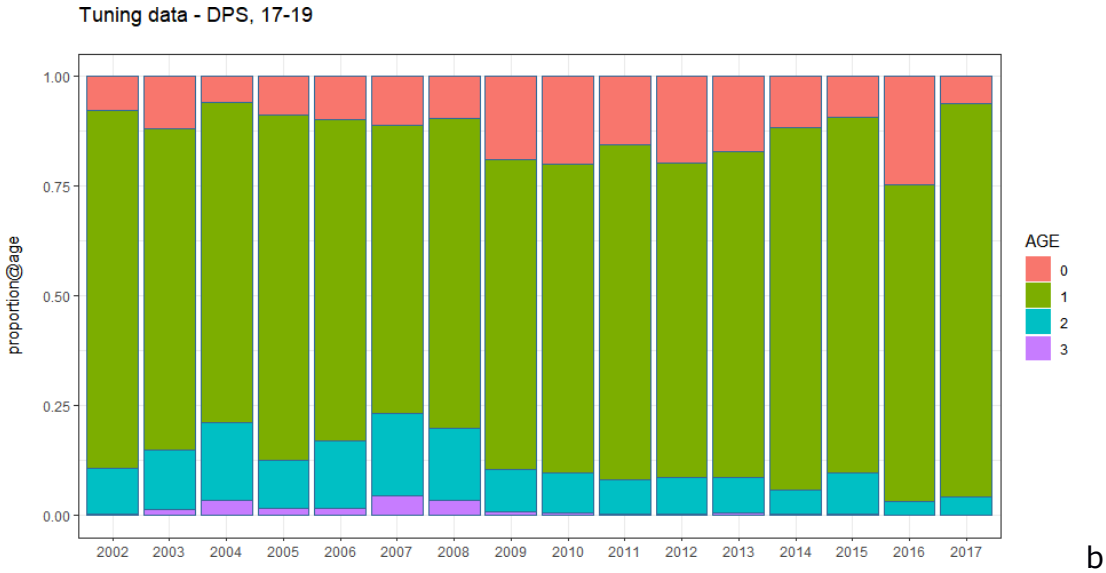


Figure Deep-water rose shrimp in GSA 17-19. Catch at age by year from length slicing and SOP correction.



a



b

Figure Deep-water rose shrimp in GSA 17-19. Proportion at age by year from catch at length (a) and index at length (b) slicing.

Table Deep-water rose shrimp in GSA 17-19. Total Catch by year in tonnes

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
all	2144	2406	3554	2951	3212	2074	2074	2290	1942	1965	2445	2744	3129	3472	4517	4834

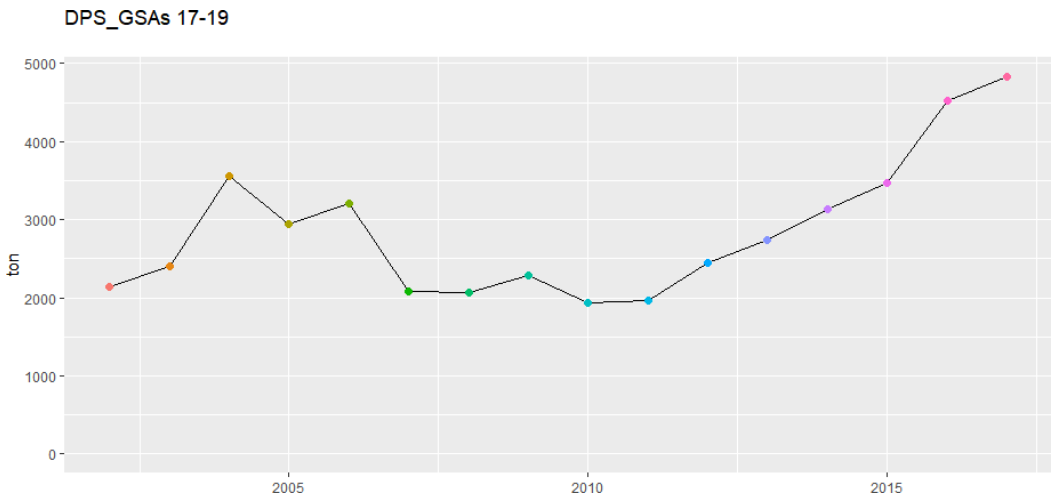


Figure Deep-water rose shrimp in GSA 17-19. Trend of total catch in tonnes used as input in the assessment.

Table Deep-water rose shrimp in GSA 17-19. Maturity and Natural mortality and catch weights at age.

Age	0	1	2	3
Maturity	0.519	0.939	0.977	1.0
Natural Mortality	0.466	0.353	0.291	0.252
weights at age (kg)	0.002	0.007	0.014	0.024

Average spawning time was set 0.5 (1st July) according to the biology of the species.

Catch were used from 2002 to 2017.

The age age range used in the assessment was 0 to 3+.

Fbar was set from 1 to 2.

The stock assessment was based on the following submodels:

fmodel: ~factor(replace(age, age > 1, 1)) + s(year, k = 6) + s(age, k = 2, by = breakpts(year, 2010)) (separable model with smoothing for year and breakpoint in 2010)

srmodel: ~factor(year) (recruitment independent by year)

n1model: ~factor(age)

qmodel: **~factor(age)**

vmodel: **catch: ~s(age, k = 3) (smooth catch model)**

IND: **~1 (One index)**

Assessment results (method a4a)

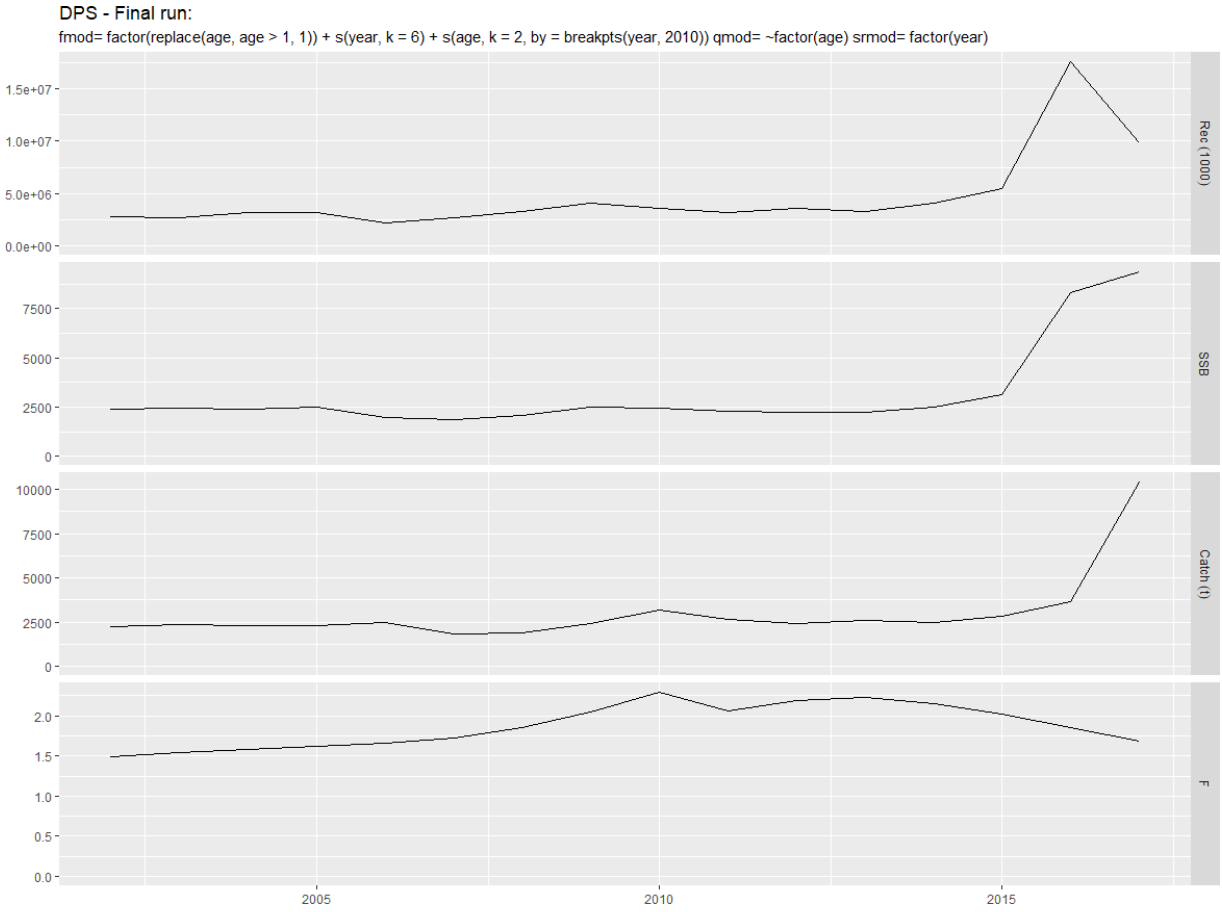


Figure Deep-water rose shrimp in GSA 17-19. Stock summary from the a4a model for recruits, SSB (Stock Spawning Biomass), catch and harvest (fishing mortality for ages 1 to 2).

Table Deep-water rose shrimp in GSA 17-19. Stock summary from the assessment.

year	Fbar 0-2	Recruitment	SSB	TB	Catch
2002	Fbar 1-2	2785160	2411	9289	2268
2003	1.49	2748991	2445	9615	2350
2004	1.54	3184531	2381	9444	2276
2005	1.59	3219191	2501	10074	2304
2006	1.62	2194468	1987	7718	2490
2007	1.65	2724979	1846	7630	1841
2008	1.72	3269371	2096	8974	1868
2009	1.85	4126159	2494	11060	2436
2010	2.04	3575085	2440	11238	3214
2011	2.29	3200568	2277	9776	2676
2012	2.06	3633111	2236	10002	2442
2013	2.19	3278316	2250	10039	2605
2014	2.23	4073328	2500	11106	2499
2015	2.15	5439999	3131	13575	2852
2016	2.02	17553416	8335	36900	3683
2017	1.85	9883771	9359	35754	10408

Table Deep-water rose shrimp in GSA 17-19. Stock number by age and by year in thousands.

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	2785200	2749000	3184500	3219200	2194500	2725000	3269400	4126200	3575100	3200600	3633100	3278300	4073300	5440000	17553000	9883800
1	565490	481880	475540	550800	556740	379480	471110	564990	712600	616930	551830	626070	564850	702030	938100	3029000
2	38662	62914	51247	48729	54923	53852	34661	38670	39304	40254	48938	39401	43598	41546	57468	87203
3	857.62	3449.2	5682.7	4953.9	4471.9	4653	4291.5	2625.1	2096.1	1572.7	1603.7	1640.2	1281.9	1525.5	1734.9	2911.5

Table Deep-water rose shrimp in GSA 17-19. Fishing Mortality by age and by year

age	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1	1.26	1.3	1.34	1.37	1.4	1.45	1.56	1.73	1.94	1.6	1.7	1.73	1.67	1.56	1.44	1.31
2	1.72	1.78	1.83	1.87	1.91	1.99	2.14	2.36	2.65	2.52	2.68	2.72	2.64	2.47	2.27	2.07
3	0.93	0.97	0.99	1.01	1.04	1.08	1.16	1.28	1.44	2.46	2.62	2.66	2.58	2.41	2.22	2.02

6.1.1 Robustness analysis

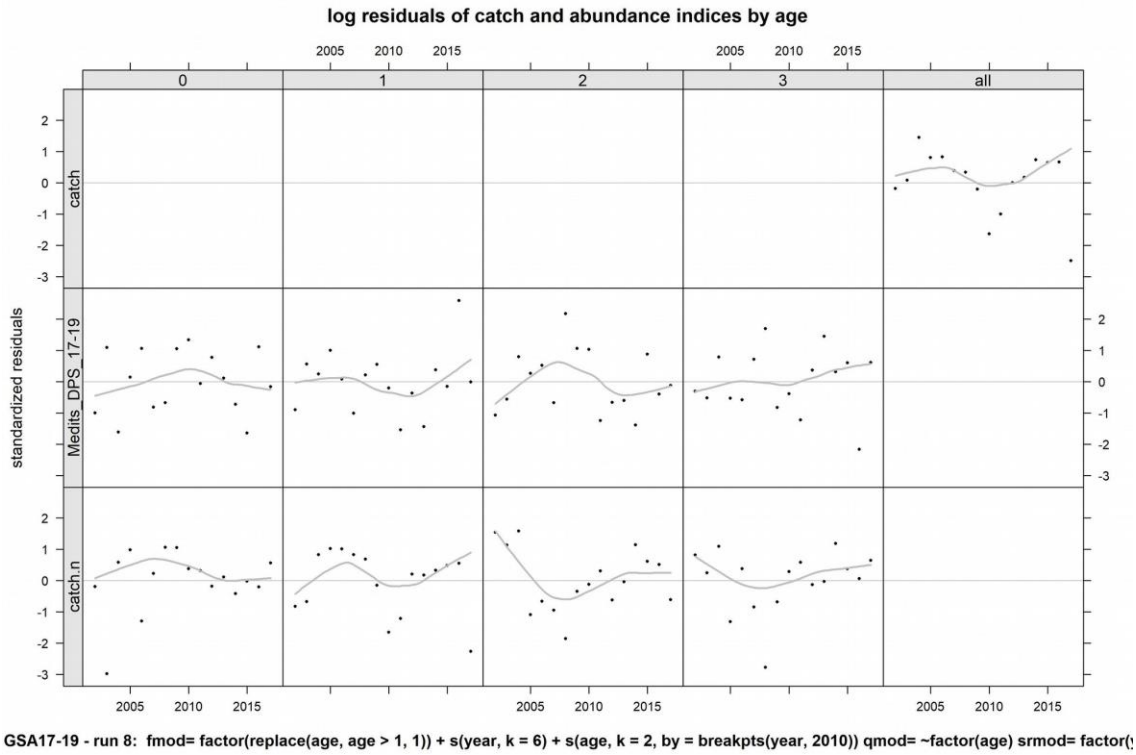


Figure Deep-water rose shrimp stocks in GSAs 17-19. Standardized residuals for abundance indices and for catch numbers (catch.n). Each panel is coded by age class, dots represent standardized residuals and lines a simple smoother.

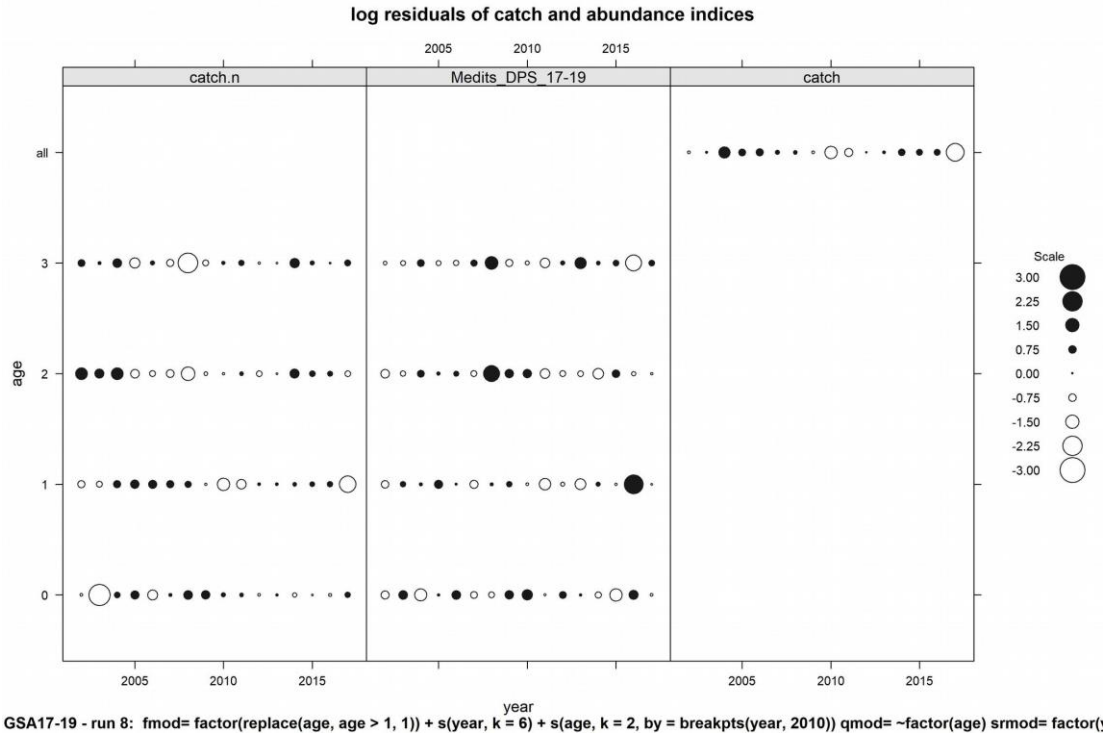


Figure Deep-water rose shrimp stocks in GSAs 17-19. Residuals of residuals for abundance indices and catch by age.

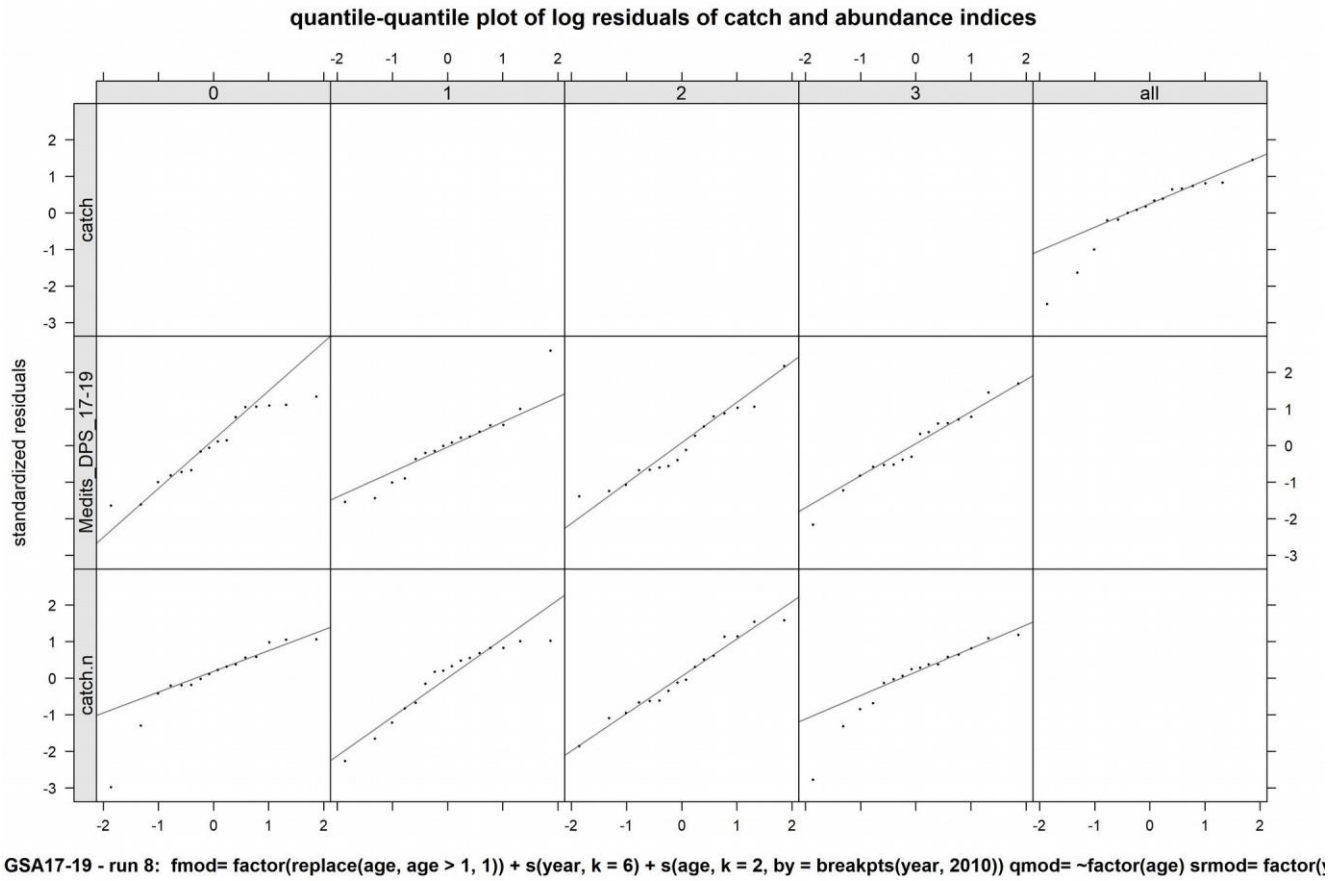


Figure Deep-water rose shrimp stocks in GSAs 17-19. Quantile-quantile plot of standardized residuals for abundance indices and for catch numbers (catch.n). Each panel is coded by age class, dots represent standardized residuals and lines the normal distribution quantiles.

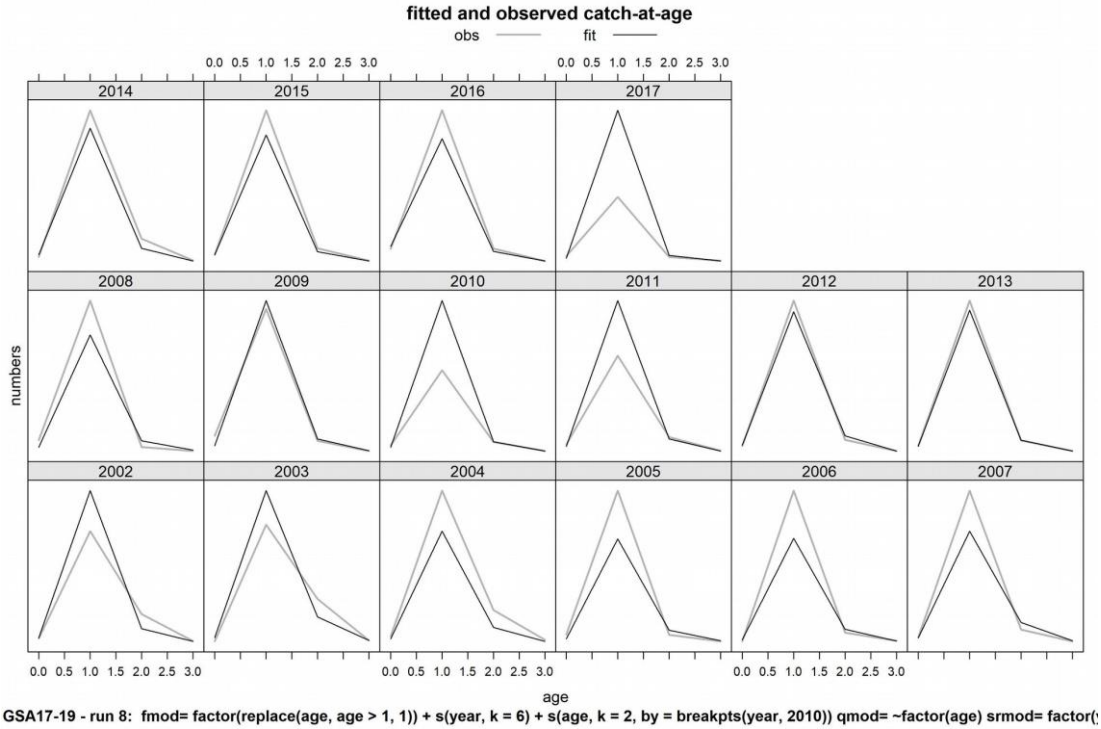


Figure Deep-water rose shrimp stocks in GSAs 17-19. Fitted and observed catch at age.

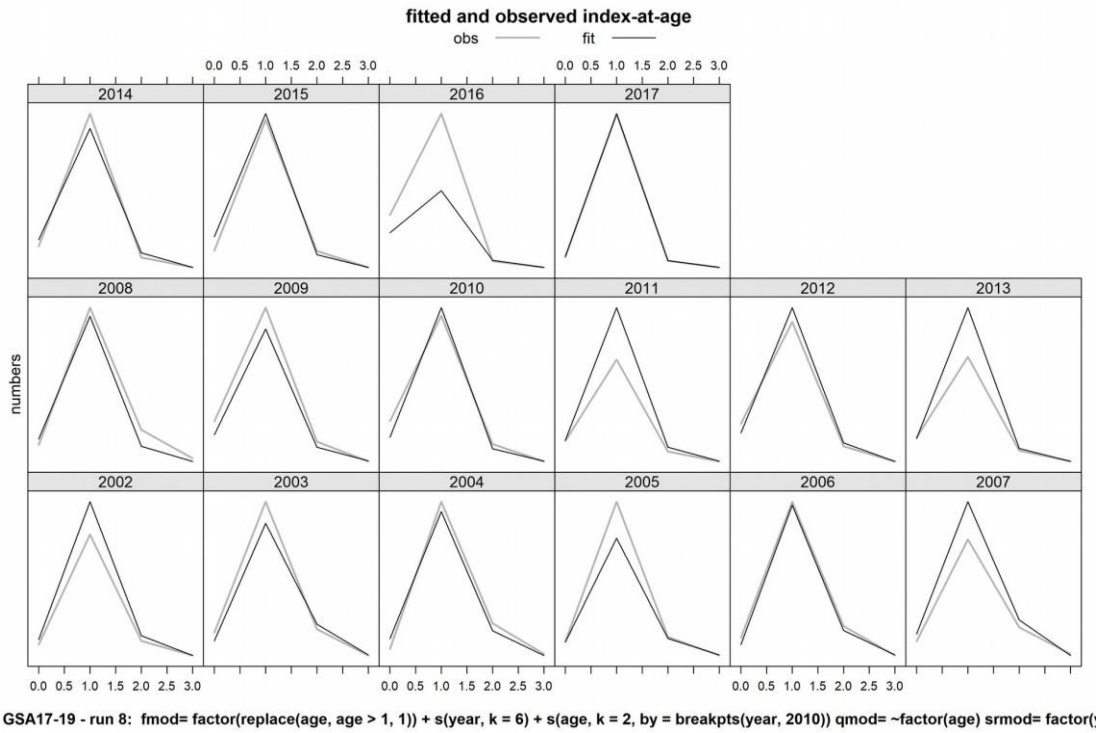


Figure Deep-water rose shrimp stocks in GSAs 17-19. Fitted and observed index at age.

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

The retrospective analysis applied up to 1 years back only due to the short time series shows quite moderate stability for the models, however, the conclusions on stock exploitation status of F>F0.1 is maintained throughtout.

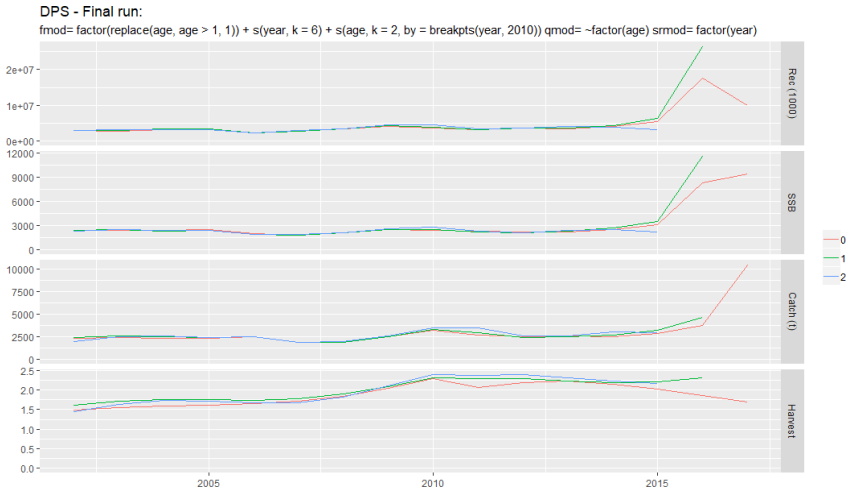


Figure Deep-water rose shrimp in GSA 17-19. Analytical retrospective 2002 to 2017, Recruitment, SSB, catch and Fishing mortality.

7. Stock predictions

This assessment is considered acceptable, the age sliced index has coherence from year to year and the assessment provides a coherent explanation of the trend in catches. Retrospective performance is moderately stable and confirms stock explitation status throughout.

Based on the a4a results, the Deep-water rose shrimp stocks in GSAs 17-19 shows SSB an increase in the last two years (2016 and 2017) and a spike in the number of recruits in 2016 with the last year's recruitment (2017) the second highest in the series with a value of 9883 thousands individuals. Fbar (1-2) fluctuated and shows a decreasing trend in the last years down to a value of 1.67 in 2017. The assessment has considerable difficulty in estimating catch in 2017. The rapidly changing recruitment over the last few years results in the assessment estimating higher than reported catches by a factor close to two. If this is incorrect, and catches are nearer reported catch, then F in the final year will be lower than the F shown in the assessment. However, F will still be above F_{msy}.

7.1 Short term predictions

A deterministic short term forecast was carried using FLSTF for years 2018 to 2020.

For mean weights, maturity, natural mortality and selection pattern, the last year was used. The recruitment in 2018 to 2020 (5186919 thousand)was taken as geometric mean of the last seven years (2010-2017).

Fishing at F0.1 in 2019 leads to reduce catch of about 53%.

Table Deep-water rose shrimp stocks in GSAs 17-19: Short term forecast results for 2017 to 2020 based on selection and biological parameters of last years, and geometric mean recruitment from 2002 to 2017.

Rationale	Ffactor	Fbar	Catch_2017	Catch_2019	Catch_2020	SSB_2020	SSB_change 2018-2020(%)	Catch_change 2018-2019(%)
zero catch	0.0	0.00	10408	0.0	0.0	9910.9	64.1	-100
F01	0.4	0.65	10408	2635.0	3048.3	6124.2	1.4	-75
Fupp	0.5	0.89	10408	3294.5	3425.1	5365.4	-11.2	-68
Flow	0.3	0.43	10408	1903.4	2466.3	7054.8	16.8	-82
Status quo	1.0	1.69	10408	4847.87	3888.88	3866.3	-36.0	-53
Different scenarios	0.2	0.34	10408	1545.1	2111.8	7544.7	24.9	-85
	0.3	0.51	10408	2169.3	2699.2	6705.8	11.0	-79
	0.4	0.68	10408	2713.9	3100.4	6029.4	-0.2	-74
	0.5	0.85	10408	3190.6	3374.2	5480.0	-9.3	-69
	0.6	1.01	10408	3609.0	3561.4	5029.9	-16.7	-65
	0.7	1.18	10408	3977.5	3690.0	4658.2	-22.9	-62
	0.8	1.35	10408	4303.0	3779.4	4348.3	-28.0	-59
	0.9	1.52	10408	4591.4	3842.6	4087.6	-32.3	-56
	1.0	1.69	10408	4847.9	3888.9	3866.3	-36.0	-53
	1.1	1.86	10408	5076.6	3924.2	3676.7	-39.1	-51
	1.2	2.03	10408	5281.2	3952.7	3512.8	-41.8	-49
	1.3	2.20	10408	5464.9	3977.1	3369.9	-44.2	-47
	1.4	2.37	10408	5630.2	3999.1	3244.3	-46.3	-46
	1.5	2.54	10408	5779.5	4019.9	3133.1	-48.1	-44
	1.6	2.71	10408	5914.8	4040.2	3033.8	-49.8	-43
	1.7	2.87	10408	6037.7	4060.4	2944.8	-51.2	-42
	1.8	3.04	10408	6149.8	4080.7	2864.4	-52.6	-41
	1.9	3.21	10408	6252.2	4101.1	2791.4	-53.8	-40
	2.0	3.38	10408	6346.1	4121.7	2724.9	-54.9	-39

8. Draft scientific advice (Examples in blue)

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	$F_{0.1}$ = 0.65			Last year	IO
	Fishing effort					
	Catch					
Stock abundance	Biomass			66th percentile		S_H
	SSB					
Recruitment					I	
Final Diagnosis	Based on these results STECF-EWG 18-16 considers the stock has been depleted well below Bmsy and been overexploited (F>Fmsy) in the last years.					

For more details please refer to

https://stecf.jrc.ec.europa.eu/reports/medbs

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)*