SAC GFCM
Sub-Committee on Stock Assessment

Date*	18	October	2010	Code*	DPS0910Col

Authors*

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Species Scientific name*

1 *Parapenaeus longirostris - DPS*
Source: GFCM Priority Species

2
Source: -

3
Source: -

Geographical area*

Western Mediterranean (FAO Subarea 37.1.)

Geographical Sub-Area (GSA)*

09 - Ligurian and North Tirrenian Sea

Combination of GSAs
1
2
3

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet #0** **Basic data on the assessment**

Code: DPS0910Col

Date*	18	Oct	2010	Authors*	Colloca F.(1), Sartor P. (2); Ligas A. (2) Mannini A.(3), Abella A.(4)

Species Scientific name*	Parapenaeus longirostris - DPS	Species common name*	Deep-sea pink shrimp

Data Source

GSA*	09 - Ligurian and North Tirrenian Sea	Period of time*	1994-2010

Description of the analysis

Type of data*	Catch, trawl survey indices	Data source*	Official Statistics
Method of assessment*	Extended Survivor analysis (XSA), Surba, Y/R	Software used*	FL-XSA, SURBA, YIELD

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	1	1	---	1	1	1	1	1	1	1	1

Comments, bibliography, etc.

Deep-Sea pink shrimp has been assessed using both trawl survey data (MEDITS 1994-2008; GRUND 1994-2007) and catch data (DCR 2006-2010). The survey-based stock assessment model SURBA (Needle, 2003) was used to reconstruct trend in population structure and fishing mortality. Equilibrium YPR reference points (F01) for the stock were estimated through the Yield software (Hoggarth et al., 2006) assuming recruitment fluctuating randomly around a constant value and 20% uncertainty in input parameters. SURBA analysis was performed using an M vector obtained using ProdBiom. Average fishing mortality (F1-3) estimated from MEDITS ranged between 0.78 and 1.8 (1.16 in 2007). A different picture was obtained using LCA on 2006-08 landing data. F1-3 was between 0.5 and 0.6, little below the estimated reference value of F0.1=0.7.
Relative indices derived from scientific MEDITS survey for the period 1994-2008 indicated an increasing trend of the spawning stock biomass with three peaks in 1999 and 2006 and 2008. In 2008 the SSB was the highest observed since 1994. GRUND data shows a very similar temporal trend in SSB. Given the current uncertainty in F estimates, the relevant fleet effort should not be increased, in order to avoid future low stock productivity and landings.

Comments, bibliography, etc.

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Abella A., Caddy J.F., Serena F. (1997) Declining natural mortality with age and fisheries on juveniles: a Mediterranean demersal fishery yield paradigm illustrated for Merluccius merluccius. Aquatic Living Resources 10: 257–269.

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Assessment form	**Sheet B** **Biology of the species**

Code: DPS0910Col

Biology

Somatic magnitude measured (LH, LC, etc)*		Carapace Length		Units*	1 millimiter

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed	47	42			Reproduction season	all year (winter-spring
Size at first maturity	24				Reproduction areas	at about 80-100m
Recruitment size	10	10			Nursery areas	coastal

Parameters used (state units and information sources)

			Sex			
		Units	female	male	both	unsexed
Growth model	L∞	cm	43.5	33.1		
	K	year-1	0.74	0.93		
	t0	year	-0.13	0.05		
	Data source	Length frequency distributions				
Length weight relationship	a				0.00686	
	b				2.24	

M			M vector (see comments)

sex ratio (mal/fem)	

Comments

The species shows a wide bathymetric distribution in the GSA 09, being present from 50 to 650 m depth with greatest abundance between 150 and 400 m depth over muddy or sandy-muddy bottoms (Ardizzone and Corsi, 1997; Biagi et al., 2002).
The highest abundances have been found in the Tyrrhenian part of the GSA (south Tuscany and Latium).
Recruits (CL 15 mm) occur all year round with a main peak from July to October (De Ranieri et al., 1997). The main nurseries revealed a high spatio-temporal persistency (Fig. 8.32.1.1.1) between 60 and 220 m depth. The core of nursery areas overlap with crinoid beds (Leptometra phalangium) over the shelf-break (Colloca et al., 2004, 2006; Reale et al., 2005). This is a peculiar habitat in the GSA 09 which is also an essential fish habitat for other commercially important species as the European hake, Merluccius merluccius. A positive size-depth distribution was found with an increased abundance of larger females with depth (Ardizzone et al., 1990).
The growth of P. longirostris has been studied in the southern part of the GSA 09 (central Tyrrhenian Sea) using modal progression analysis (Ardizzone et al., 1990). The following sets of Von Bertalanffy growth parameters were estimated: Females: L = 43.5, K=0.74, t0=-0.13; Males: L = 33.1, K=0.93, t0 =-0.05. The life cycle is of 3-4 years. Females grow faster than males attaining larger size-at-age.
In the northern Tyrrhenian Sea, the reproduction area of P. longirostris is located from 150 to 350 m; mature females are present all year round, even though the species shows two peaks in reproductive activity, one in spring and another at the beginning of autumn (Mori et al., 2000a). In the central Tyrrhenian Sea, the southern part of GSA 09, a main winter spawning was hypothesized (Ardizzone et al., 1990). The size at onset of sexual maturity estimated for different years in northern Tyrrhenian Sea is about 24 mm CL (Mori et al., 2000a).

Comments

The number of oocytes in the ovary was related to the size of the females and ranged from 23,000 oocytes at 26 mm CL to 204,000 at 43 mm CL. An exponential relationship was observed between fecundity and carapace length: Fecundity = 0.0569 CL4.0177 (r = 0.829) (Mori et al., 2000a).
The abundance of P. longirostris show a clear increasing trend in the GSA 9, significantly correlated with the rise of sea water temperature (SST) observed in the area during the last 15 years (Ligas et al., 2011).

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Assessment form

Sheet P1
General information about the fishery

Code: DPS0910Col

Data source*	Official Statistics+ MEDITS trawl surveys	Year (s)*	2005-2010
Data aggregation (by year, average figures between years, etc.)*	By year 2005-2010		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ITA	09	E - Trawl (12-24 metres)	03 - Trawls	33 - Demersal shelf species	DPS
Operational Unit 2						
Operational Unit 3						
Operational Unit 4						
Operational Unit 5						

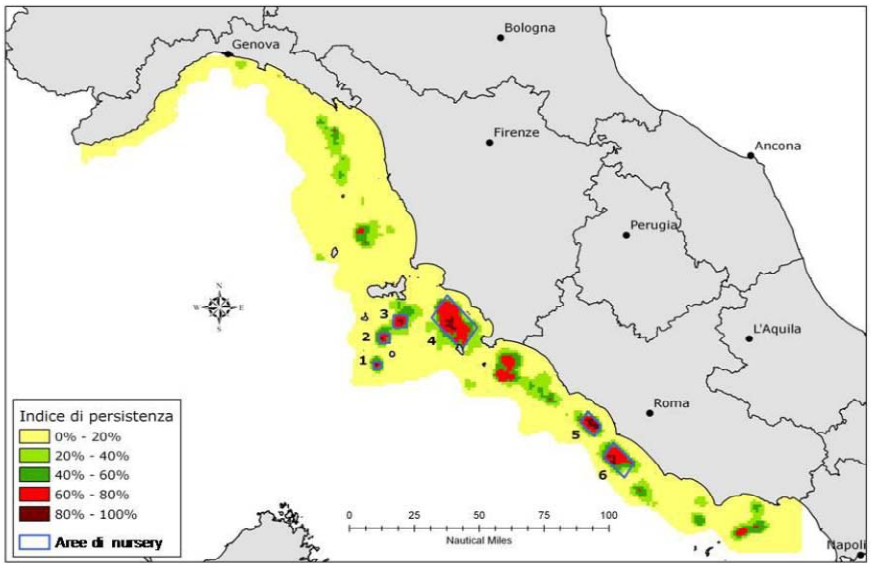
Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ITA 09 E 03 33 - DPS	339	Tons	490	ephrops, horse m		Macroramphosus	
Total	339		490				

Legal minimum size	20 mm CL

Comments

In the GSA 09 the deep water pink shrimp is one of the most important target species of the fishery carried out on the shelf break and upper part of continental slope. The species is exclusively exploited with otter bottom trawling.
The fishing grounds are located in the southern part of the GSA 09, to the south of Elba Island (northern and central Tyrrhenian Seas); they are mainly exploited by several trawlers of Porto Santo Stefano, Porto Ercole, Fiumicino, Terracina and Gaeta. *P. longirostris* belongs to a fishing assemblage distributed from 150 to 350 m depth, where the main target species are hake, *Merluccius merluccius*, horned octopus, *Eledone cirrhosa* and Norway lobster, *Nephrops norvegicus*, at greater depths (Biagi *et al.*, 2002; Colloca *et al*., 2003; Sartor *et al*., 2003; Sbrana et al., 2006).
The fishing grounds are located in the southern part of the GSA 09, to the south of Elba Island (northern and central Tyrrhenian Seas); they are mainly exploited by several trawlers of Porto Santo Stefano, Porto Ercole, Fiumicino, Terracina and Gaeta. P. longirostris belongs to a fishing assemblage distributed from 150 to 400 m depth, where the main target species are *Merluccius merluccius*, *Eledone cirrhosa* and *Nephrops norvegicus* at greater depths (Biagi et al., 2002; Colloca et al., 2003; Sartor et al., 2003; Sbrana et al., 2006). Total landings of deep water rose shrimps fluctuated from 161 tons in 2002 to 254 tons in 2008, showing a peak in 2006 corresponding to 462 tons. Discards of P. longirostris are generally scarce Sbrana et al. (2006). They ranged from 36.7 tons in 2009 corresponding to 11% of the total catch and to 5% of the total catch in 2010 (36.7 tons). Discards occurred mainly on the fishing grounds located at depths of less than 200 m, where juvenile specimens are more abundant. About 9 tons of discards were

Comments



Distribution and temporal persistence of nurseries of *Parapenaeus longirostris* in the GSA 9 estimated from MEDITS data (1994-2006)

The

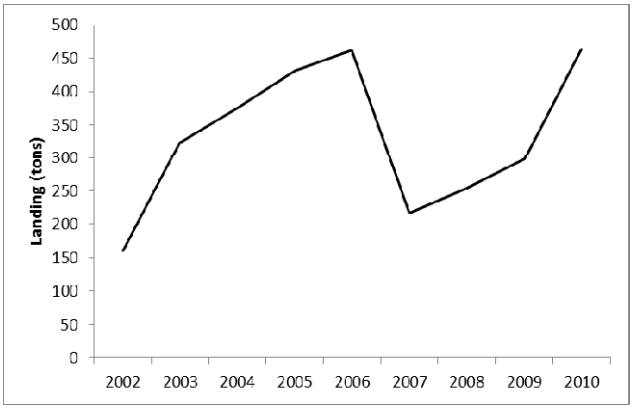


Fig.

Annual landing of *Parapenaeus longirostris* from 2002 to 2010

Data source*	Official Statistics	OpUnit 1*	ITA 09 E 03 33 - DPS

Time series

Year*	2003	2004	2005	2006	2007	2008
Catch	323	376	431	462	217	254
Minimum size				13	13	17
Average size Lc				30	28.3	27.9
Maximum size				43	42	43
Fleet				1	1	1

Year	2009	2010				
Catch	335	490				
Minimum size	11	11				
Average size Lc						
Maximum size	49	47				
Fleet	1	1				

Selectivity

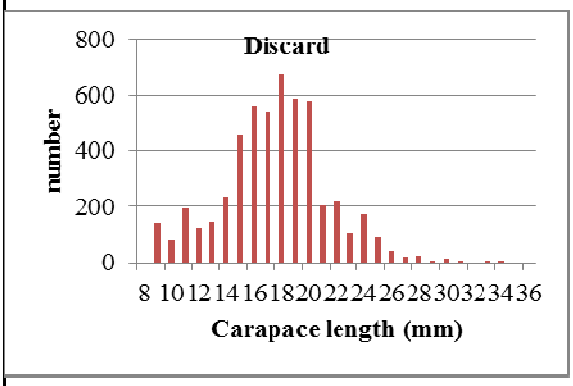
L25	
L50	14.8
L75	
Selection factor	0.37

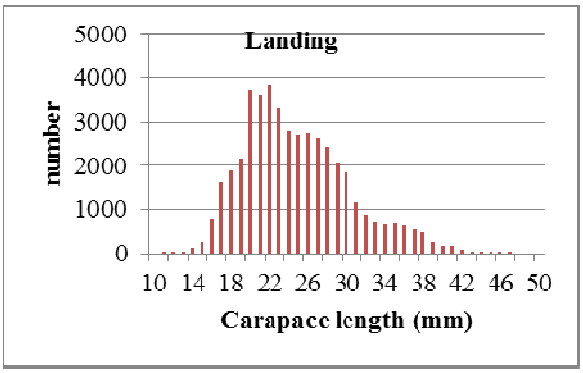
Remarks

This L50 value was obtained with a 40 mm stretched mesh size in the cod end (estimated during GRUND survey 1998).

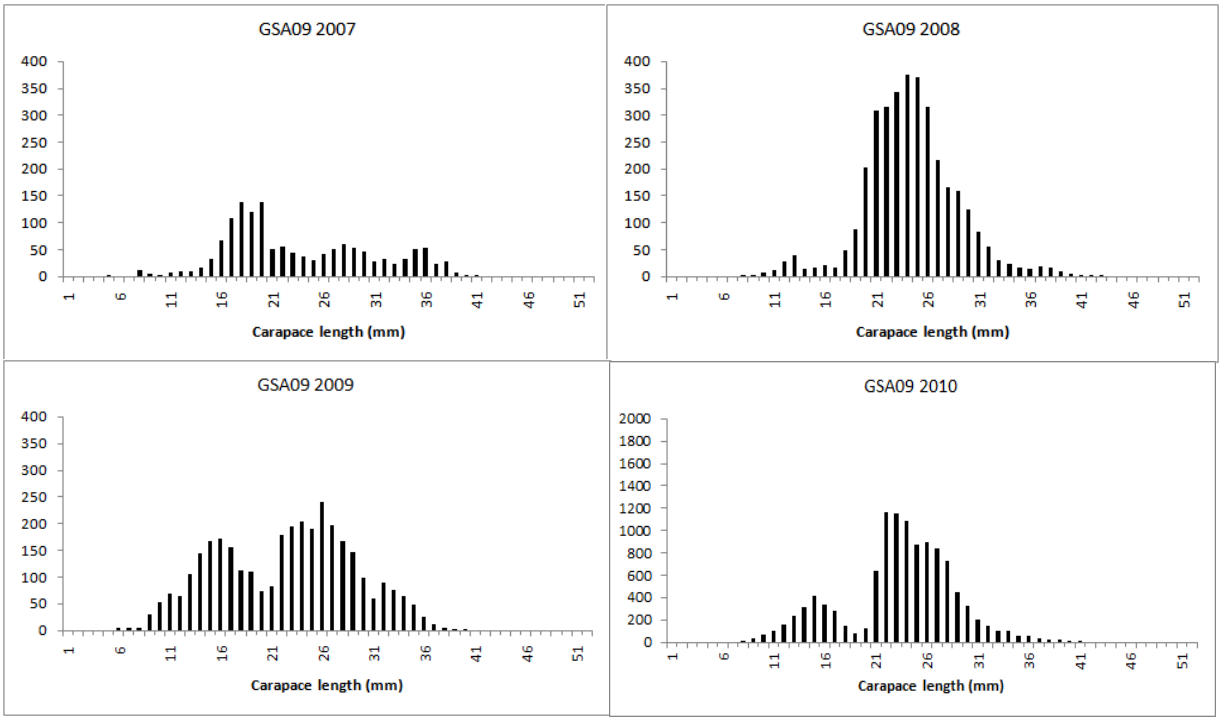
Structure by size or age

Length frequency distribution of *P. longirostris* landed and discarded in the GSA 09 in 2010 by the





Structure by size or age



MEDITS length frequency distribution of P. longirostris (2007-2010)

Data source*	Official Statistics	OpUnit 1*	ITA 09 E 03 33 - DPS

Regulations in force and degree of observance of regulations

Fishing closure for trawling: 30 days in late summer (only enforced some years)
Minimum landing sizes: EC regulation 1967/2006: 20 cm TL for hake.
Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.
Two small No Take Zones ("Zone di Tutela Biologica", ZTB) are present inside the GSA9; one off the Giglio Island (50 km2, northern Tyrrhenian Sea) another off Gaeta, (125 km2, central Tyrrhenian Sea). In both areas fishing gears operating on the bottom are not allowed six months per year.

Fishing license: fully observed
Minimum landing size 20 mm: almost observed
Fishing allowed for 5 days a week: fully observed
Technical measures regulations fully observed

Accompanying species

The most important are:

Horse mackerel (*Trachurus trachurus*)
Hake (*Merluccius merluccius*)
Norway lobster (*Nephrops norvegicus*)
Horned octopus (*Eledone cirrhosa*)
Southern shortfin squid (*Illex coindetii*)
Blue whiting (*Micromesistius poutassou*)

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Assessment form — **Sheet A1** — **Indirect methods: VPA, LCA**

Code: DPS0910Col

Sex*	both

Analysis # *	XSA

Time series

Data	Size	Age
(mark with X)		X

Model	Cohorts	Pseudocohorts
(mark with X)	X	

Equation used	Catch equation	Tunig method	
# of gears	1	Software	FLXSA 2.1 (R script)
$F_{terminal}$	0.245		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	11	1	Recruitment	231.2	924
Average			Average population	4E+05	2656
Maximum	47	4	Virgin population		
Critical			Turnover		
					1467 (SSB)
				millions	tons

Average mortality

		Gear					
	Total						
F_1	0.29	Trawl					
F_2							
Z							

(F1 and F2 represent different possible calculations. Please state them)

Comments

DCF data for deep sea pink shrimp landings and discards, including numbers at age and maturity at age, were used to compile XSA input data for 2006-2010. Data on the amount and length structure of discards were available for 2006, 2009 and 2010. The discard proportion of the 0 group available for 2006 was used to estimate discard for 2007, while discard data for 2009 were used to estimate the discard proportion in 2008. An M at age was used (1, 0.78, 0.69, 0.65).
The XSA was run setting shrinkage at 0.5, 1.0, 2.0. The three different settings produced very different estimates of recruitment and SSB. Model with 1.0 shrinkage was adopted as final model based on the analysis of residual distributions which showed a low trend (from positive residuals in the first two years to negative residuals in 2009 2010 for age groups 2 and 3).
In 2010 the estimated spawning stock biomass (1467 tons) was more than two times higher than the SSB estimated for 2009 (632.5 tons). Recruitment estimates increased constantly since 2006 peaking in 2009 (415x106 recruits) and decreasing in 2010 (231x106 recruits). A similar increasing trend of SSB and recruitment was observed during Medits which also indicated the highest recruitment peak in 2009 and the SSB peak in 2010.
F1-3 shows a decreasing trend from 1.26 in 2006 to 0.29 in 2010 as probably determined by the stock size increase observed in the last 5 years.

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Assessment form — **Sheet A2** — **Indirect methods: data**

Code: DPS0910Col

Sex*	M+F	Gear*	Trawl	Analysis # *	XSA

Data	DCF catch data 2006-2010

Data

XSA input data

Catch-at-age (thousands)

Age class	2006	2007	2008	2009	2010
0	550	1169	3402	19465	20765
1	15457	10825	11852	12113	25752
2	12364	5211	5072	2617	3005
3	2063	792	912	667	527
4+	467	332	951	1129	738

Weight-at-age (kg)

Age class	2006	2007	2008	2009	2010
0	0.001492	0.001488	0.001485	0.001389	0.004002
1	0.009213	0.009028	0.009151	0.00893	0.009362
2	0.017515	0.017289	0.017556	0.01727	0.01756
3	0.023571	0.023472	0.023581	0.023413	0.014115
4+	0.0296	0.0296	0.0296	0.027165	0.026548

Maturity-at-age

Age class	2006	2007	2008	2009	2010
0	0	0.5	1	1	1
1	0	0.5	1	1	1
2	0	0.5	1	1	1
3	0	0.5	1	1	1
4+	0	0.5	1	1	1

Mortality-at-age

Age class	2006	2007	2008	2009	2010
0	1.00	0.78	0.69	0.65	0.50
1	1.00	0.78	0.69	0.65	0.50
2	1.00	0.78	0.69	0.65	0.50
3	1.00	0.78	0.69	0.65	0.50
4+	1.00	0.78	0.69	0.65	0.50

Tuning data
Medits 2006-2010

	Age class			
year	0	1	2	3+
2006		209.47	53.649	7.7446
2007		57.919	26.043	4.0169
2008		260.72	16.413	3.7285
2009		278.7	64.54	3.57
2010		1214.7	79.52	9.28

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Assessment form

Sheet A3
Indirect methods: VPA results

Code: DPS0910Col

Sex*	M+F	Gear*	TRAWL	Analysis #*	XSA

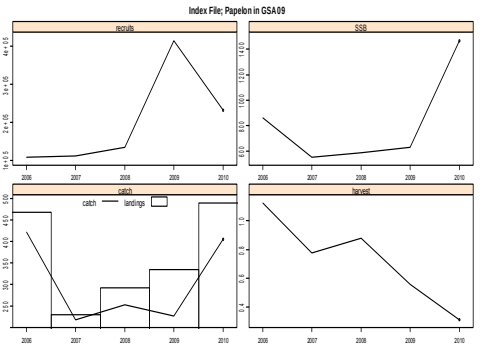
Population in figures

Numbers at age (thousands)

age class	2006	2007	2008	2009	2010
0	107400	111145	133732	414866	231212
1	47848	39177	40179	47134	140815
2	21500	11468	10630	10394	13405
3	4393	2027	2062	1739	3360
4+	925	802	2011	2780	4563

Population in biomass

	2006	2007	2008	2009	2010
SSB (tons)	860.2	552.5	588.9	632.5	1467.7
Total biomass (tons)	1108.6	788.7	861.0	1292.8	2656.7
Recruitment (millions)	107.4	111.1	133.7	414.8	231.2
Yield (landing)	422	218	252	227	405



Fishing mortality rates

F-at-age

age class	2006	2007	2008	2009	2010
0	0.01	0.02	0.04	0.08	0.16
1	0.65	0.52	0.57	0.48	0.31
2	1.67	1.03	1.12	0.44	0.38
3	1.05	0.78	0.95	0.76	0.24
4+	1.05	0.78	0.95	0.76	0.24
$Fbar_{1-3}$	**1.26**	**0.86**	**1.00**	**0.65**	**0.29**

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet Y** **Indirect methods: Y/R**

Code: DPS0910Col

Sex	both	Analysis #	Y/R

# of gears		Software	YIELD

Parameters used

Vector F	0-3
Vector M	0.75 CV=0.2
Vector N	recruitment = 10.000

Model characteristics

The Yield software uses a standard analytical model to estimate yield and biomass-based indicators and reference points, allowing for uncertainty in parameter inputs. Yield predicts both the yield to the fishery and the biomass of the fish stock that might occur at different levels of F, and with different closed seasons and size limits. Both the indicators and reference points can be expressed per recruit, or as absolute values. In the first case, constant numbers of new recruits are

Results

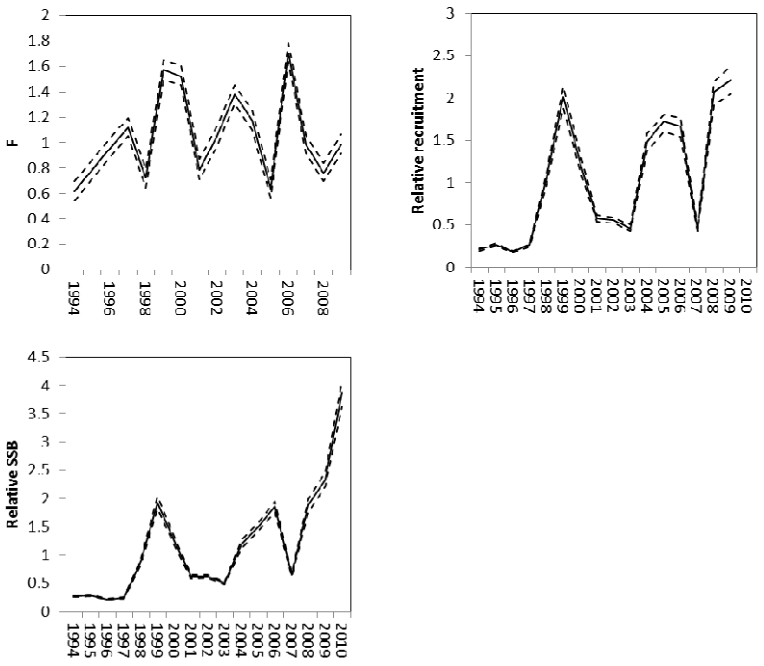
	Total	Gear			
Current YR	2.35 g	Trawl			
Maximum Y/R					
Y/R 0.1	2.62 g				
F_{max}					
$F_{0.1}$	0.78				
Current B/R	5.25 g				
Maximum B/R					
B/R 0.1	5.21 g				

Comments

Equilibrium YPR reference points (F01)for the stock were estimated through the Yield software (Hoggarth et al., 2006) assuming recruitment fluctuating randomly around a constant value and 20% uncertainty in input parameters.
.

Other assessment methods

The survey-based stock assessment model SURBA (Needle, 2003) was used to reconstruct trend in population structure and fishing mortality.
Figure below shows the population trend in relative spawning stock biomass, recruitment and fishing mortality as estimeted using GRUND (1994-2007) and MEDITS (1994-2008) survey indeces.
Standardized time series of length-frequency-distributions were sliced into different age-groups using the following parameters for the whole time series:
•Growth: Linf = 43.5 mm carapace length; K = 0.6; to = 0
•Length-Weight relationhips: a = 0.00686; b = 2.24
•Natural mortality: Mvector = 1.0 (age 1), 0.78 (age 2), 0.69 (age 3), 0.65 (age 4)
•Length-at-maturity L50=24 mm
•Lc100 = 20 mm
Average mortality (F1-3) estimated from MEDITS ranged between 0.63 (1994) and 1.8 (2008) and was 0.99 in 2009. Relative indices derived from MEDITS survey for the period 1994-2010 indicated large fluctuation with main peaks in 1999, 2006 and 2010. The stock shows a fast increasing since 2007 both in the spawning stock biomass and recruitment. In 2010 the SSB was more than 4 times higher than SSB in 2007.



Estimated trend in F_{1-3}, relative SSB and recruitment index at age 1+ of *P. longirostris* in the GSA 09, dotted lines are 2.5% and 97.5% confidence intervals

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Assessment form	**Sheet D Diagnosis**

Code: DPS0910Col

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB					
F					
Y					
CPUE					
F0.1	0.28	x year	0.78		
Fmsy					

Stock Status* Use one (or both) of the following two systems for the stock assessment status description

Unidimensional		
	☐	? - (or blank) Not known or uncertain. Not much information is available to make a judgment;
	◉	U - Underexploited, undeveloped or new fishery. Believed to have a significant potential for expansion in total production;
	☐	M - Moderately exploited, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;
	☐	F - Fully exploited. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion;
	☐	O - Overexploited. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse;
	☐	D - Depleted. Catches are well below historical levels, irrespective of the amount of fishing effort exerted;
	☐	R - Recovering. Catches are again increasing after having been depleted or a collapse from a previous;

Bidimensional

Exploitation rate

☐	No or low fishing
◉	Moderate fishing
☐	High fishing mortality
☐	Uncertain / Not assessed

Stock abundance

☐	Virgin or high abundance
☐	Intermediate abundance
☐	Low abundance

☐	Depleted
☐	Uncertain / Not assessed

Comments

Survey index of SSB and XSA estimates showed a rapid increasing pattern since 2007 with a high peak in 2010. The current proportion of SSB over the total biomass (TB) is 55% while the ratio between the current SSB and the SSB of a virgin stock (SSBcur/SSBvir), calculated using a Y/R model is 0.67.
The ratio between the SSBcur and SSB at F01 (SSBF01) is 1.55.
According to these estimates the current dimension of the SSB is over a safe level with reduced danger of stock collapse. Recruitment is increasing over time and a strong year class was observed in 2009 (424.8 millions).
Both landing and survey data confirm this positive trend. Relative indices for age 1+ from survey data indicated a general increasing trend since 1994 with three main recruitment peaks in 1999, 2005 and 2009. In 2009 recruitment at age 1+ (MEDITS) was 180% of the short term average (2005-07). XSA estimates for 2006-2010 showed a reduced recruitment in 2006-07.

Abstract for SCSA reporting

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Year 2010

Species Scientific name Parapenaeus longirostris - DPS

Source: GFCM Priority Species

Source: -

Source: -

Geographical Sub-Area 09 - Ligurian and North Tirrenian Sea

Fisheries (brief description of the fishery)*

The deep sea pink shrimp is one of the most important species exploited commercially by the trawl fleet (361 vessels) in the GSA9. The fishing grounds are distributed from 150 to 400 m depth, where the main target species are hake, Merluccius merluccius, horned octopus, Eledone cirrhosa and Norway lobster, Nephrops norvegicus, at greater depths. The stock is more abundant in the southern part (central northern Tyrrhenian Sea) than in the northern part (Ligurian Sea).
Landings in 2006 and 2008 were concentrated on adults of age classes 2-4. High landings were observed in 2006. Fishing mortality peaked for specimens of age classes 2 and 3.
Recruitment and relative SSB showed an increasing trend in the last ten years.
Current fishing mortality estimated from catch data (2006-08) using LCA is currently slight below the estimated F reference point (F01). Trawl surveys data returned higher F values well above F01.

Source of management advice*

(brief description of material -data- and methods used for the assessment)

Data used: catch data collected from 2006-08. Trawl survey data (Grund: 1994-2007; Medits: 1994-2008).

Assessment has been done comparing Fcurr respect to Fref (F01). Estimates of Fcurr have been obtained using Length Cohort Analysis (LCA) and Survey Based Assessment (SURBA).
Yield software has been used to estimate F01 given a set of biological parameters and fisheries data and assuming a given uncertainty level for some parameters (CV=0.2).

Stock Status*

U - Underexploited, undeveloped or new fishery. Believed to have a significant potential for expansion in total production;

Exploitation rate

Moderate fishing mortality

Stock abundance

Comments

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According to these estimates the current dimension of the SSB is over a safe level with reduced danger of stock collapse. Recruitment is increasing over time and a strong year class was observed in 2009 (424.8 millions).
Both landing and survey data confirm this positive trend. Relative indices for age 1+ from survey data indicated a general increasing trend since 1994 with three main recruitment peaks in 1999, 2005 and 2009. In 2009 recruitment at age 1+ (MEDITS) was 180% of the short term average (2005-07). XSA estimates for 2006-2010 showed a reduced recruitment in 2006-07.

Management advice and recommendations*

F0.1=0.7 was proposed as limit management reference point consistent with high long term yield and lower risk of stock collapse.
The XSA results showed a decreasing trend in F during the investigated period (2006-2010). In 2010 the F1-3 is well below the estimated reference value of F0.1=0.7, therefore the stock has been harvested sustainably consistent with high long term yield and lower risk of stock collapse. It is important to consider that this stock appears to be strongly positively driven by environmental factors (e.g. water temperature) and perhaps and ecological factors (e.g. predatory release effect) that can make difficult to evaluate the effect of fishing on the stock.
Given the current uncertainty respect to the role played by the density independent factors thand the strong fluctuaction in stock biomass and recruitment observed in the last 5 years the fishing effort should not be increased.

Advice for scientific research*

We recommend to increase the current knowledge on the effect of environmental variability on the spatio-temporal dynamic of the stock in order to disentangle environmental and fishing effects.
Also knowledge on catchability need to be improved to better understand the impact of fishery on recruitment. Even though current trawl mesh (40 mm) retains small-sized individuals (L50= 15 mm) the proportion of juveniles (LC<20 mm) either in the commercial or experimental trawl catch is always very reduced.