

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)

Assessment form

Sheet #0

Basic data on the assessment

Code: ARS99091)

Date*	11	Jun	2009	Authors*	1) Fabio Fiorentino 2) Leyla Knittweis 1) Vita Gancitano 2) Mark Dimech
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Species Scientific name*	Aristaeomorpha foliacea - ARS	Species common name*	Giant Red Shrimp
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Data Source

GSA*	15 - Malta Island, 16 - South of Sicily	Period of time*	GSA 15: 2002-2008; GSA 16: 1994-2008
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Description of the analysis

Type of data*	GSA 15: survey data 2002-2008; GSA 16: survey data 1994-2008 / landings data 2006-2008	Data source*	Medits Trawl Survey Data, EU Data Collection Framework Data
Method of assessment*	LCA, surveys based assessment and Y/R analyses	Software used*	VIT4win, YIELD, LFDA, SURBA

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	2	4	---	3	1	1	1	4	1	1	---

Comments, bibliography, etc.

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Abella A., Caddy J., Serena F. (1997). Do natural mortality and availability decline with age? An alternative yield paradigm for juvenile fisheries, illustrated by the hake *Merluccius merluccius* fishery in the Mediterranean. *Aquat. Living Res.* 10, 257±269.

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Comments, bibliography, etc.

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Sheet B
Biology of the species

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Biology

Somatic magnitude measured (LH, LC, etc)*		CL		Units*	mm
Sex	Fem	Mal	Both	Unsexed	
Maximum size observed				Reproduction season	spring-autumn
Size at first maturity	37.17	27.41		Reproduction areas	Known
Recruitment size				Nursery areas	Unknown

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L ∞	mm;y	68.9			
	K		0.61			
	t0		-0.2			
	Data source	SGMED 02, 2009				
Length weight relationship	a	mm;g	0.0013			
	b		2.636			
	M		0.4			
	sex ratio (mal/fem)		0.89			

Comments

- Maturity ogive was given by CNR_IAMC (2009), with L50% = 37.17 mm CL and slope g = 0.54 in females and L50% = 27.4 mm CL and slope g = 0.988 in males
- Spawning takes place from spring-autumn, with a summer peak in maturity (Ragonese and Bianchini, 1995)
- Sex ratio (in numbers) from MEDITS 2002-2008 data in GSA 15 as F/(M+F) was 0.53
- Vectorial natural mortality was calculated using the PRODBIOM Excel spreadsheet (Abella et al., 1997; 1998), which resulted in 0.62, 0.30, 0.23, 0.19, 0.17, 0.16

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Sheet P1

General information about the fishery

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Data source*	Data collected within the EU Data Collection Framework	Year (s)*	1994-2008; 2005-2008
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Data aggregation (by year, average figures between years, etc.)*	By year
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Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	MLT	99	E - Trawl (12-24 metres)	03 - Trawls	34 - Demersal slope species	ARS
Operational Unit 2	MLT	99	F - Trawl (>24 metres)	03 - Trawls	34 - Demersal slope species	ARS
Operational Unit 3	ITA	99	E - Trawl (12-24 metres)	03 - Trawls	34 - Demersal slope species	ARS
Operational Unit 4	ITA	99	F - Trawl (>24 metres)	03 - Trawls	34 - Demersal slope species	ARS
Operational Unit 5						

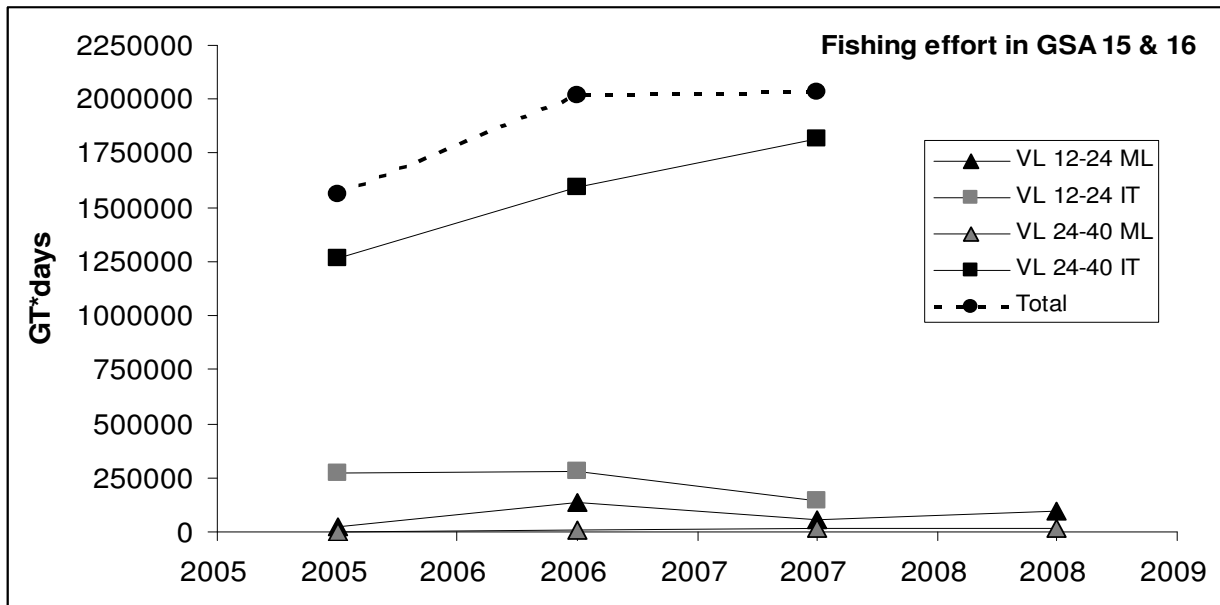
Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
MLT 99 E 03 34 - ARS	10	Tons	26.3				GT*d
MLT 99 F 03 34 - ARS	2	Tons	0.88				GT*d
ITA 99 E 03 34 - ARS	315	Tons	291.47				GT*d
ITA 99 F 03 34 - ARS	151	Tons	968.66				GT*d
Total	478		1287.31				

Legal minimum size	none
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Comments

Catch and fleet refer to 2008

Comments



Fishing effort in terms of GT * days of trawlers targetting demersal species in GSA 15 and 16. **No specific data on effort on red shrimp is available.**

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Sheet P2a
Fishery by Operational Unit

Code: ARS99091)

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Data source*	Data collected within EU Data Collection Framework	OpUnit 1*	MLT 99 E 03 34 - ARS
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Time series

Year*	2005	2006	2007	2008		
Catch	17.6	23.5	31.3	26.3		
Minimum size						
Average size Lc						
Maximum size						
Fleet	10	10	10	10		

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25	15	Selectivity parameters from: Ragonese et al., (1994) Study of the selectivity and assessment of the coefficient of retention of the trawl nets used for red shrimp fishing in the Sicilian Channel (Central Mediterranean Sea). European Community – DG XIV, Project: MED92/010 Final Report: 89 pp + annexes
L50	18	
L75	21	
Selection factor	0.45	
	40 mm opening	

Structure by size or age

		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>No information on length structure of catches of this operative unit (MLT OTB 12-24) available. See later</p> </div>
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Sheet P2a
Fishery by Operational Unit

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Data source*	Data collected within EU Data Collection Framework	OpUnit 2*	MLT 99 F 03 34 - ARS
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Time series

Year*	2005	2006	2007	2008		
Catch	0.012	2.3	3	0.9		
Minimum size						
Average size Lc						
Maximum size						
Fleet	2	2	2	2		

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25	15	No information on length structure of catches of this operative unit (MLT OTB >24) is available . Selectivity parameters from Ragonese et al., 1994
L50	18	
L75	21	
Selection factor	0.45	
	40 mm opening	

Structure by size or age

<p>No information on length structure of catches of this operative unit (MLT OTB >24) available. See later</p>
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Sheet P2a
Fishery by Operational Unit

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Data source*		OpUnit 3*	ITA 99 E 03 34 - ARS
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Time series

Year*	2004	2005	2006	2007	2008	
Catch	176.1	467.1	328.6	346	291.5	
Minimum size						
Average size Lc						
Maximum size						
Fleet	353	363	350	315	315	

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25	15	Selectivity parameters from Ragonese et al., 1994.
L50	18	
L75	21	
Selection factor	0.45	
	40 mm opening	

Structure by size or age

Length structure of catches of this operative unit ITA OTB 12-24 were combined with those of ITA >24. See later

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Sheet P2a
Fishery by Operational Unit

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Data source*		OpUnit 4*	ITA 99 F 03 34 - ARS
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Time series

Year*	2004	2005	2006	2007	2008	
Catch	610.1	803.2	1095.7	1194.5	968.7	
Minimum size						
Average size Lc						
Maximum size						
Fleet	156	151	172	152	151	

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

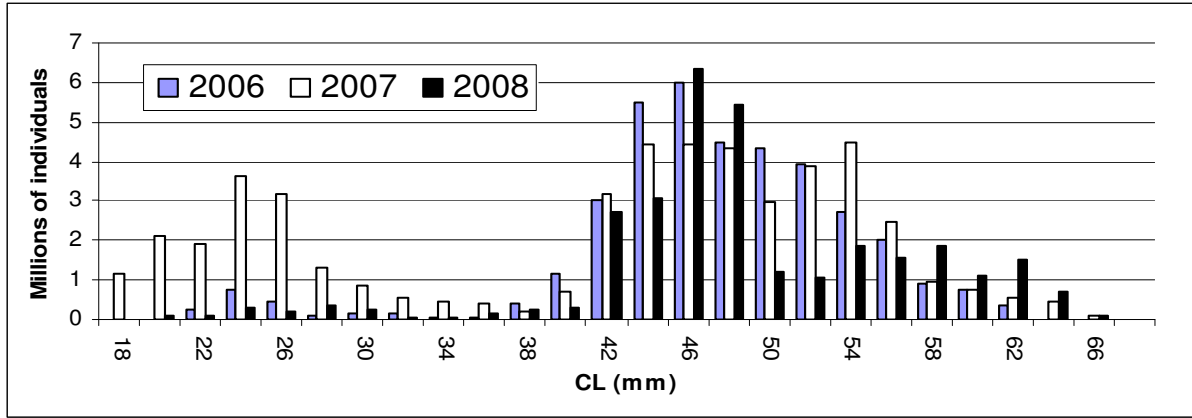
Remarks

L25	15	Selectivity parameters from Ragonese et al., 1994.
L50	18	
L75	21	
Selection factor	0.45	
	40 mm opening	

Structure by size or age

Due to a reduction in *A. foliacea* landings since 2004, some of the Italian trawlers based in Mazara del Vallo (main fleet operating in GSA 15 / 16), moved to the Aegean and Levant Sea to fish giant red shrimp.

Length structure of catches of this operative unit ITA OTB >24 were combined with those of ITA12-24. The following length structure in absolute numbers of red shrimps were considered as representative of the total catches in GSA 15 and 16



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Fishery by Operational Unit

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Data source* EC 1967/2006

OpUnit 1*

MLT 99 E 03 34 - ARS

Regulations in force and degree of observance of regulations

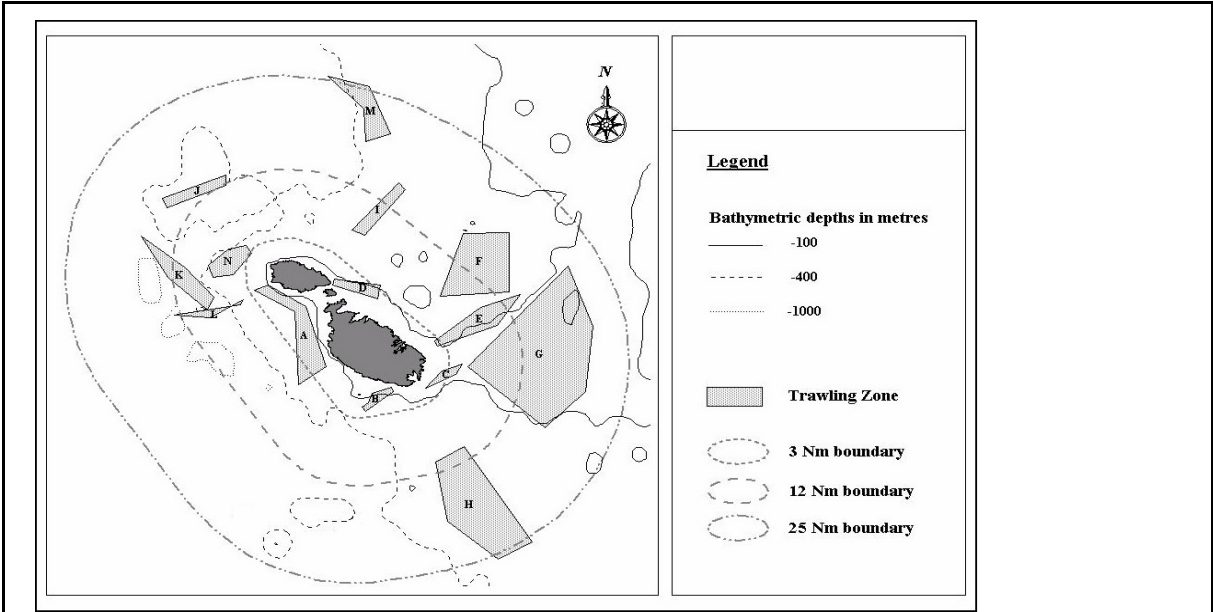
At present there are no regulations in force specifically targeting giant red shrimp. However, in order to limit the over-capacity of fishing fleet, Maltese fishing licenses have been fixed at a total of 16 trawlers since 2000. Eight new licences were however issued in 2008, a move made possible under EU law by the reduction of the capacities of other Maltese fishing fleets.

Moreover, the Maltese Islands are surrounded by a 25 nautical miles (nm) fisheries management zone, where fishing effort and capacity are being managed by limiting vessel sizes, as well as total vessel engine powers (EC 813/04; EC 1967/06). Trawling is allowed within this designated conservation area, however only by vessels not exceeding an overall length of 24m and only within designated areas. Such vessels fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1627/94, and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned. Moreover, the overall capacity of the trawlers allowed to fish in the 25nm zone can not exceed 4 800 kW, and the total fishing effort of all vessels is not allowed to exceed an overall engine power and tonnage of 83 000 kW and 4 035 GT respectively. The fishing capacity of any single vessel with a license to operate at less than 200m depth can not exceed 185 kW. In addition, the use of all trawl nets within 1.5nm of the coast is prohibited according to EC regulation 1967 / 2006, although again a transitional derogation is at present in place until 2010.

Accompanying species

In terms of technical measures, the new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). Mesh size had to be modified to square 40 mm or diamond 50 mm in July 2008, however derogations are possible up to 2010.

Giant red shrimps are frequently caught together with Norway lobster (*Nephrops norvegicus*), large sized deep water pink shrimp (*Parapenaeus longirostris*), the more rare violet shrimp (*Aristeus antennatus*), the scorpionfish *Helicolenus dactylopterus*, the grater forkbeard (*Phycis blennioides*), the flat fish *Lepidorombus boscii*, the squid *Todarodes sagittaus* as well as large hake (*Merluccius merluccius*).



Map of the Maltese islands showing the 25 nautical mile Fisheries Management Zone and legally trawlable areas.

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Sheet P2b

Fishery by Operational Unit

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Data source* EC 1967/2006

OpUnit 2*

MLT 99 F 03 34 - ARS

Regulations in force and degree of observance of regulations

At present there are no regulations in force specifically targeting giant red shrimp. However, in order to limit the over-capacity of fishing fleet, Maltese fishing licenses have been fixed at a total of 16 trawlers since 2000. Eight new licences were however issued in 2008, a move made possible under EU law by the reduction of the capacities of other Maltese fishing fleets.

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Fishery by Operational Unit

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Data source* EC 1967/2006

OpUnit 3*

ITA 99 E 03 34 - ARS

Regulations in force and degree of observance of regulations

At present there are no formal management objectives for giant red shrimp fisheries in the Strait of Sicily.

In terms of technical measures, the new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). Mesh size had to be modified to square 40 mm or diamond 50 mm in July 2008, however derogations are possible up to 2010. No minimum landing sizes have been established for this species (EC 1967/06).

A medium term management plan for 2008-2013 has been agreed for Italian trawlers operating in the GSA 15 and 16. This Italian Management Fishery Plans (IFMP) is based on :

- a fleet reduction of 25% of the current capacity obtained in two steps. The first (12.5%) from 2008 to 2010, and the second (12.5%) from 2011 to 2013;
- a trawling ban of 45 days per year between January and March (targeted to deep water pink shrimp fishery which is the main commercial species in the GSA 15 and 16);
- changing the mesh opening in the cod-end from the 40 mm to 50 mm (diamond) from 2010;

Although designed mainly for deep water pink shrimps, the adoption of the management measures of the IFMP are also expected to improve the stock status of giant red shrimp in the area.

Accompanying species

Giant red shrimps are frequently caught together with Norway lobster (*Nephrops norvegicus*), large sized deep water pink shrimp (*Parapenaeus longirostris*), the more rare violet shrimp (*Aristeus antennatus*), the scorpionfish *Helicolenus dactylopterus*, the grater forkbeard (*Phycys blennioides*), the flat fish *Lepidorombus boscii*, the squid *Todarodes sagittatus* as well as large hake (*Merluccius merluccius*).

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Fishery by Operational Unit

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Data source*	EC 1967/06	OpUnit 4*	ITA 99 F 03 34 - ARS
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Regulations in force and degree of observance of regulations

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Sheet A1
Indirect methods: VPA, LCA

Code: ARS99091)

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Sex*

Analysis # *

Time series

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	VPA	Tuning method	NONE
# of gears	1	Software	Vit4win
F_{terminal}	0.15		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	23	0.46	Recruitment	73800000	
Average	38.7	1.28	Average population	79300000	1883 t
Maximum	63	3.84	Virgin population		
Critical	44	1.47	Turnover		

Average mortality

	Total	Gear					
		trawling					
F_1	0.733						
F_2	0.879						
Z	0.989						

(F_1 and F_2 represent different possible calculations. Please state them)

Comments

Pseudocohort (VPA equation) analysis was used for 2006, 2007 and 2008, keeping the years separate. Results detailed above are for 2006.

F_1 = mean F over all sizes

F_2 = mean F, 1-3 age groups

Z = mean Z over all sizes

Analyses were carried out on the Italian trawlers, which contribute to more than 97% of the total yield in GSA 15 and GSA 16. Since females reach larger sizes than males and amount to more than 75% of landings in weight (Gancitano et al. 2008), female parameters were used to assess stock exploitation.

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Indirect methods: VPA, LCA

Code: ARS99091)

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Sex*

Analysis # *

Time series

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	VPA	Tunig method	NONE
# of gears	1	Software	Vit4win
F _{terminal}	0.15		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	18	0.33	Recruitment	95300000	
Average	36	1.16	Average population	87500000	1825 t
Maximum	66	5.86	Virgin population		
Critical	42	1.34	Turnover		

Average mortality

	Total	Gear				
		trawling				
F ₁	0.806					
F ₂	1.01					
Z	0.985					

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

Comments

Pseudocohort (VPA equation) analysis was used for 2006, 2007 and 2008, keeping the years separate. Results detailed above are for 2007.

F1 = mean F over all sizes
 F2 = mean F, 1-3 age groups
 Z = mean Z over all sizes

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Sheet A1
Indirect methods: VPA, LCA

Code: ARS99091)

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Sex* F

Analysis # * LCA

Time series

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	VPA	Tunig method	NONE
# of gears	1	Software	Vit4win
F _{terminal}	0.15		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	20	0.4	Recruitment	62800000	
Average	38.6	1.32	Average population	70500000	1721 t
Maximum	66	5.86	Virgin population		
Critical	42	1.34	Turnover		

Average mortality

	Total	Gear				
		Trawling				
F ₁	0.774					
F ₂	0.849					
Z	0.943					

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

Comments

Pseudocohort (VPA equation) analysis was used for 2006, 2007 and 2008, keeping the years separate. Results detailed above are for 2008.

F1 = mean F over all sizes
 F2 = mean F, 1-3 age groups
 Z = mean Z over all sizes

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Sheet A2
Indirect methods: data

Code: ARS99091)

Sex*	F	Gear*	Trawling (OTB)	Analysis # *	LCA
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Data source	Landings data, GSA 16, females only
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Data**Absolute number by length class (CL in mm)**

CL (mm)	2006	2007	2008
18	0	1147734	0
20	0	2127086	100309
22	237775	1890516	100309
24	772770	3623983	305050
26	475551	3149768	215550
28	118888	1318593	341753
30	127266	842297	256323
32	127266	532429	58259
34	31831	470665	41614
36	31831	408899	145916
38	379236	181206	243625
40	1142386	711999	327251
42	3044008	3151318	2740892
44	5496558	4435325	3064386
46	6012676	4454360	6327938
48	4499250	4313970	5444486
50	4328759	2964055	1190896
52	3934095	3878377	1051100
54	2702964	4481251	1845141
56	2027310	2456775	1555210
58	904016	962723	1846338
60	760428	761051	1128533
62	359591	574772	1515948
64	0	446168	712475
66	0	110053	101305
Total	37516461	49397379	30662613

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Assessment form

Sheet A3

Indirect methods: VPA results

Code: ARS99091)

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Sex*	F	Gear*	Trawling (OTB)	Analysis #*	VPA, Pseudocohort
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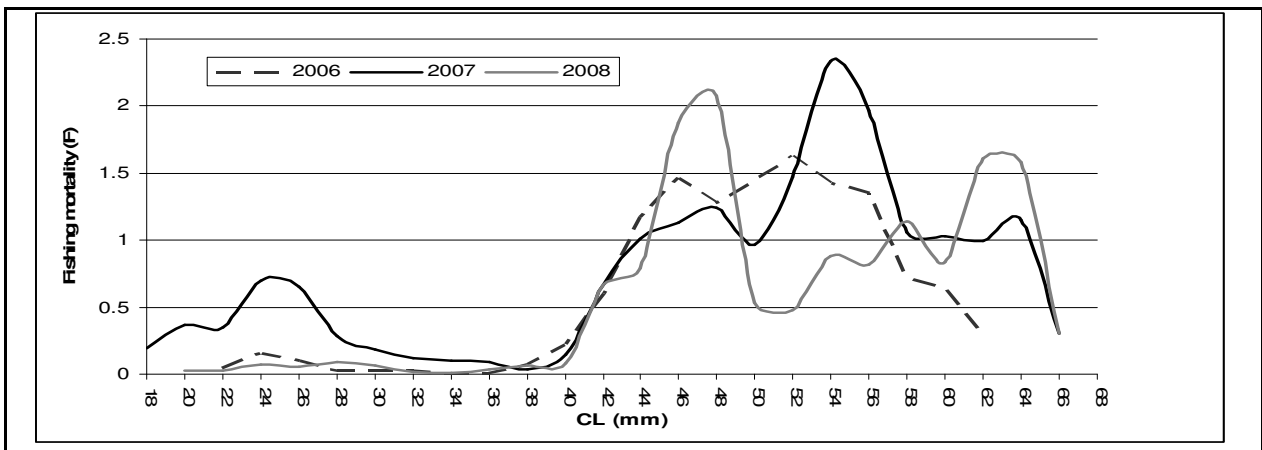
Population in figures

CL (mm)	2006	2007	2008	CL (mm)	2006	2007	2008
18	0	6.004326	0	44	4.727354	4.37161	3.873074
20	0	5.720663	4.1492	46	4.125458	3.947703	3.36682
22	5.100293	5.447787	4.04493	48	3.534913	3.479353	2.620776
24	4.974822	5.15141	3.959966	50	2.995267	3.084951	2.245391
26	4.869192	4.83392	3.893739	52	2.413515	2.645345	2.21222
28	4.814803	4.62676	3.846637	54	1.90053	1.920878	2.09604
30	4.798507	4.530469	3.816773	56	1.499492	1.247945	1.895739
32	4.808861	4.489964	3.820167	58	1.267719	0.911782	1.620289
34	4.858582	4.495952	3.860876	60	1.178641	0.740978	1.345479
36	4.946135	4.535708	3.923478	62	1.198638	0.577505	0.941695
38	5.054608	4.624139	4.006243	64	0	0.389399	0.449835
40	5.13841	4.729848	4.109892	66	0	0.366845	0.337684
42	5.079277	4.673563	4.078662	total	79.28502	87.5488	70.51561

Population in biomass

Main results of VIT analyses	Year	2006	2007	2008	Median
	Reconstructed yield (t)	1424	1540	1260	1424
	Biomass at sea (t)	1883	1825	1721	1825
	SSB at sea (t)	1418	1307	1304	1307

Fishing mortality rates



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Sheet Y
Indirect methods: Y/R

Code: ARS99091)

Sex F

Analysis # Y/R, SSB/R

# of gears	1	Software	VIT4 win & Yield
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Parameters used

Vector F	
Vector M	See comments
Vector N	

Model characteristics

Yield package.: All parameters were converted from Carapace Length (CL) in mm to Total Length (TL) by using the relation given by Gancitano (Pers. Com.): $LT (mm) = 2.678 CL (mm) + 28.564$. The new parameters were subsequently converted in terms of cm and g. The M value was 0.4. A guess estimate of uncertainty in terms of coefficient of variation was added to each parameter. Recruitment was assumed to be constant with a random variability among years of $CV=0.4$.

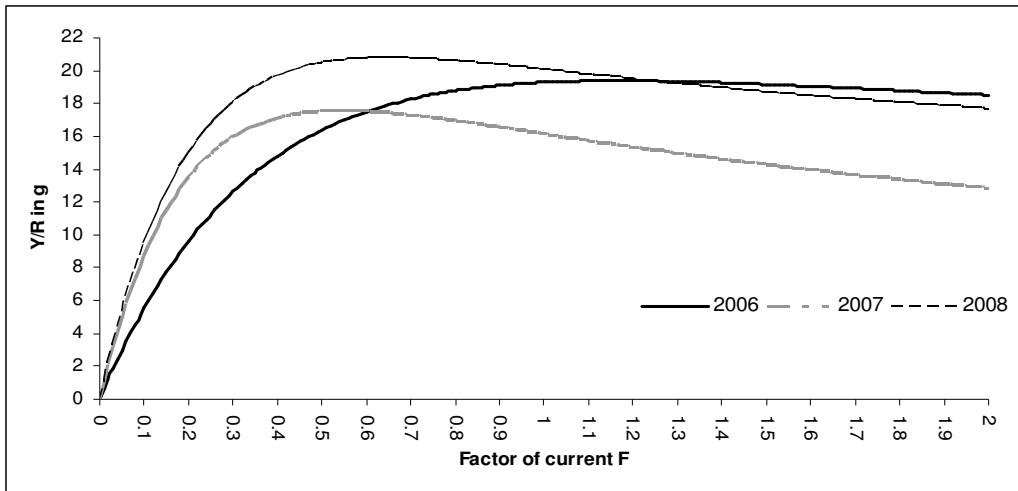
Results

	Total	Gear			
		VIT, 2006	VIT, 2007	VIT, 2008	Yield pack.
Current YR					
Maximum Y/R					
Y/R 0.1					
F_{max}		0.91	0.451	0.476	0.75
$F_{0.1}$		0.542	0.282	0.293	0.4
Current B/R					
Maximum B/R					
B/R 0.1					

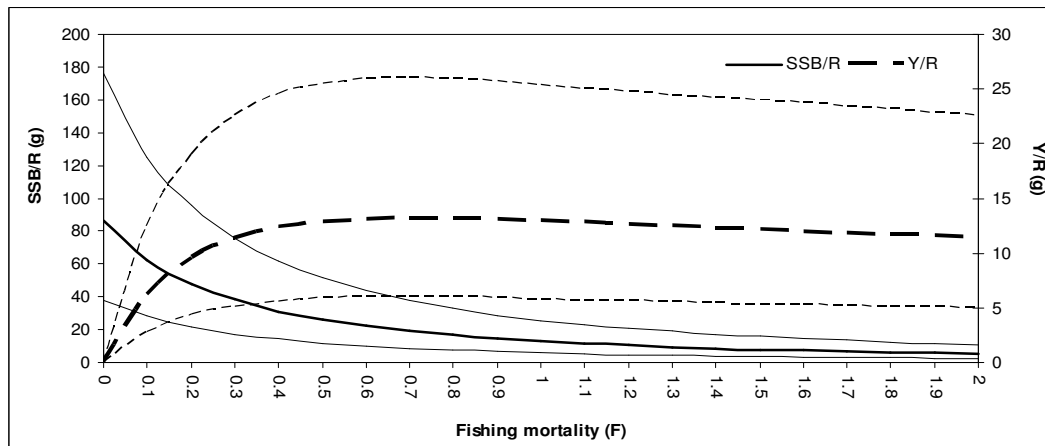
Comments

Vector of maturity and natural mortality by size used in VIT package								
CL (mm)	18	20	22	24	26	28	30	32
p of mature	0	0	0	0.001	0	0.01	0.02	0.06
M	1.1	1	0.9	0.8	0.73	0.65	0.6	0.52
CL (mm)	34	36	38	40	42	44	46	48
p of mature	0.152	0.347	0.61	0.822	0.93	0.98	0.99	1
M	0.45	0.4	0.33	0.3	0.28	0.26	0.24	0.22
CL (mm)	50	52	54	56	58	60	62	64
p of mature	0.999	1	1	1	1	1	1	1
M	0.19	0.18	0.16	0.15	0.14	0.12	0.12	0.11

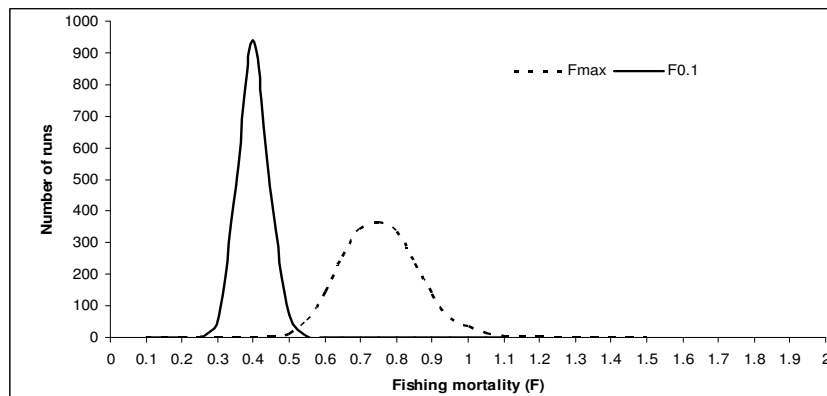
Comments



Yield per recruit varying current fishing mortality (F_c) by a multiplicative factor according to the **VIT package**. Analyses deal with pseudo-cohorts 2006, 2007 and 2008.



Median of yield and spawning stock biomass per recruit and corresponding uncertainty of female giant red shrimps in the GSA 15 and 16 according to the **Yield package**.



Searching for biological reference points (BRP) through 2000 simulation by **Yield package** produced the probability distribution of F_{max} and $F_{0.1}$ shown in Fig. below. The median value of **$F_{max} = 0.75$** should be considered as Limit Reference Points (LRP) whereas the median value of **$F_{0.1} = 0.4$** should be considered as Target reference points (TRP).

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Sheet other

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Other assessment methods

The availability of length frequency distribution (LFD) time series (2002-2008 for GSA 15 and 1994-2008 for GSA 16) from trawl survey data allowed the reconstruction of the evolution of main stock parameters (recruitment and spawning stock biomass indices, as well as fishing mortality rates) of giant red shrimps in the GSA 15 and 16 by using the SURBA software package. Only specimens from MEDITS strata d & e (200-800m depth) were considered in the analysis.

Firstly the LFD by sex from the MEDITS trawl surveys was corrected by including the data for the individuals with unidentified sexes. This was based on the sex ratio per size class. The corrected LFDs by sex for each GSA were then converted in numbers by age group using the subroutine "age slicing" as implemented in the software package LFDA (Kirkwood et al., 2001). Secondly we estimated the mean weight and maturity at age using VBGF and a vectorial natural mortality at age (PRODBIOM excel sheet as implemented by Abella in SGMED 01 09) for the SURBA software to run the analysis. Then the numbers at age were used to estimate time series of fishing mortality rates, as well as recruitment and SSB indices. This was done due to the difficulties in obtaining feasible information from commercial fisheries data, especially from GSA 15 where length frequencies distributions from landings do not exist.

Values by age used for **Surba analyses** for giant red shrimp (females) in GSA 15 & 16

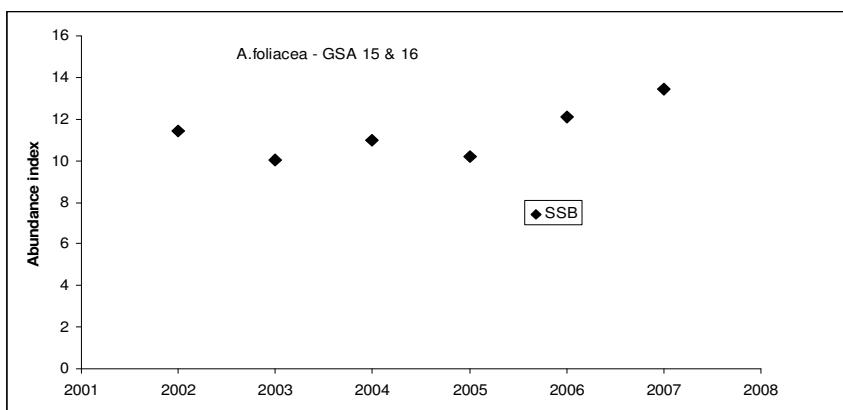
Age	0	1	2	3	4	5+
Natural mortality at age	0.62	0.30	0.23	0.19	0.17	0.16
Maturity at age	0.00	1.0	1.0	1.0	1.0	1.0
Weight at age	10.44	34.95	56.48	70.97	79.72	85.5
Catchability coefficient	0.4	1.0	1.0	1.0	1.0	1.0

Other assessment methods

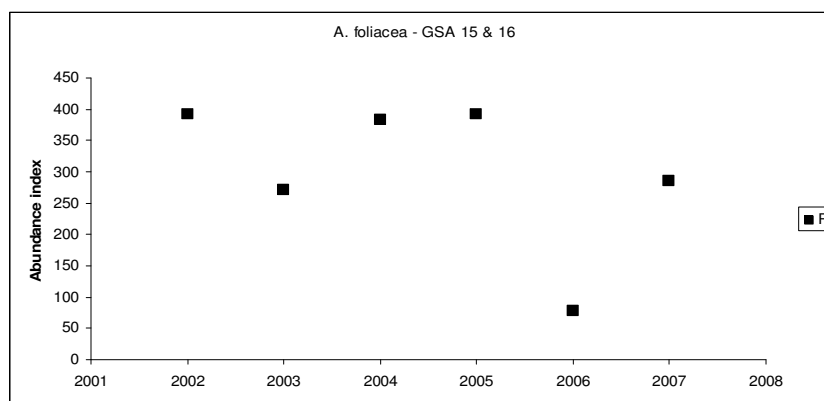
Combining GSAs indicated that the stock varied without an evident trend in the last year (2002-2008), although SSB reached its highest level in 2008 compared with the last 6 years. Considering only the GSA 16 where the time series is longer (1994-2008), SSB show stably low level since 2001.

Survey indices in 2008 indicate the recruitment level to have recovered to average levels following a sharp drop in 2006. The stability of recruitment indices in the last years is also confirmed by the analysis of the longer series from GSA 16.

SSB in kg/km2 (MEDITS survey) in GSA 15 & 16 from SURBA.



Recruits n/km2 (MEDITS survey) in GSA 15 & 16 from SURBA analysis.



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Other assessment methods

The values of F (age 1-3) in GSA 16 from 2000 to 2004 remains very stable around 0.83 (SD=0.06) according to SURBA results. Time series from GSA 15 is not long enough to evaluate any trend.

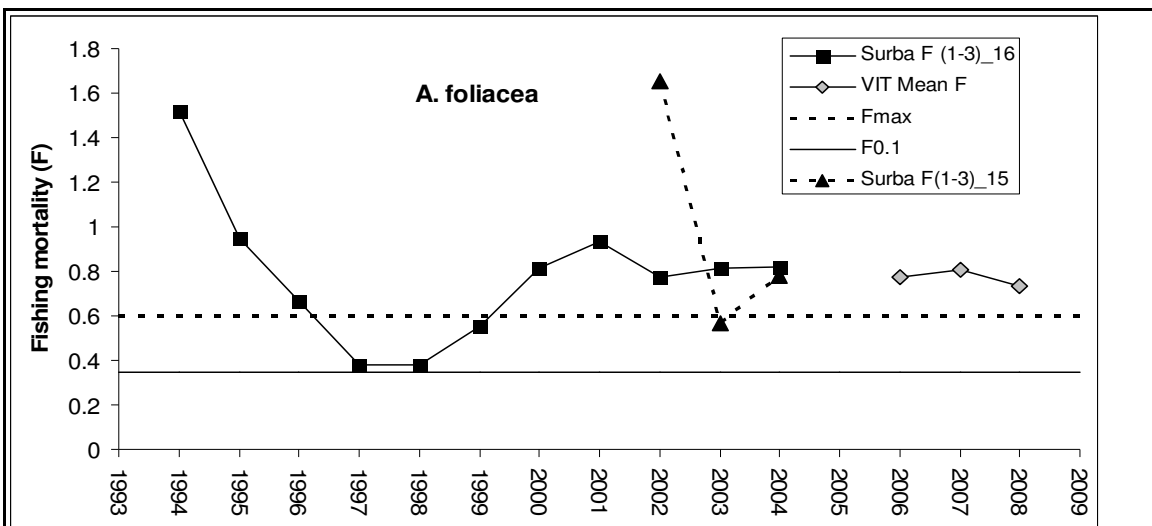
Probability distributions of biological reference points (BRP) Fmax and F0.1 were estimated with 2000 simulations in the Yield package as well as for GSA 16 landings with the VIT package for years 2006, 2007 and 2008 separately.

Estimation of current F, as Fmean, and optimal ones, as F max and F0.1, by pseudo cohorts according to VIT package:

	2006	2007	2008
Fcurrent	0.774	0.806	0.733
Fmax	0.913	0.451	0.476
F0.1	0.542	0.282	0.293

Estimation of F max and F0.1, by Yield package:

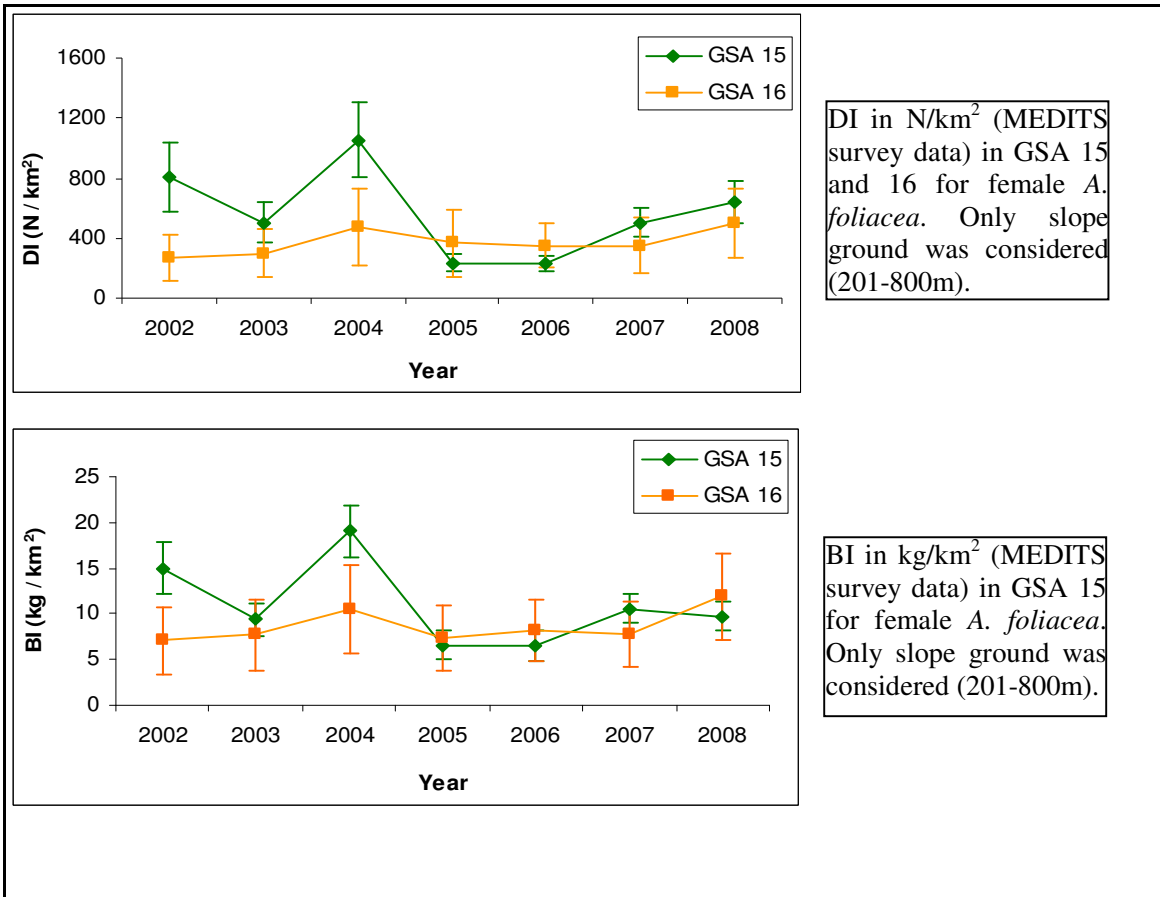
Fmax	0.75
F0.1	0.4



Development of fishing mortality in GSA 15 and 16 on females of giant red shrimps. Time series was composed by combining Surba (1994-2004) and VIT (2006-2008) results. The reported BRP were obtained as intermediate value between YIELD and VIT results. $F_{max} = 0.6$, should be considered as Limit Reference Points (LRP), whereas $F_{0.1} = 0.35$ should be considered as Target reference points (TRP).

Other assessment methods

Analysis of MEDITS biomass and density indices based on MEDITS survey data showed the *A. foliacea* stock to vary without an evident trend in the last year (2002-2008), although the abundance of giant red females in both GSAs reached its highest level in 2008 compared with the last 3 years.



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Assessment form

Sheet D
Diagnosis

Code: ARS99091)

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB					
F	0.73-0.81		F0.1		F0.1 = 0.29-0.4 (VIT 08 analysis / SURBA & Yield analysis respect.)
Y					
CPUE					
F	0.73-0.81		Fmax		Fmax = 0.48-0.75 (VIT 08 analysis / SURBA & Yield analysis respect.)

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

Unidimensional	<input type="checkbox"/>	? - (or blank) Not known or uncertain . Not much information is available to make a judgment;
	<input type="checkbox"/>	U - Underexploited, undeveloped or new fishery . Believed to have a significant potential for expansion in total production;
	<input type="checkbox"/>	M - Moderately exploited , exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;
	<input type="checkbox"/>	F - Fully exploited . The fishery is operating at or close to an optimal yield level, with no expected room for further expansion;
	<input checked="" type="checkbox"/>	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;
	<input type="checkbox"/>	D - Depleted . Catches are well below historical levels, irrespective of the amount of fishing effort exerted;
	<input type="checkbox"/>	R - Recovering . Catches are again increasing after having been depleted or a collapse from a previous;

Bidimensional	Exploitation rate		Stock abundance	
	<input type="checkbox"/>	No or low fishing	<input type="checkbox"/>	Virgin or high abundance
	<input type="checkbox"/>	Moderate fishing	<input checked="" type="checkbox"/>	Intermediate abundance
	<input checked="" type="checkbox"/>	High fishing mortality	<input type="checkbox"/>	Low abundance
	<input type="checkbox"/>	Uncertain / Not assessed	<input type="checkbox"/>	Depleted
			<input type="checkbox"/>	Uncertain / Not assessed

Comments

The deep water pink shrimp in the Northern sector of the Strait of Sicily is considered overfished since the current fishing mortality is higher than both F_{max} and $F_{0.1}$.

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Assessment form

Sheet Z

Objectives and recommendations

Code: ARS99091)

Management advice and recommendations*

Considering in more detail GSA 16, for which both commercial and trawl surveys data are available and where the great majority of catches are landed, all the stock assessments performed during the SGMED suggest quite similar diagnoses in terms of exploitation state in the long term. Adopting $F_{0.1}$ as target reference points, a reduction of at least 30% of the current F is needed to reach a more sustainable pattern of fishery exploitation. With the exception of VPA on the 2006 pseudo-cohort, a reduction of current F is also suggested if F_{max} is considered as Biological Reference Point.

Advice for scientific research*

1. Improve biological sampling of catches and discards
2. Introduce second annual scientific survey campaign in autumn to improve temporal resolution of survey data, in particular data on recruitment
3. Identify major nursery and spawning areas of *A. foliacea* and carry out detailed investigation into red shrimp stock structure
4. Make available Vessel Monitoring System data to researchers (GSA 16, VMS already available to researchers from GSA 15), to analyse the spatial distribution of fishing effort