SAC GFCM
Sub-Committee on Stock Assessment

Date* | 27 | November | 2009   **Code*** | **ARA0509Car**

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Species Scientific name*

1 *Aristeus antennatus - ARA*
Source: GFCM Priority Species

2
Source: -

3
Source: -

Geographical area* Western Mediterranean (FAO 37.1.1)

Geographical Sub-Area (GSA)* 05 - Balearic Island

Combination of GSAs
1
2
3

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Species Scientific name*	Aristeus antennatus - ARA	Species common name*	Red shrimp, Crevette rouge, Gamba roja

Data Source

GSA*	05 - Balearic Island	Period of time*	1992-2008

Description of the analysis

Type of data*	Monthly size distribution, and year-age classes. Daily landing bt vessel, and monthly port landing	Data source*	Fishery Department local authorities and DCR data sampling IEO programme.
Method of assessment*	LCA-Pseudochohort and Y/R, VPA-Separable Virtual Analysis and XSA-Extended Survivor Analysis	Software used*	VIT (Lleonart and Salat, 1997) VPA-XSA (Darby and Flatman, 1994)

Sheets filled out

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

Comments, bibliography, etc.

Lleonart, J., and J. Salat. 1997. VIT: Software for fishery analysis--. User's manual FAO Computerized information Series (Fisheries) Nº 11. Rome, FAO. 1997. 105 p.

Darby, C. and D. Flatman. 1994. Virtual Population Analysis: version 3.1. (Windows/Dos) user guide. Infor. Tech. Ser., MAFF Direct. Fish. Res., Lowestof (1):85 pp.

Carbonell, A., M. Carbonell, M. Demestre, A. Grau, S. Monserrat.1999. The red shrimp Aristeus antennatus (Risso, 1816) fishery and biology in the Balearic Islands, Western Mediterranean. Fisheries Research 44.1-13.

Carbonell A, Azevedo, M. 2003. Application of non-equilibrium production models to the red shrimp (Aristeus antennatus, Risso 1816) fishery in the North-western Mediterranean.). Fisheries Research 65, 323-334.

Carbonell, A., A. Grau, V. Lauronce, C. Gómez. 2006. Ovary Development Of the Red Shrimp Aristeus antennatus from Northwestern Mediterranean Sea.Crustaceana 79(6).727-743 (2006).

Carbonell, A., Lloret, J., Demestre, M. 2007. Relationship between condition and recruitment success of the red shrimp (Aristeus antennatus) in the balearic sea (Northwestern Mediterranean). Journal of Marine Systems 71 (2008) 403-412.

Comments, bibliography, etc.

The assessment were based on analysis of long-term data (landings, effort, CPUE, mean sizes in Aristeus catches in the Mallorca Island and from models (LCA, Y/R, VPA and XSA). Dates were obtained from the Fishery Department of Autonomus Govern (landings and effort) and from the IEO own sampling programmes (IEO sampling programe from 1992 to 2003, and DCR sampling programmes from 2003 to 2008) for biological data (Size distribution, growth, maturity, sex-ratio, lenght-weight relationship, and natural mortality).

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Biology

Somatic magnitude measured (LH, LC, etc)*					Units*	
Sex	Fem	Mal	Both	Unsexed		
Maximum size observed	66	38			Reproduction season	April-September
Size at first maturity	26	22			Reproduction areas	GSA 5
Recruitment size	13-22	Oct-18			Nursery areas	GSA 5

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L∞	mm	75.5	42		
	K	mm/month	0.249	0.422		
	t0		-0.3936	-0.65		
	Data source	Carbonell et al., 1999				
Length weight relationship	a		0.00244	0.00246		
	b		2.4536	2.4311		

M			0.363	0.517		

sex ratio (mal/fem)	30/70

Comments

Aristeus present different growth and sexual maturity for females and males. The majority of landings are females dominated The results of the assessment by sex are difficult to apply for management purposes. In 2005 (SCSA 2005) we presented a comparison with the summation of the assessment made by sex and the analysis of sex combined assessment, results showed no major differences in the estimates of recruitment, fishing mortaliy, and stock biomass, therefore the assessment of Aristeus were carried out by sex combined from it.

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Data source*	Govern Autonomus Balearic Islands, Fishery Department	Year (s)*	1992-2008

Data aggregation (by year, average figures between years, etc.)*	Annual agregation by year, and average of all years

Fleet and catches (please state units)

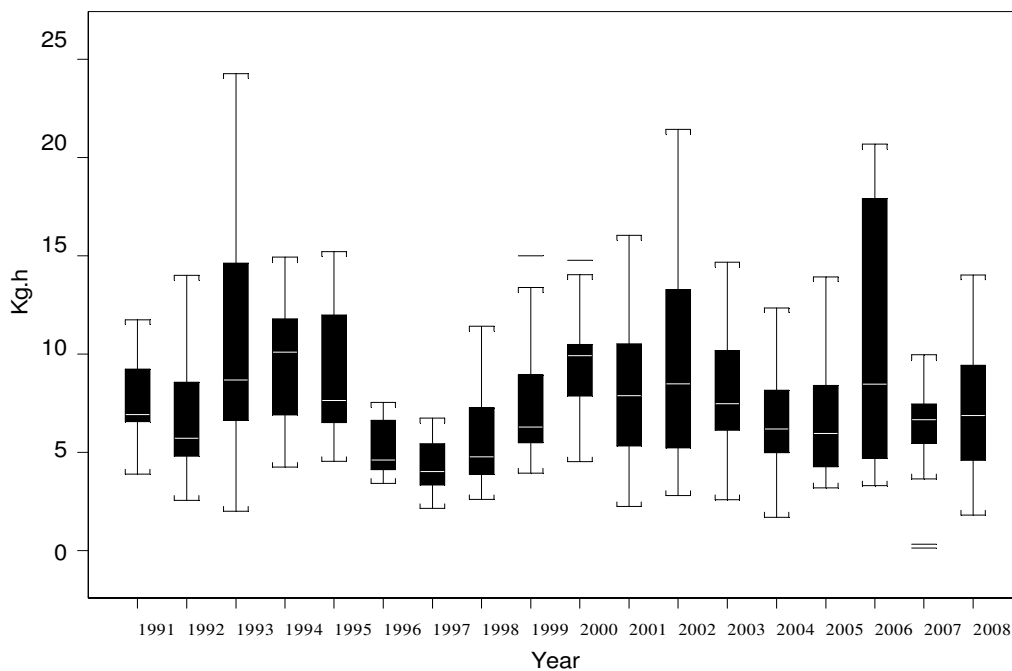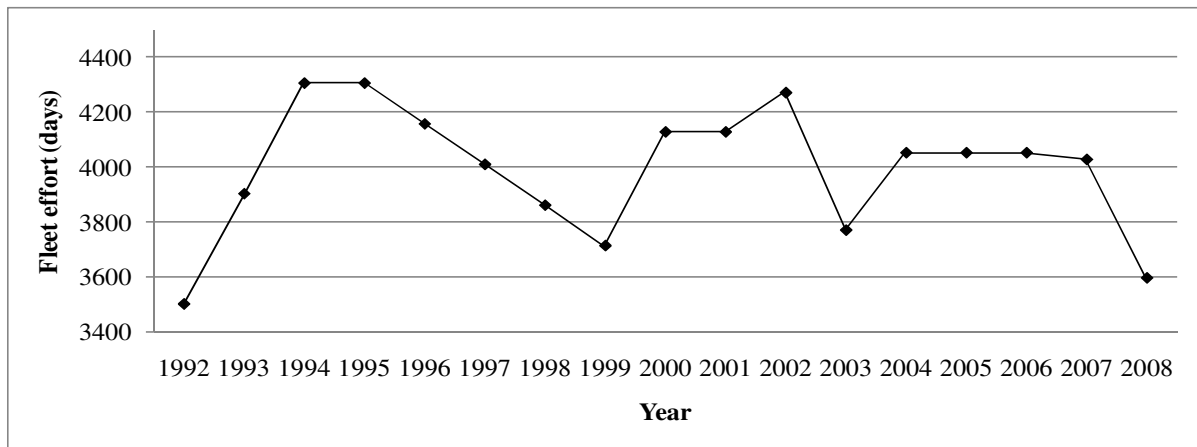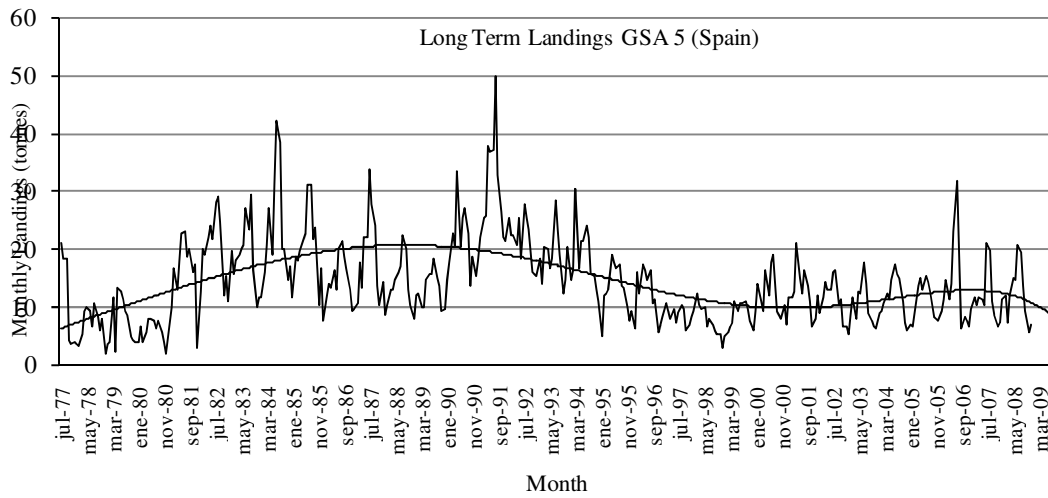|	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ESP	05	E - Trawl (12-24 metres)	03 - Trawls	34 - Demersal slope species	ARA
Operational Unit 2						
Operational Unit 3						
Operational Unit 4						
Operational Unit 5						

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ESP 05 E 03 34 - ARA	34	Tons	148.94		0.00%	30%	Days
Total	34		148.94		0.00001	0.3	

Legal minimum size	

Comments

The number of vessels was reduced from the initial census in 1992, which for the slope fleet was estimated in 49 trawl vessels, while the Fishing fleet census in 2008 was 34 trawl vessels, for the whole GSA 5 area. Annual landings in the Mallorca Island in nineties (1992-1999) were around 200 tonnes and were produced by a total effort of between 3500-4400 fishing days*vessel (number of days*vessel). From 2000 years landing arise around 150 tonnes and total effort between 3200-4200 fishing days.

Comments

Long Term Landings GSA 5 (Spain)

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Data source*	Autonomus Govern. Fishing statistics	OpUnit 1*	ESP 05 E 03 34 - ARA

Time series

Year*	1997	1998	1999	2000	2001	2002
Catch	143	103	93	100	145	141
Minimum size	17	16	15	15	15	17
Average size Lc	28.3	28.48	27.25	29.02	30.13	31.34
Maximum size	64	64	65	63	65	61
Fleet	24	22	22	22	23	20

Year	2003	2004	2005	2006	2007	2008
Catch	115	140	172	164	141	149
Minimum size	15	13	15	17	15	17
Average size Lc	31.98	29.05	29.49	30.57	33.1	33.31
Maximum size	64	64	62	62	58	64
Fleet	24	16	16	16	16	17

Selectivity   Remarks

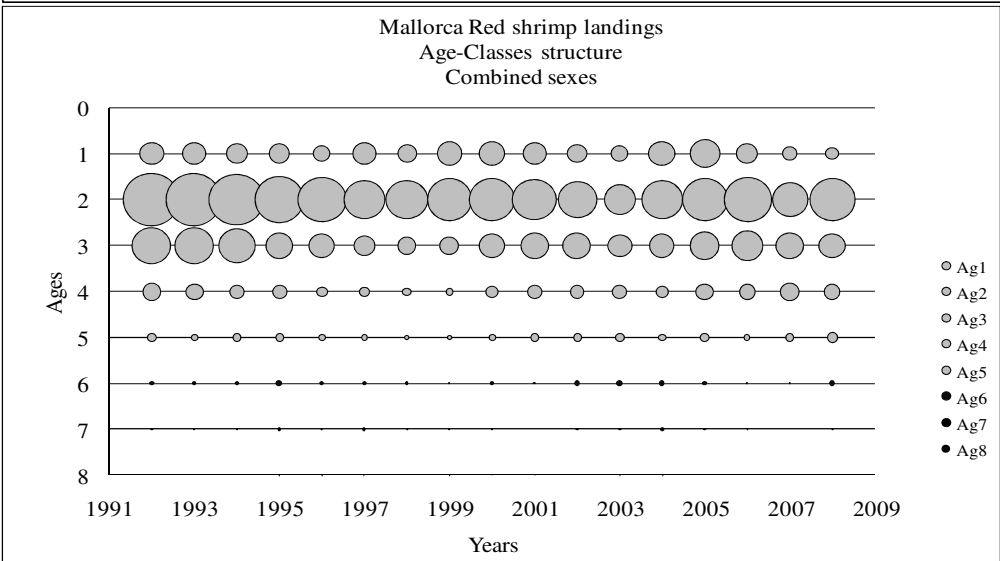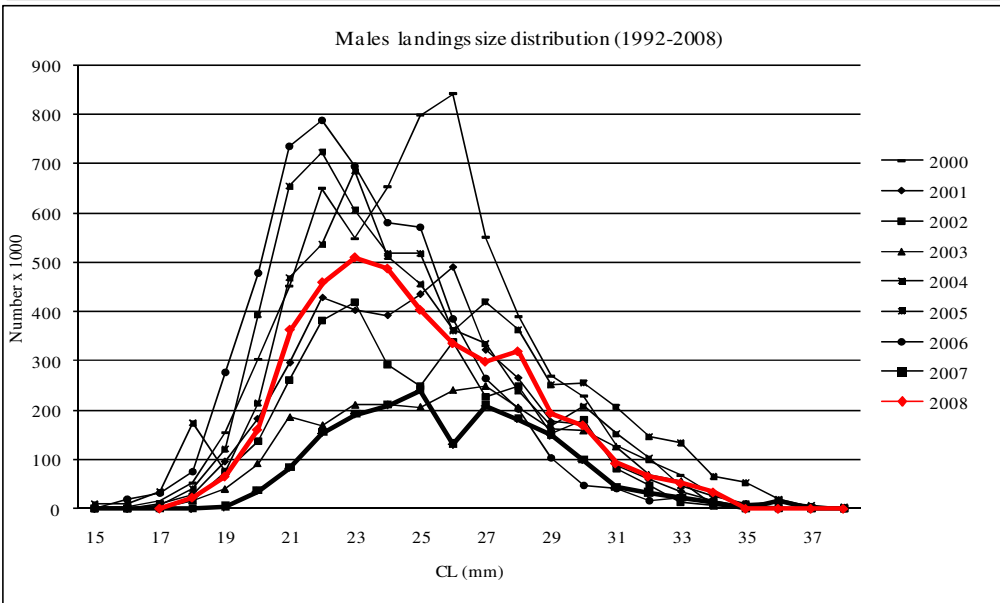| L25	20.1
L50	22.1
L75	24.1
Selection factor	

Structure by size or age

Size structure remain quite stable. The whole trawl fleet can potentially fishing in the slope, although the number of vessels fishing at the same time in the slope use be between 50 and 75% of the total fleet.

Summary of assessment carried out by the red shrimp in the GSA 5

	Females	Males	Sum of sex	Combined
LCA (Length	X	X	X	
VPA (Age				X
XSA				X
Y/R	X	X		

Structure by size or age

Females landings size distribution (1992-2008)

Males landings size distribution (1992-2008)

Mallorca Red shrimp landings
Age-Classes structure
Combined sexes
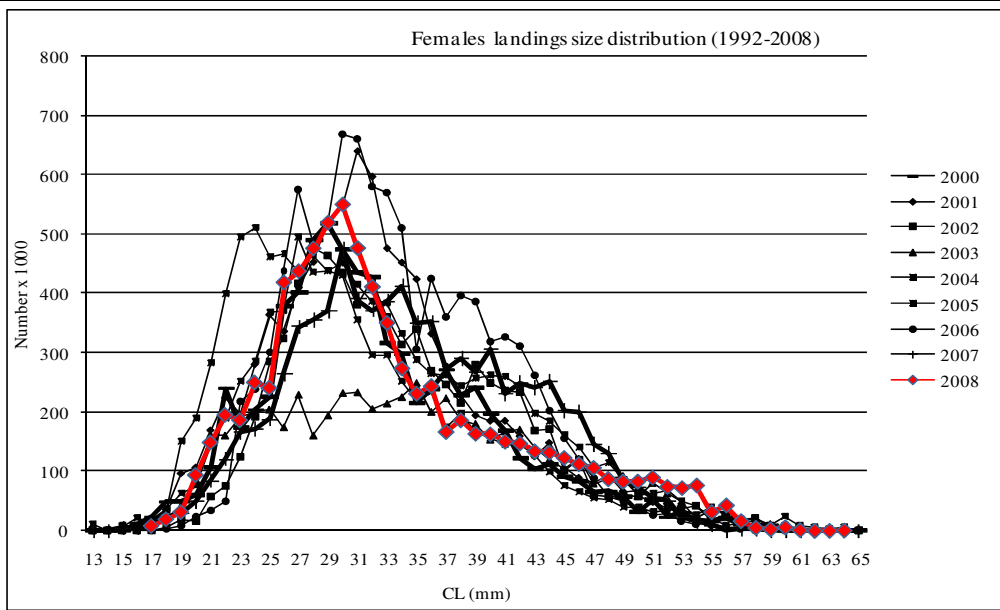
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Assessment form

Sheet P2b
Fishery by Operational Unit

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Data source*	BOE (Boletín Oficial del Estado) and personal observa	OpUnit 1*	ESP 05 E 03 34 - ARA

Regulations in force and degree of observance of regulations

Fishing license: fully observed
Engine power limited to 500 HP: not fully observed
Fishing forbidden at < 50 m depth: fully observed
Time at sea 5 days a week during 12 hours at sea: fully observed

EC Regulations:
The minimum mesh size of all bottom gear may not be less done 40 mm (EC Regulation 1967/2006).
In addition trawling activity cannot be performed within 3 miles off the coast, where sea bed is less than 50 m depth.
Minimum landings sizes have been established for the most important commercial specises, although there is not a minimum landing size for the red shrimp according to EC Regulation 1967/2006, which has replaced the previous EC Regulation 1626/94.
The use of towed dredges and trawl nets is at depth beyond 1000 m prohibited (EC Regulation 1967/2006) ational Regulations:
Effort regulations (APA/254/200) authorised trawls fishing 5 days a week during 12 hours at sea.

Accompanying species

- Red Shrimp bottom trawl main accompanying species are listed below:
- European hake (*Merluccius merluccius*)
- Black mouth catshark (*Galeus melastomus*)
- Pandalid shrimps (*Plesionika spp . Pasiphaea*)
- Giant red shrimp (Aristaeomorpha foliacea)
- Crabs (*Macropipus tuberculatus , Geryon longipes*)
- Megrims (*Lepidorhombus spp .*)
- Seabreams (*Pagellus acarne*)
- Siver scabbard fish (*Lepidopus caudatus*)
- Anglerfish (*Lophius spp .*)
- Blue-whiting (*Micromesistius poutassou*)
- Greater forkbeard (*Phycis blennoides*)
- Rockfish (*Helicolenus dactylopterus*)
- Conger eel (*Conger conger*)

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Assessment form

Sheet G
Indirect methods. Global model

Data source*		Gear*	

Model characteristic

Type of model*		Fitting criterion	
Software		Bibliographical source	

Data

Year						
Catch						
Effort						
CPUE						

Year						
Catch						
Effort						
CPUE						

Adjustment

RMS	

Results

Carryng capacity		a	
Growth rate		b	
Catchability			
MSY			
EMSY		TACMSY	
E0.1		TAC0.1	
Ecurrent			

Comments

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Sex*	Both

Time series

Analysis # *	LCA

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	Capture	Tunig method	
# of gears	1	Software	VIT (Lleonart and Salat, 1997)
$F_{terminal}$	0.4		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	13	0	Recruitment	23286249.44	34.3 t
Average	33.72	2.067	Average population	28171296.99	211.18 t
Maximum	64	8	Virgin population		957.06 t
Critical	29	1.55	Turnover		102.54 t

Average mortality

		Gear					
	Total	Females	Males				
F_1	Mean F	1.65	1.63				
F_2	Global F	0.377	0.558				
Z							

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

Comments

Minimum and Maximm sizes and ages are those observed in the landings. Average and critical values refer to the stock.

Total Biomass balance (D): 226764859.7
---   Biomass   Percentage
Recruitment   34313975.41   12.53
Growth   192450884.30   67.38
Natural death   81511910.69   35.95
Fishing   145252949.00   64.04
R/B(mean)   27.695
D/B(mean)   118.745
B(max)/B(mean)   55.12
B(max)/D   45.695

B/R   SSB/R
5.050   15.441

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Sex*	Sex Combined	Gear*	TRAWL		Analysis # *	VPA, XSA

Data source	

Data

Quality of data and inputs: Length frequency data for landings are available on a monthly basis. It was run a single VPA of males and females combined, using VPA package. Effort series used in days is considered representative of the effort for the whole fleet, however must be considered as rough estimates of the effort, since the effort data and landings are estimated from the Mallorca Island where most of the fleet fish. The male and female length distributions for year (1992-2008) were split using L2Age, slicing ICES package to ages . The catch-at-age for the two sexes were then summed to combined input file for separable VPA and XSA. Catch weights-at-age were averages weighted by numbers -at-age for each sex. Tuning data series was made using the Palma harbour reference fleet. and BALAR_MEDITS Surveys

PARAMETERS	Females	Males	Total
Linf	75.5	42	75.7
K	0.249	0.422	0.285
to	-0.3936	-0.65	-0.45326
a	0.00244	0.00246	0.00242601
b	2.4536	2.4311	2.4701264
L50	26	21	21
M	0.363	0.517	0.517
Modal Age Cla	Females	Males	Total
Edades			
0	22.1	22	25.7
1	33.9	29.5	38.1
2	43.1	34.5	47.4
3	50.2	37.8	54.4
4	55.8		59.7
5	60.1		63.7
6	63.5		
GRUPO PLUS	6+	3+	5+

XSA: Setting used in the assessment -Males and females combined

GSA: Year range 1992-2008; Age range: 0-8; Classe plus 6+

TUNING FLEET: Palma port; Year range: 1992-2008; Age range: 0-8; Classe plues 6+

TUNING SURVEY: MEDIT_BALAR; Year range: 2001-2008;Age range: 0-8; Classe plus 6+

First age for normal catchability independ analysis: Age class 2

First age at which q is considered independent of age: Age class 3

Tape time weighting applied? YES, Tricubic over 20 years

F shrinkage: YES; YEAR RANGE = 5

Population shrinkage: YES

AGE RANGE = 3-6

Minimum Log SE for terminal population estimates: 1.0

Tuning had not converged after 30 iterations: Total absolute residuals between iterations 29 and 30 = 0.00043

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Sex*	COMBI	Gear*	TRAWL		Analysis #*	**VPAseparable; XSA**

Population in figures

XSA RECRUITS AGE 0

YEAR	NUMBER	YEAR	NUMBER
1992	37797	2000	26075
1993	30559	2001	20662
1994	24758	2002	18084
1995	22667	2003	24886
1996	16841	2004	32020
1997	20835	2005	29370
1998	25163	2006	21282
1999	28250	2007	22958
		2008	22041

Thousands

$VPA_{separable}$ RECRUITS Age 0

YEAR	NUMBER	YEAR	NUMBER
1992	36418	2000	25273
1993	29382	2001	20017
1994	23693	2002	17601
1995	21515	2003	24361
1996	15798	2004	32412
1997	19658	2005	32839
1998	24622	2006	27105
1999	27158	2007	35064
		2008	19119

Population in biomass

XSA TOTAL BIOMASS Tones

YEAR	TB	YEAR	TB
1992	670	2000	426
1993	604	2001	425
1994	516	2002	383
1995	396	2003	361
1996	322	2004	427
1997	270	2005	484
1998	290	2006	462
1999	359	2007	414
		2008	392

VPAseparable:TOTAL BIOMASS Tones 1992 645

YEAR	TB	YEAR	TB
1992	645	2000	399
1993	580	2001	400
1994	494	2002	363
1995	375	2003	347
1996	303	2004	416
1997	249	2005	494
1998	269	2006	516
1999	334	2007	549
		2008	561

Fishing mortality rates

XSA : FBAR (0-5)

YEAR		YEAR	
1992	0.4372	2000	0.3883
1993	0.4201	2001	0.3861
1994	0.4801	2002	0.4063
1995	0.4509	2003	0.3698
1996	0.4961	2004	0.3853
1997	0.4512	2005	0.4048
1998	0.3881	2006	0.3912
1999	0.3303	2007	0.3808
		2008	0.4049

VPAseparable: FBAR (0-5)

YEAR		YEAR	
1992	1.3508	2000	1.0685
1993	1.1438	2001	0.842
1994	1.094	2002	0.8245
1995	1.2587	2003	1.036
1996	1.0856	2004	0.9581
1997	1.2853	2005	1.8502
1998	1.1937	2006	1.1107
1999	0.5004	2007	0.7745
		2008	0.599

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Assessment form

Sheet A3
Indirect methods: VPA results

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Sex*		Gear*		Analysis #*	

Population in figures

Population in biomass

Fishing mortality rates

Table	9	Relative	F	at	age				
YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE									
0	0.0669	0.082	0.0861	0.0806	0.0817	0.1274	0.088	0.2587	0.1865
1	0.7075	0.8372	1.2579	1.0256	1.3909	1.1484	1.2144	1.9811	1.1466
2	1.1213	1.467	1.5676	1.1896	1.5302	1.1542	1.1929	1.28	1.2971
3	1.3529	1.0383	1.1084	1.1189	0.9964	1.1085	0.9786	0.9433	0.9897
4	1.4301	1.3038	0.8421	1.2867	0.8484	1.2405	1.3267	0.694	1.2283
5	1.3213	1.2717	1.1379	1.2986	1.1523	1.221	1.1993	0.8429	1.1518
##########	1.3213	1.2717	1.1379	1.2986	1.1523	1.221	1.1993	0.8429	1.1518
REFMEAN	1.0508	0.9475	0.9013	1.0527	0.8992	0.9728	0.7409	0.3891	0.6496
	2001	2002	2003	2004	2005	2006	2007	2008	MEAN
YEAR	2001	2002	2003	2004	2005	2006	2007	2008	
AGE	0.2112	0.1517	0.0701	0.1405	0.1063	0.1007	0.0465	0.0268	0.058
0	1.3735	1.1396	0.6595	0.8562	0.4589	0.8468	0.6984	0.6847	0.7433
1	1.5608	1.5376	1.244	1.079	0.7142	0.8559	1.3528	0.6525	0.9537
2	1.4583	1.1363	1.4451	1.0934	1.3893	1.1021	1.3942	1.2382	1.2448
3	1.0255	1.2234	1.1842	1.6474	1.9848	2.1147	1.2808	1.7404	1.712
4	0.3707	0.8114	1.397	1.1835	1.3464	0.9798	1.2273	1.6574	1.2882
5	0.3707	0.8114	1.397	1.1835	1.3464	0.9798	1.2273	1.6574	
##########	0.5488	0.6295	0.733	0.718	1.3423	0.9616	0.7762	1.2439	

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Sex	

Analysis #	

# of gears		Software	

Parameters used

| Vector F	
Vector M	
Vector N	

Model characteristics

Yield per Recruit analysis were made for landings by sex , assuming the current steady state exploitation pattern. Results of equilibrium landings and SSB/R estimated the current exploitation close to the maximum. Yield per Recruit curves the predicted small long-term gains upon a reduction of current F at $F_{0.1}$ would be 29% .

Results

	Total	Gear			
Current YR	5.65				
Maximum Y/R	5.7				
Y/R 0.1	5.4				
F_{max}	1.24				
$F_{0.1}$	0.57				
Current B/R	15.64				
Maximum B/R	14.614				
B/R 0.1	34.92				

Comments

Comments
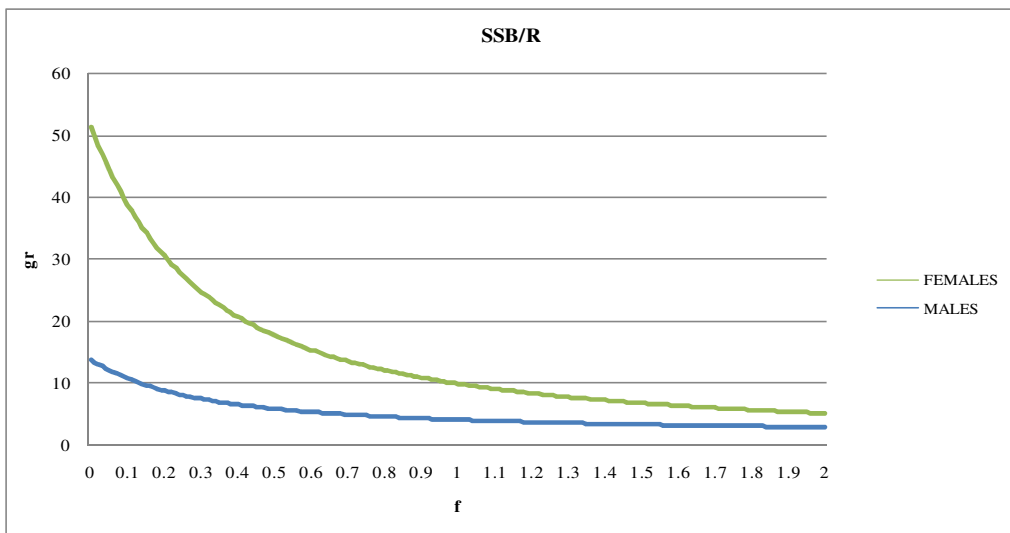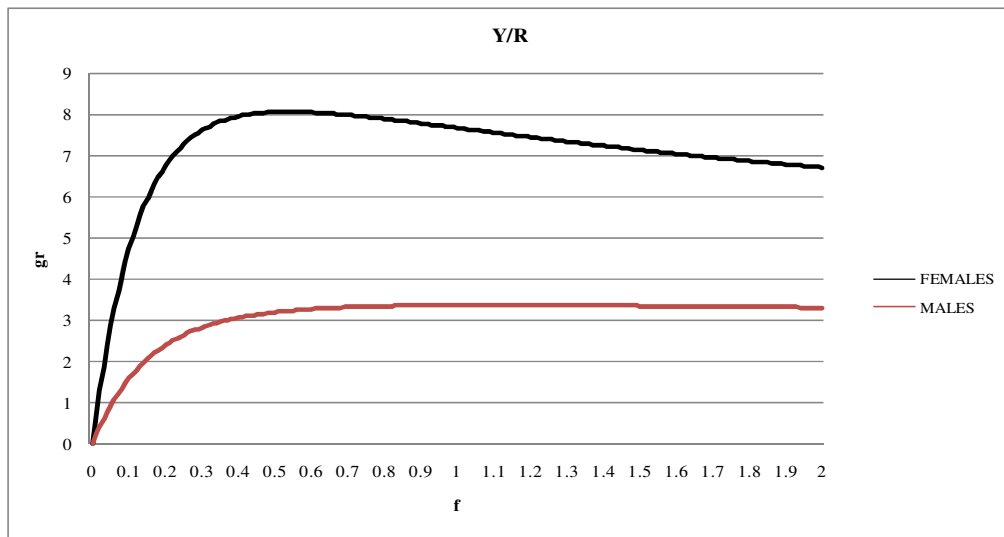
Y/R

SSB/R

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Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B	666				
SSB	572				
F	0.285				
Y	5.65				
CPUE	39	Kg/day			

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;

	Exploitation rate	Stock abundance	
Bidimensional	○ No or low fishing	○ Virgin or high abundance	○ Depleted
	◉ Moderate fishing	○ Intermediate abundance	○ Uncertain / Not assessed
	○ High fishing mortality	◉ Low abundance	
	○ Uncertain / Not assessed		

Comments

The XSA log catchability residuals are high for ages 0,1, 2. This can be explained by the ontongenic and biological behaviour of the species for the youngest age classe (Recruits of Age 0) only partially recruit to the fishery. Howver residuals for ages 1 and 2 can be explianed for some year effects. The log catchability residuals for the surveys time series (2001-2008) were lower than those of the fleet, but again they show year effects. The two tuning (fleet and survey) give similar estimates of survivors and have the similar weight in the F-at-age estimates. Total Biomass decreased from 700 tones (1992) to 270 tonnes (1997), from them fluctuated between 300 and 500 tonnes. The present stock is at lower biomass level compared to the beginning of the time series and compared to the last year, this year's assessment shows a slightly better picture.