

## SAC GFCM Sub-Committee on Stock Assessment

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**Date\***

5	November	2010
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**Code\***

PIL0110Qui
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**Authors\***

Quintanilla L.F.*, Bellido J.M., Torres P., Giráldez A., Ceruso C., González M <sup>a</sup> .
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**Affiliation\***

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**Species Scientific name\***

**1**  
Source: GFCM Priority Species

**2**  
Source: -

**3**  
Source: -

**Geographical area\***

Western Mediterranean (FAO Subarea 37.1.)
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**Geographical Sub-Area (GSA)\***

01 - Northern Alboran Sea
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Combination of GSAs      

1	
2	
3	

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

Assessment form

Sheet #0

Basic data on the assessment

Code: PIL0110Qui

Date*	5	Nov	2010	Authors*	Quintanilla L.F.*, Bellido J.M., Torres P., Giráldez A., Ceruso C., González M <sup>a</sup> .
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Species Scientific name*	Sardina pilchardus - PIL	Species common name*	Sardine, Sardina
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### Data Source

GSA*	01 - Northern Alboran Sea	Period of time*	2000-2009
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### Description of the analysis

Type of data*	Landings, Length and biological samplings. Tuning from Acoustic	Data source*	Official Statistics, IEO Sampling Network, Acoustic Survey
Method of assessment*	XSA - Extended Survivor Analysis (Shepherd, 1999).	Software used*	FLR Packages

### 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	---

### Comments, bibliography, etc.

The assessment of the Spanish sardine stock in GSA01 was carried out by means of VPA Extended Survivor Analysis (XSA) (Shepherd, 1999) using catch data collected by the Spanish National Data Collection (DCF official data). The XSA tuning was performed using abundance index series derived from echo-surveys carried out in the GSA 01. XSA diagnostics and retrospective analysis were also run. Yield per recruit analyses was conducted based on the exploitation pattern resulting from the XSA model and population parameters. The annual exploitation rate ( $E=F/Z$ ) was calculated and compared with the threshold ( $E=0.4$ ) proposed as biological reference point for small pelagics (Patterson, 1992).

This is the fourth assessment of *Sardina pilchardus* from GSA01 using XSA. The software used were FLR 2.2 packages in 2010 and the Lowestoft suite (Darby and Flatman 1994) in previous years. Previous assessments can be viewed at <http://www.gfcm.org>.

**Comments, bibliography, etc.****Bibliography (Published papers and books):**

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.

Caddy, J.F. (1991). Death rates and time intervals: Is there an alternative to the constant natural mortality axiom? *Rev. Fish Bio./ Fisheries*, 1: 109-138.

De Oliveira, J.A.A., Uriante, A., and Roel, B., 2005. Potential improvements in the management of Bay of Biscay anchovy by incorporating environmental indices as recruitment predictors. *Fisheries Research*, 75: 2-14.

Freon, P. and Misund, O.A., 1999. *Dynamics of Pelagic Fish Distribution and Behaviour: Effects on Fisheries and Stock Assessment*. Fishing News Books, UK, 348 pp.

Hilborn, R. and Walters C.J., 1992. *quantitative Fisheries Stock Assessment; Choice, Dynamics and Uncertainty*. New York: Chapman and Hall, 570 pp.

Leonard, J. and Maynou, F., 2003. Fish Stock Assessment in the Mediterranean: state of the art. *Scientia Marina*, 67: 37-49.

Patterson, K., 1992. Fisheries for small pelagic species: an empirical approach to management targets. *Review in Fish Biology and Fisheries*, 2: 321-338.

Ramon M.M and Castro, J.A., 1997. Genetic variation in natural stocks of *Sardina pilchardus* (Sardines) from the western Mediterranean Sea. *Heredity*, 78: 520-528.

Shepherd, J.G., 1999. Extended Survivors Analysis: An improved method for the analysis of catch-at-age data and abundance indices. *Journal of Marine Science*, 56: 584-591.

**Bibliography (Technical Reports and grey literature):**

Darby, C.D. and Flatman, S., 1994. *Virtual Population Analysis, version 3.1 (Windows/DOS) user guide*. Information Technology Series 1. CEFAS, Lowestoft, UK.

Reports from the SCSA and SAC of the General Fisheries Commission for the Mediterranean (GFCM), available at [http://www.fao.org/fi/body/rfb/GFCM/gfcm\\_home.htm](http://www.fao.org/fi/body/rfb/GFCM/gfcm_home.htm) and/or <ftp://cucafera.icm.csic.es/pub/scsa/>

Reports from the Assessment Working Groups of the International Council for the Exploration of the Seas (ICES), particularly the small pelagics assessment working group WGMHSA. Available at [www.ices.dk](http://www.ices.dk)

Reports from the SGMED Working Groups on the Mediterranean of the Scientific, Technical and Economic Committee for Fisheries (STECF). Available at <http://fishnet.jrc.it/web/stecf>.

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

Assessment form

Sheet B  
Biology of the species

Code: PIL0110Qui

**Biology**

Somatic magnitude measured (LH, LC, etc)*				Total Length	Units*	1/2 centimeter
Sex	Fem	Mal	Both	Unsexed		
Maximum size observed			24.5		Reproduction season	Oct-Mar
Size at first maturity			13.5		Reproduction areas	All the coast
Recruitment size			10		Nursery areas	Bays

**Parameters used (state units and information sources)**

		Units	Sex			
			female	male	both	unsexed
Growth model	L $\infty$	cm			22	
	K	year-1			0.45486	
	t0	year			-1.41571	
	Data source	Otoliths				
Length weight relationship	a				0.0059	
	b				3.1406	
M				M vector (see comments)		
sex ratio (mal/fem)		46/54				

**Comments**

ALKs 2003-2009, combined ALK for 2000-2002. Length Distributions 2003-2009, combined for 2000-2002.

Biological sampling 2003-2009 for Maturity at age and Weight-Length relationships.

Natural Mortality value (M) - Following the recommendation from the Workshop on Mediterranean Stock Assessment Standardization (SG-ECA/RST/MED 09-01), a vector (declining value of M with age) instead of a constant value was used. The vector was estimated using the ProdBiom method (Abella et al., 1997) based on Caddy (1991).

Age	M
0	1.17
1	0.44
2	0.32
3	0.27
4	0.25
5+	0.24



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

Assessment form

Sheet P1

General information about the fishery

Code: PIL0110Qui

Data source*	Official Statistics, IEO Sampling Network, Acoustic	Year (s)*	2000-2009
Data aggregation (by year, average figures between years, etc.)*	By year 2000-2009		

### Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ESP	01	G - Purse Seine (6-12 metres)	02 - Seine Nets	31 - Small gregarious pelagic	PIL
Operational Unit 2	ESP	01	H - Purse Seine (12-24 metres)	02 - Seine Nets	31 - Small gregarious pelagic	PIL
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 01 G 02 31 - PIL	20	Tons	5926				
ESP 01 H 02 31 - PIL	93	Tons					
<b>Total</b>	<b>113</b>		<b>5926</b>				

Legal minimum size	11 cm TL
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### Comments

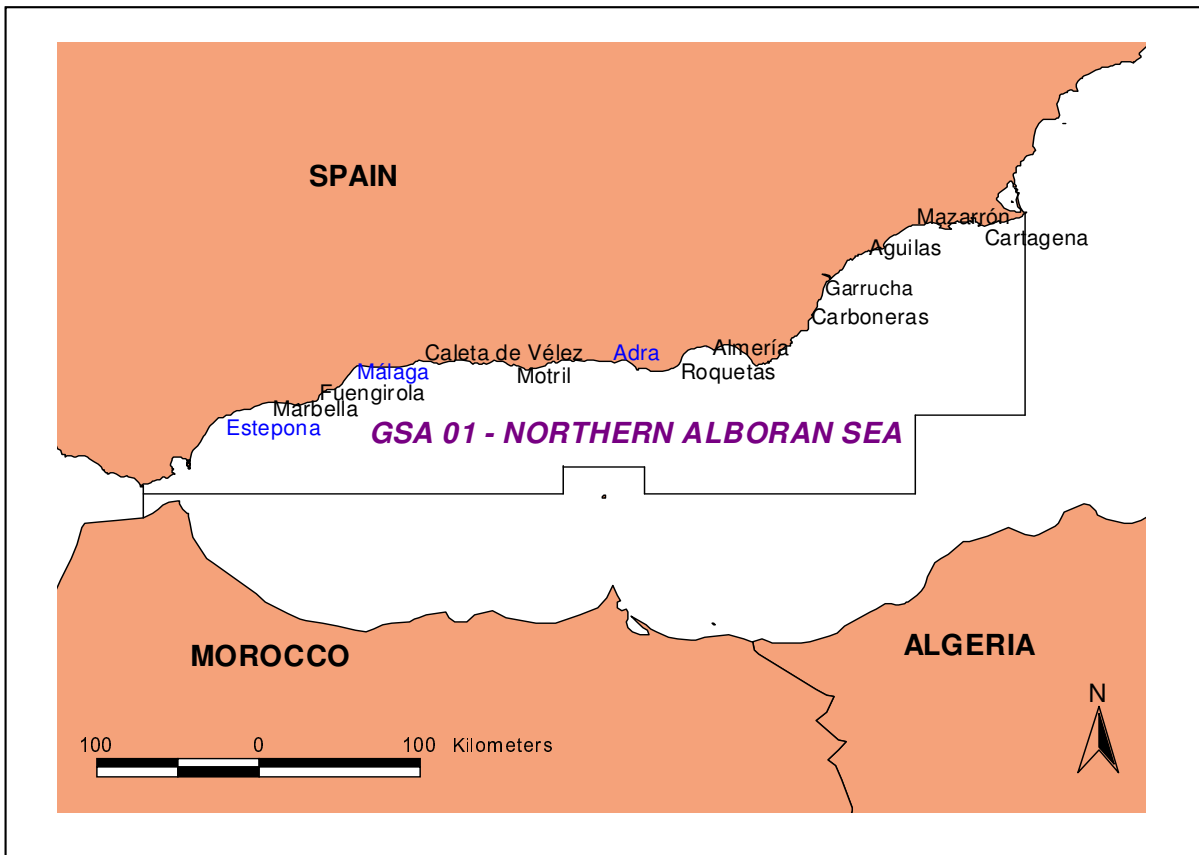
The catch (landings) is not split by Fleet segments. It comprises 5926 Tons in 2009 for the two Operational Units. Although landings are not still separated by Fleet segments we can provide a segmentation of the pelagic fleet in GSA01, with number of boats for every fleet segment:

The Fleet Segment G - Purse Seine (6-12 metres) comprises 20 boats in GSA01 in 2009  
 The Fleet Segment H - Purse Seine (12-24 metres) comprises 93 boats in GSA01 in 2009

Beacuse that landing aggregation we prefer to fill pages P2a and P2b considering the two fleet segments as an unique pelagic fleet. We aim to split landings by Fleet segment in a near future.

Landing Ports are shown in the attached Figure. Sampling ports are highlighted in blue.

Comments



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

Assessment form

Sheet P2a  
Fishery by Operational Unit

Code: PIL0110Qui

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Data source*	Official Statistics, IEO Sampling Network	OpUnit 1*	ESP 01 G 02 31 - PIL
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### Time series

Year*	2000	2001	2002	2003	2004	2005
Catch	9325 t	7457 t	5348 t	8244 t	3964 t	7208 t
Minimum size	6 cm	6 cm	6 cm	8 cm	6 cm	6 cm
Average size Lc	18.12 cm	18.12 cm	18.12 cm	18.09 cm	18.57 cm	18.16 cm
Maximum size	24 cm	24 cm	24 cm	22 cm	23.5 cm	24 cm
Fleet	187	184	168	167	160	149

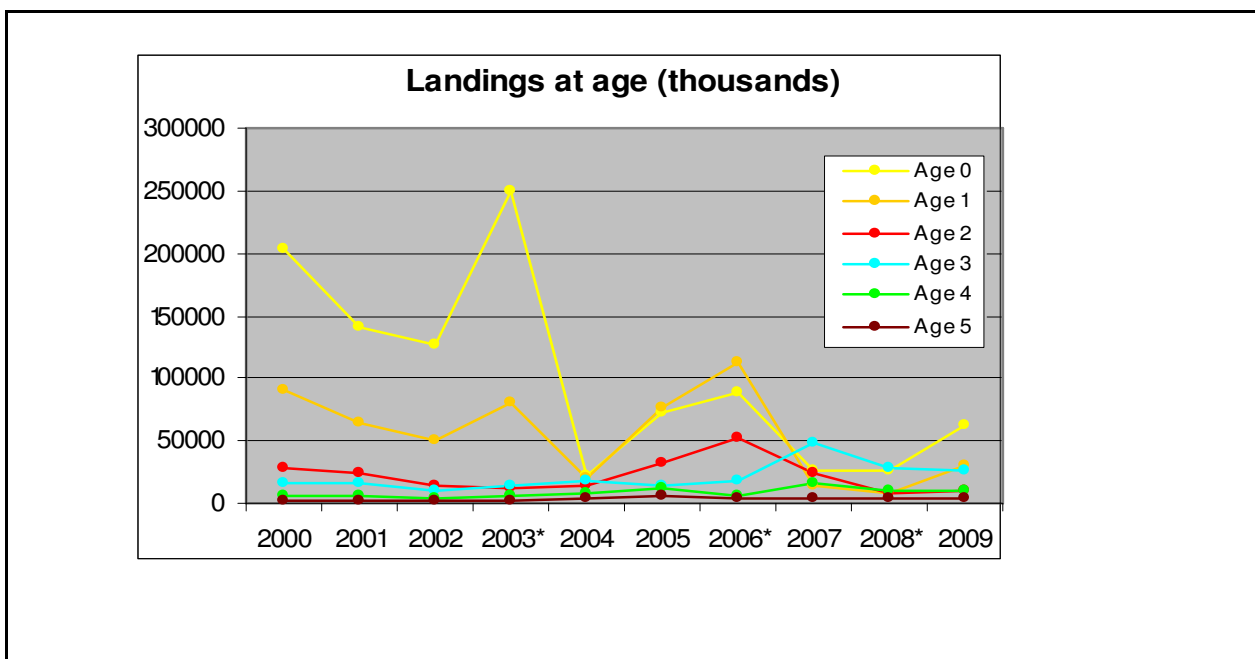
Year	2006	2007	2008	2009		
Catch	10002 t	6766 t	4423 t	5926 t		
Minimum size	10.5 cm	9.5 cm	7.0 cm	9.2		
Average size Lc	18.13 cm	18.79 cm	17.37	16.9		
Maximum size	22 cm	22.5 cm	23.0 cm	24.6		
Fleet	135	136	136	113		

### Selectivity

### Remarks

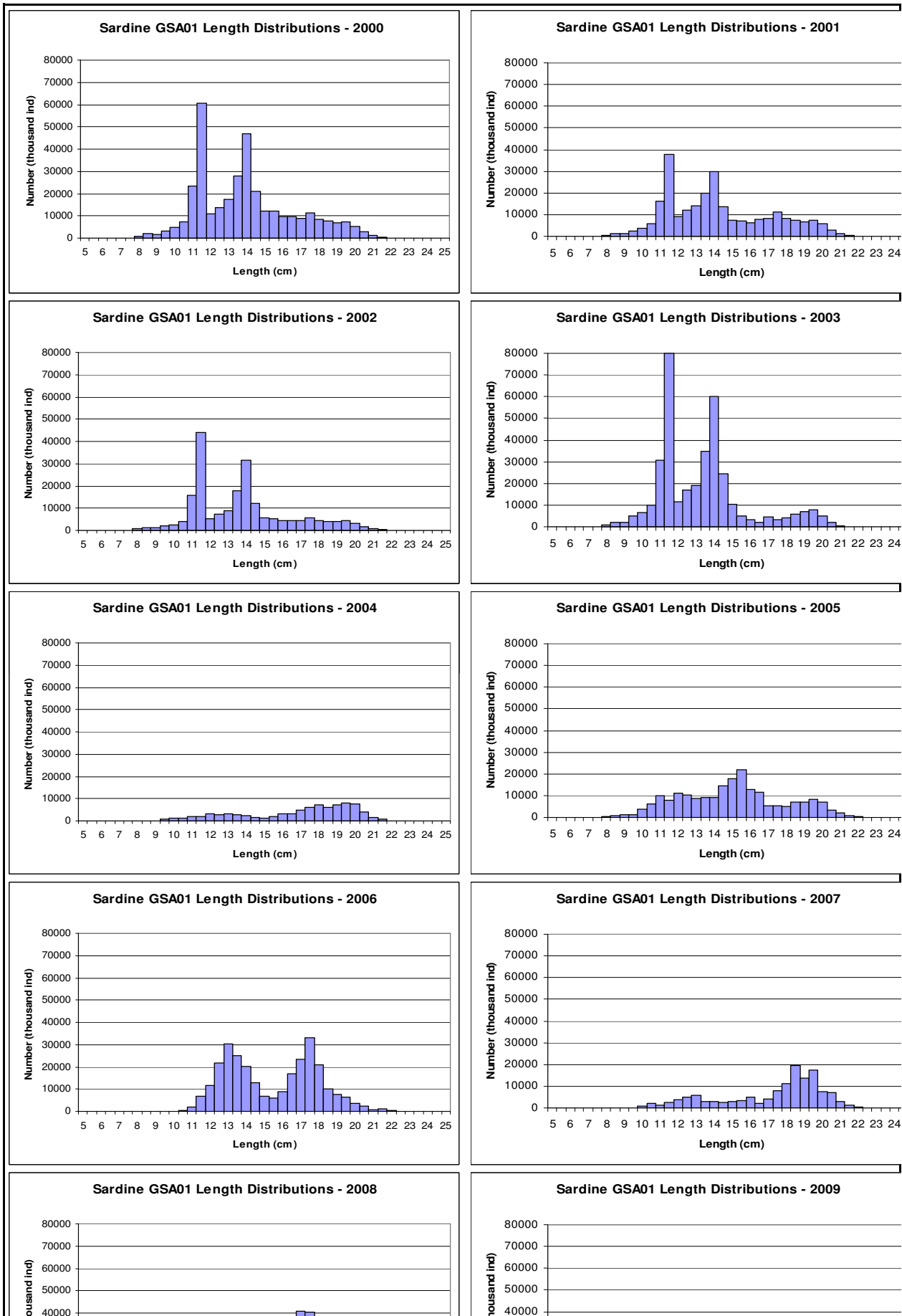
L25		
L50		
L75		
Selection factor		

### Structure by size or age





Structure by size or age



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

Assessment form

Sheet P2a  
Fishery by Operational Unit

Code: PIL0110Qui

Page 2 / 2

Data source*		OpUnit 2*	ESP 01 H 02 31 - PIL
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**Time series**

Year*						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

**Selectivity**

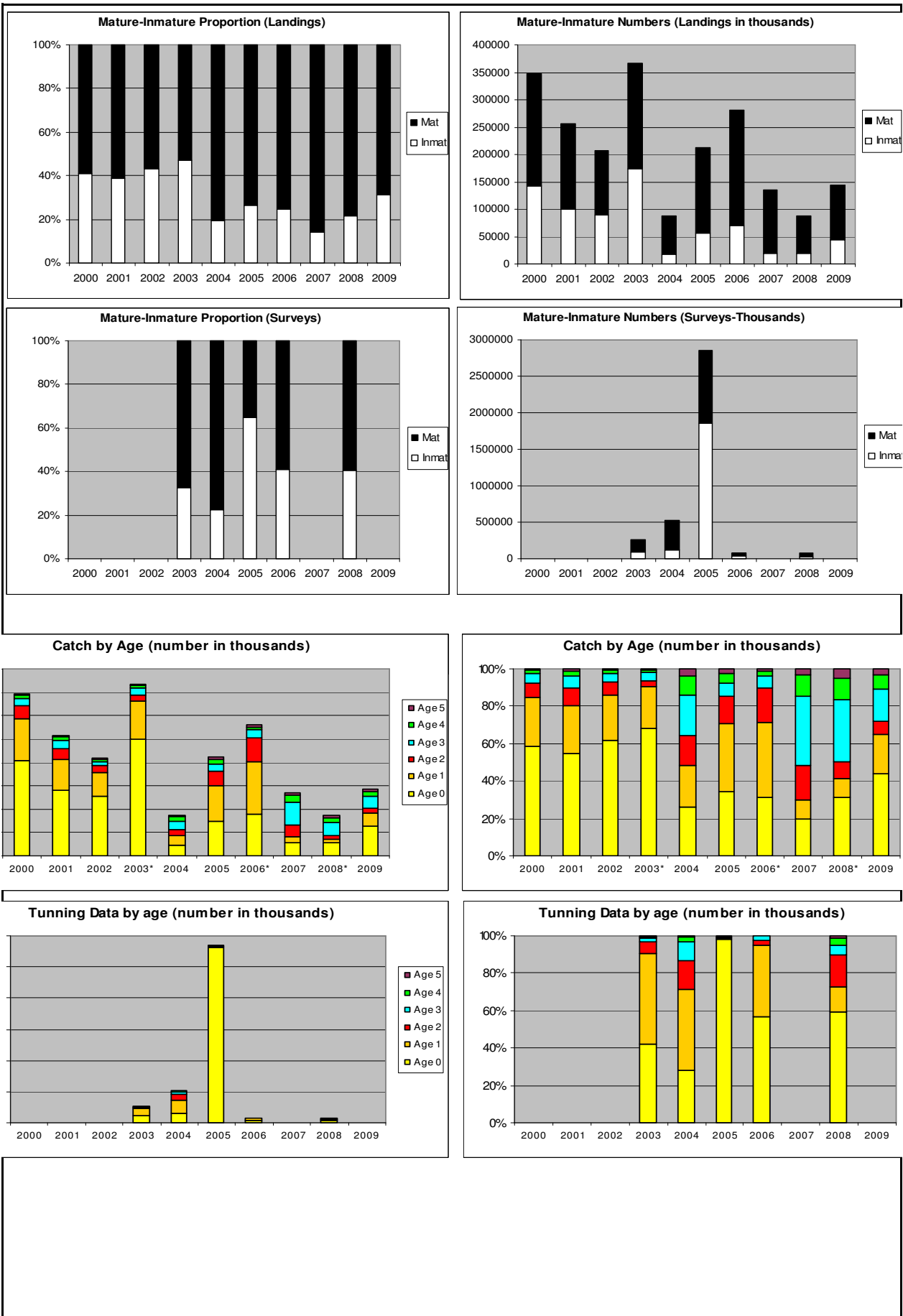
**Remarks**

L25		
L50		
L75		
Selection factor		

**Structure by size or age**

Catch by Age (number in thousands)										
	2000	2001	2002	2003*	2004	2005	2006*	2007	2008*	2009
Age 0	202618	141258	127761	250550	22550	73366	87984	26972	26930	63166
Age 1	90143	64800	50449	80714	19613	76927	112297	13569	8842	29731
Age 2	27599	24263	14384	12442	13812	31410	51779	25071	7988	9968
Age 3	16690	16795	9498	15078	19018	14541	18059	49316	28664	25352
Age 4	6784	7012	4028	6070	8744	11182	6133	15806	10039	10063
Age 5	2810	2836	1688	1930	3196	5103	4250	4048	4586	5016
Tunning Data by Age (number in thousands)										
	2000	2001	2002	2003*	2004	2005	2006*	2007	2008*	2009
Age 0	NA	NA	NA	111356	144702	2806356	47276	NA	44671	NA
Age 1	NA	NA	NA	126889	226070	12962	32466	NA	9907	NA
Age 2	NA	NA	NA	18057	81859	22838	1981	NA	13054	NA
Age 3	NA	NA	NA	4802	50659	6179	2011	NA	3651	NA
Age 4	NA	NA	NA	2073	14107	5412	60	NA	2986	NA
Age 5	NA	NA	NA	973	4141	2313	0	NA	849	NA

Structure by size or age



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

Assessment form

Sheet P2b  
Fishery by Operational Unit

Code: PIL0110Qui

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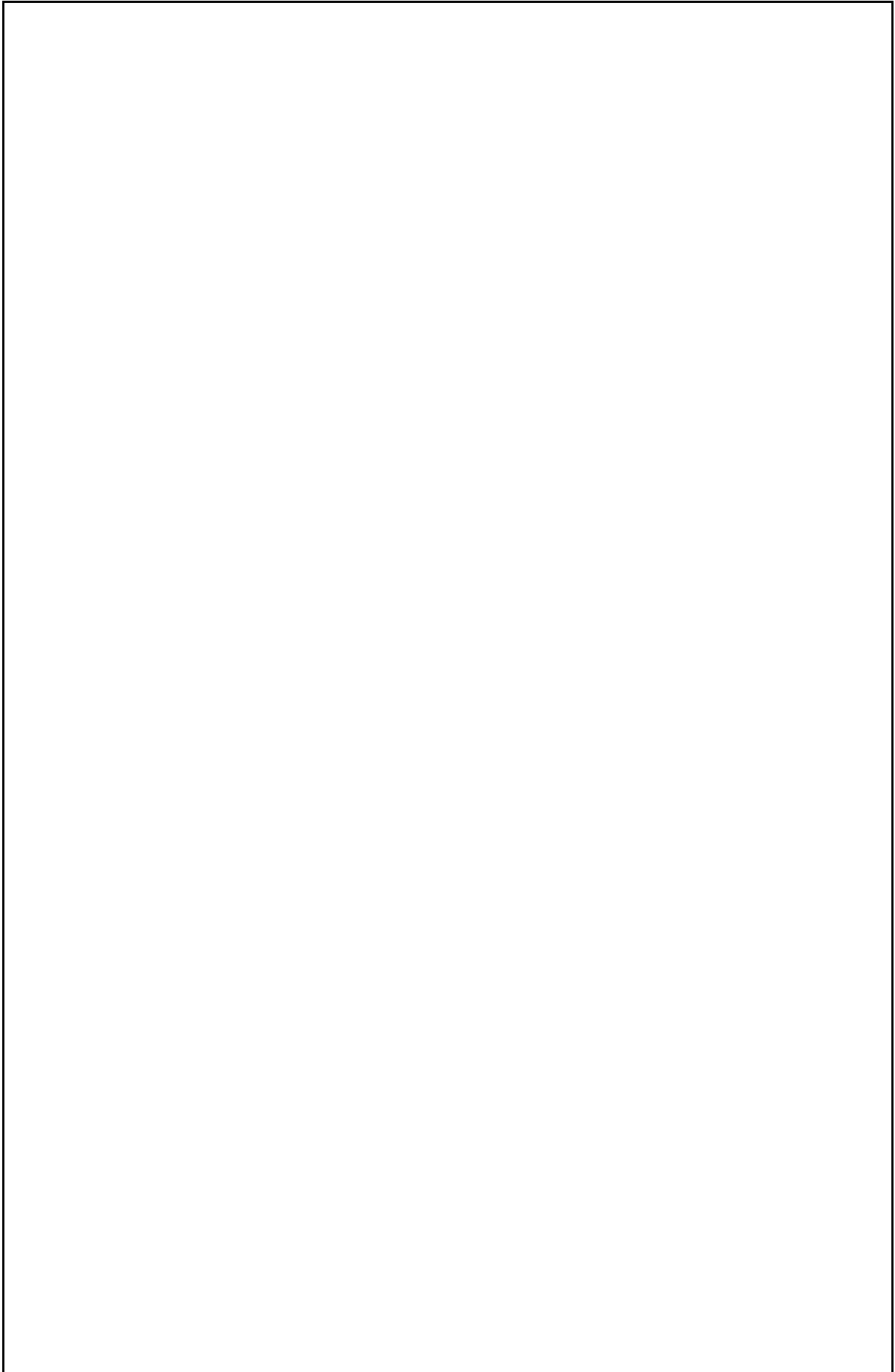
Data source*	Official Statistics, IEO Sampling Network	OpUnit 1*	ESP 01 G 02 31 - PIL
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### Regulations in force and degree of observance of regulations

Fishing license: fully observed  
Minimum landing size 11cm: not fully observed.  
No fishing allowed on weekend. Time at sea 12 hours per day and 5 days a week: fully observed  
Several technical measures regulations (gear and mesh size, engine, GRT, etc...): fully observed  
Temporary fishing closures (March and April): fully observed.

### Accompanying species

The most important are:  
Anchovy (*Engraulis encrasicolus*)  
Mediterranean Horse Mackerel (*Trachurus mediterraneus*)  
Other Horse Mackerels (*Trachurus trachurus* and *Tachurus picturatus*)  
Mackerel (*Scomber scombrus*)  
Chub Mackerel (*Scomber japonicus*)  
Round sardinella (*Sardinella aurita*)  
Bogue (*Boops boops*)



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

Assessment form

Sheet A1  
Indirect methods: VPA, LCA

Code: PIL0110Qui

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Sex\* Both

Analysis # \* XSA

**Time series**

Data	Size	Age
(mark with X)	X	X

Model	Cohorts	Pseudocohorts
(mark with X)	X	

Equation used	VPA	Tuning method	XSA
# of gears	Purse seiners	Software	FLR 2.2.
F <sub>terminal</sub>			

**Population results (please state units)**

	Sizes	Ages		Amount	Biomass
Minimum	9.2	0	Recruitment	1258 millions	(in 2009)
Average	16.9		Average population		
Maximum	24.6	5+	Virgin population		
Critical			Turnover		

**Average mortality**

	Total	Gear				
F <sub>1</sub>	Fbar(1-3)=0.15					
F <sub>2</sub>						
Z	See Comments					

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

**Comments**

Reference F is Fbar1-3 (average of ages 1 to 3 are considered the reference ages). A natural mortality vector instead of a constant value was used. The vector was estimated using the ProdBiom method (Abella et al., 1997) based on Caddy (1991).

Age	0	1	2	3	4	5+
F	0.09	0.13	0.10	0.23	0.13	0.13
M	1.17	0.44	0.32	0.27	0.25	0.24

XSA main settings were Fbar 1-3; Age 2 for q stock-size independent and age 3 for q independent of age; Fshrinkage=0.5; S.E. 0.3 for fleet terminal estimates.

Landings increased in 2009, reaching up 5926 t. The time series shows a rather fluctuating trend, with the lowest value in 2004 (3960 t) and the greatest in 2006 (10000 t). Since 2000 fishing mortality (F1-3) has varied between 0.43 and 0.11. The maximum was observed in 2000, then falling down to the minimum in 2008. F1-3 remains at low levels in 2009 (0.15). After the maximum observed in 2004 (2110 millions), recruitment followed a decreasing trend reaching their minimum in 2007 (709 millions). In 2009, the recruitment (1258 millions) continues the recovery trend observed in 2008. Since 2000, when the minimum was observed (20200 t), SSP showed an increasing trend reaching its maximum in

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

Assessment form

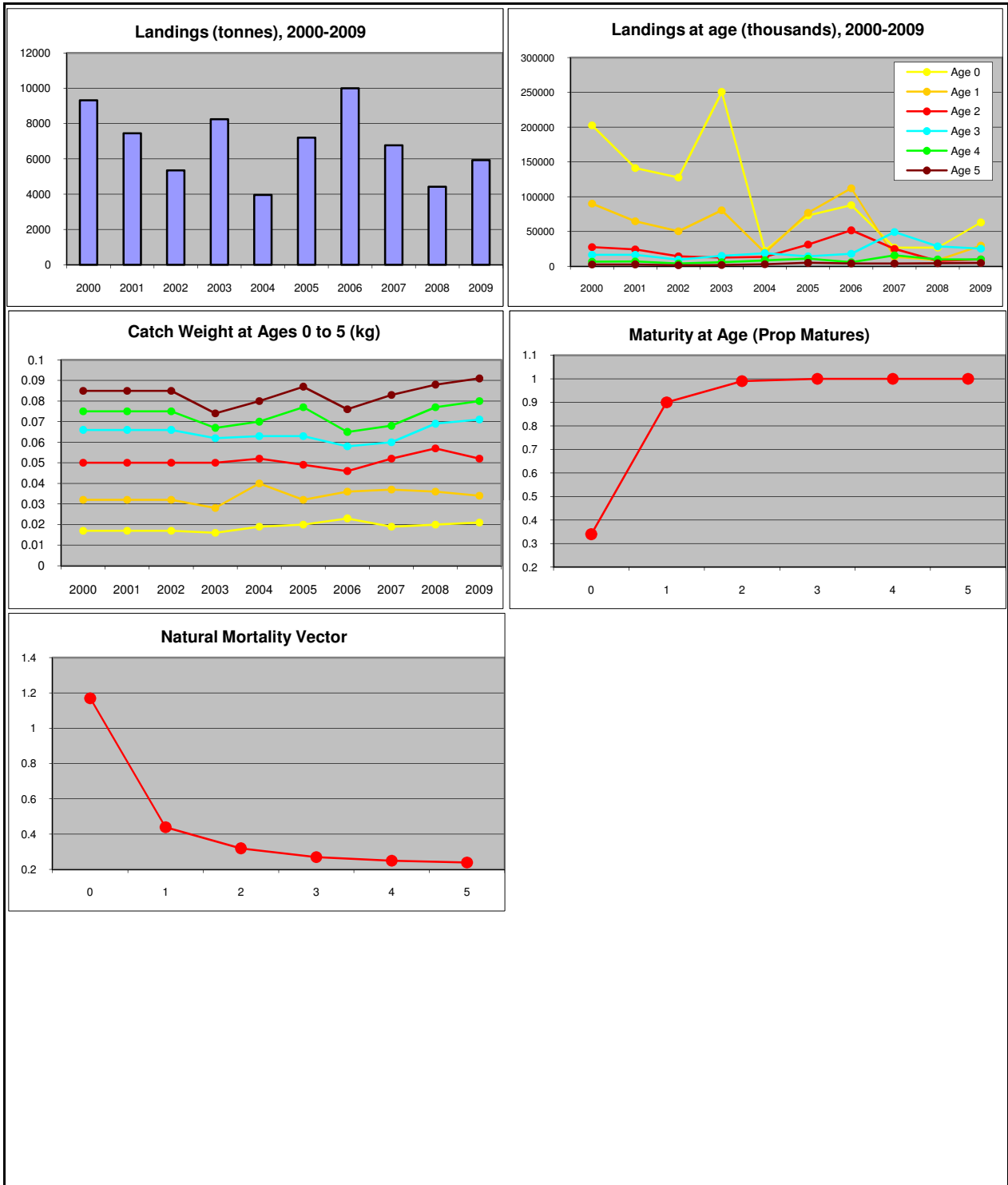
Sheet A2  
Indirect methods: data

Code: PIL0110Qui

Sex*	Both	Gear*	Purse seiners	Analysis # *	XSA
------	------	-------	---------------	--------------	-----

Data	Input data for XSA
------	--------------------

**Data**



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

Assessment form

Sheet A3  
Indirect methods: VPA results

Code: PIL0110Qui

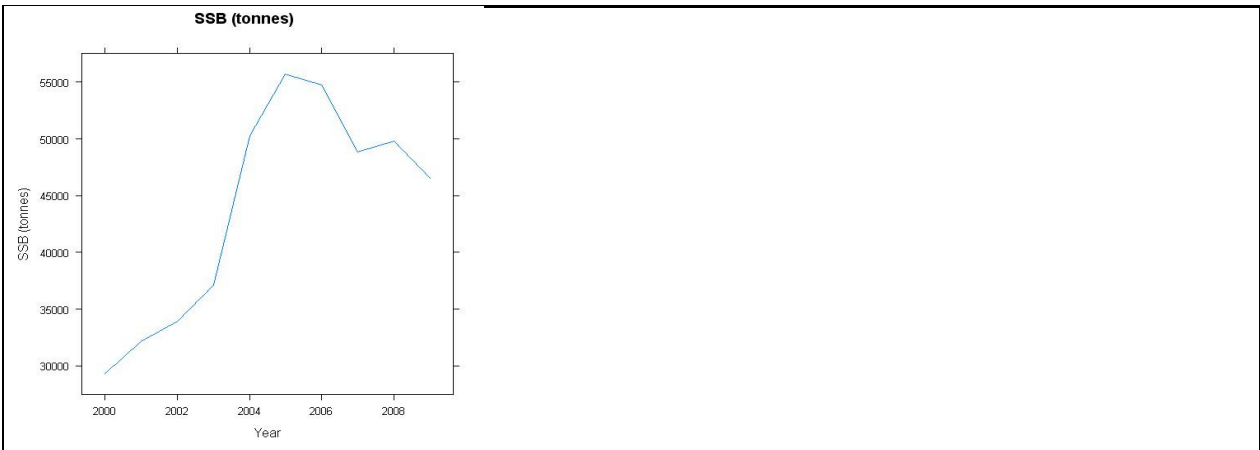
Page 1 / 1

Sex*	Both	Gear*	Purse Seiners	Analysis #*	XSA
------	------	-------	---------------	-------------	-----

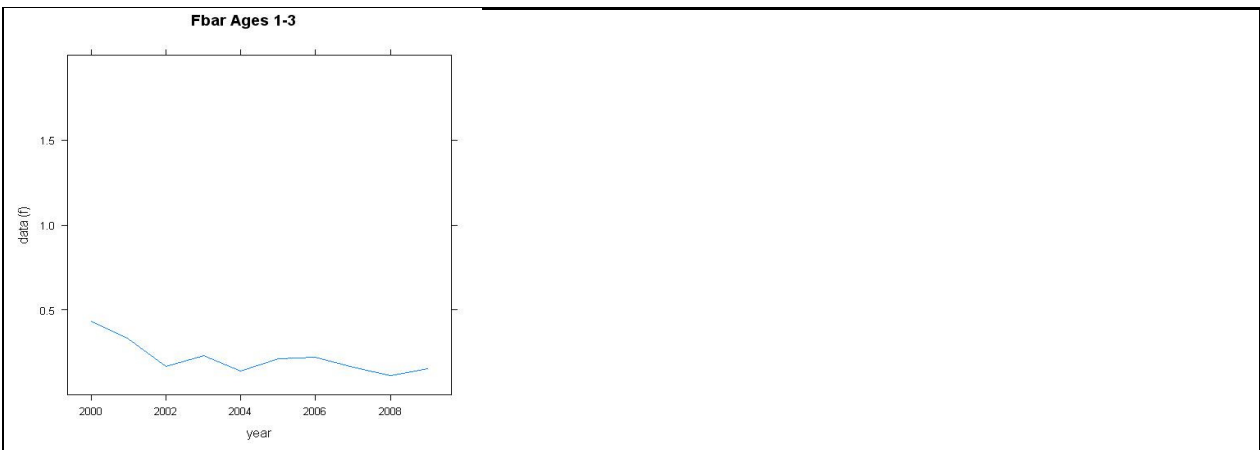
## Population in figures



## Population in biomass



## Fishing mortality rates





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

Assessment form

Sheet A3

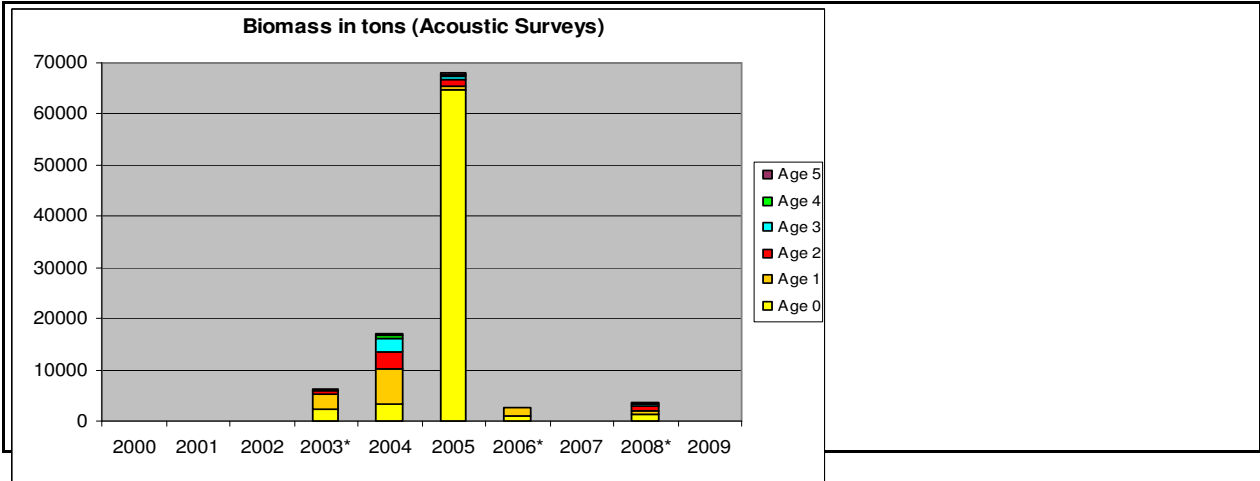
Indirect methods: VPA results

Code: PIL0110Qui

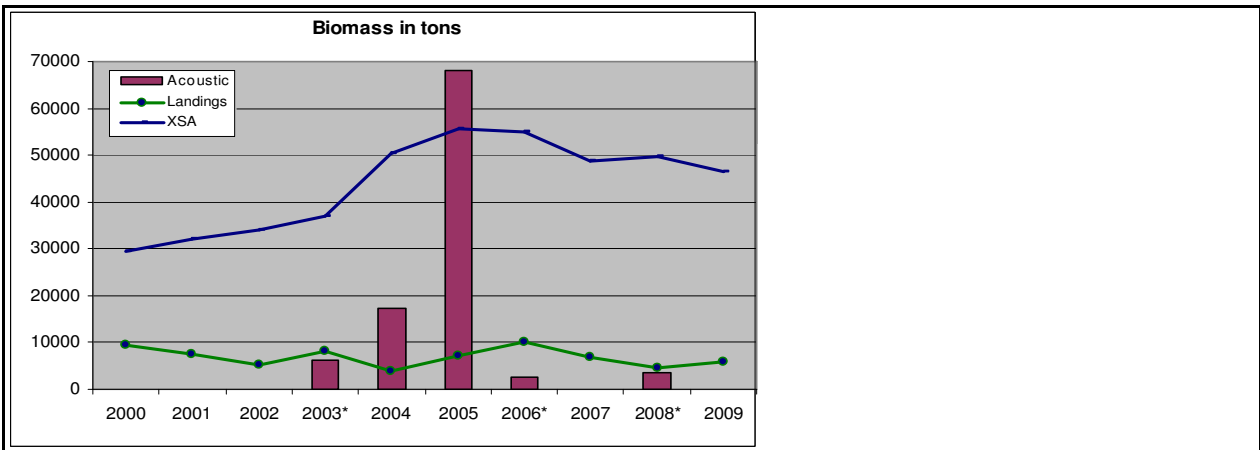
Page 2 / 1

Sex*		Gear*		Analysis #*	
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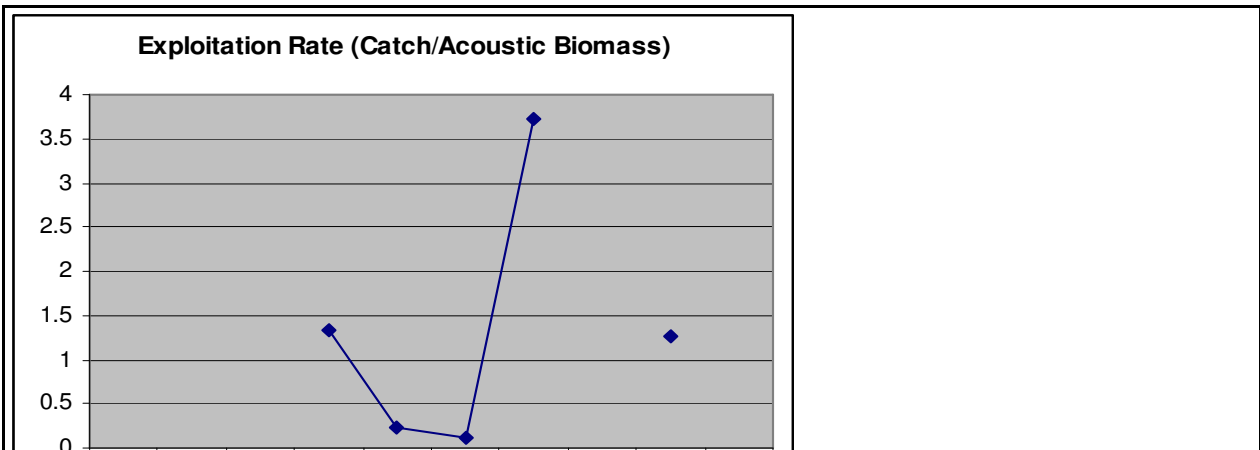
**Population in figures**



**Population in biomass**



**Fishing mortality rates**



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

		<b>Code: PIL0110Qui</b>	
Sex	Both	Analysis #	Y/R

# of gears	Purse Seiners	Software	
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**Parameters used**

Vector F	
Vector M	
Vector N	

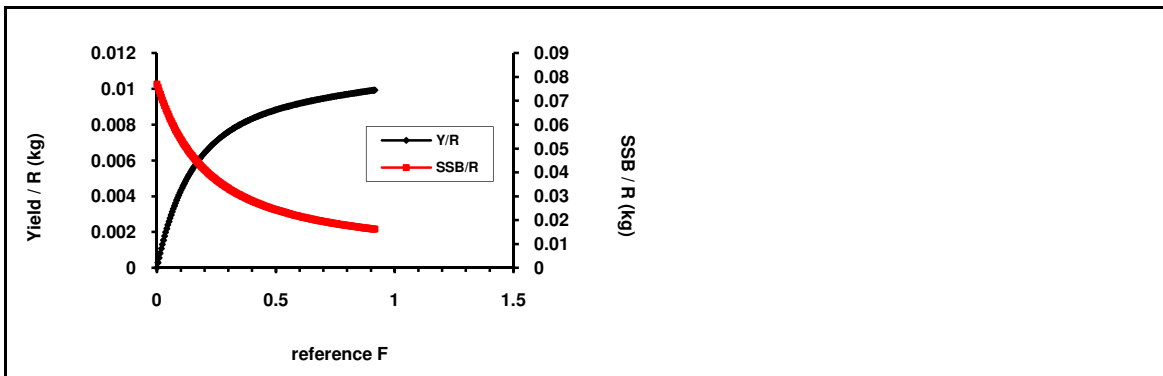
**Model characteristics**

Inputs	age group	stock weight	catch weight	maturity	F	M
	0	0.019	0.019	0.34	0.0945	1.17
	1	0.034	0.034	0.90	0.1335	0.44
	2	0.051	0.051	0.99	0.0983	0.32
	3	0.064	0.064	1	0.2287	0.27
	4	0.073	0.073	1	0.1265	0.25
	5	0.083	0.083	1	0.1265	0.24

**Results**

	Total	Gear		
Current YR				
Maximum Y/R				
Y/R 0.1				
F <sub>max</sub>	0.9164			
F <sub>0.1</sub>	0.3868			
Current B/R				
Maximum B/R				
B/R 0.1				
Fref	0.1535			

**Comments**



**Comments**

The use of yield-per-recruit analysis for estimating targets for long-term management of pelagic fisheries has been discouraged (Patterson, 1992). Also, Y/R analyses were not considered reliable due to its flat-topped shape. Therefore, F0.1 cannot be used as a reference point for this stock.

Other assessment methods

ACOUSTIC SURVEYS

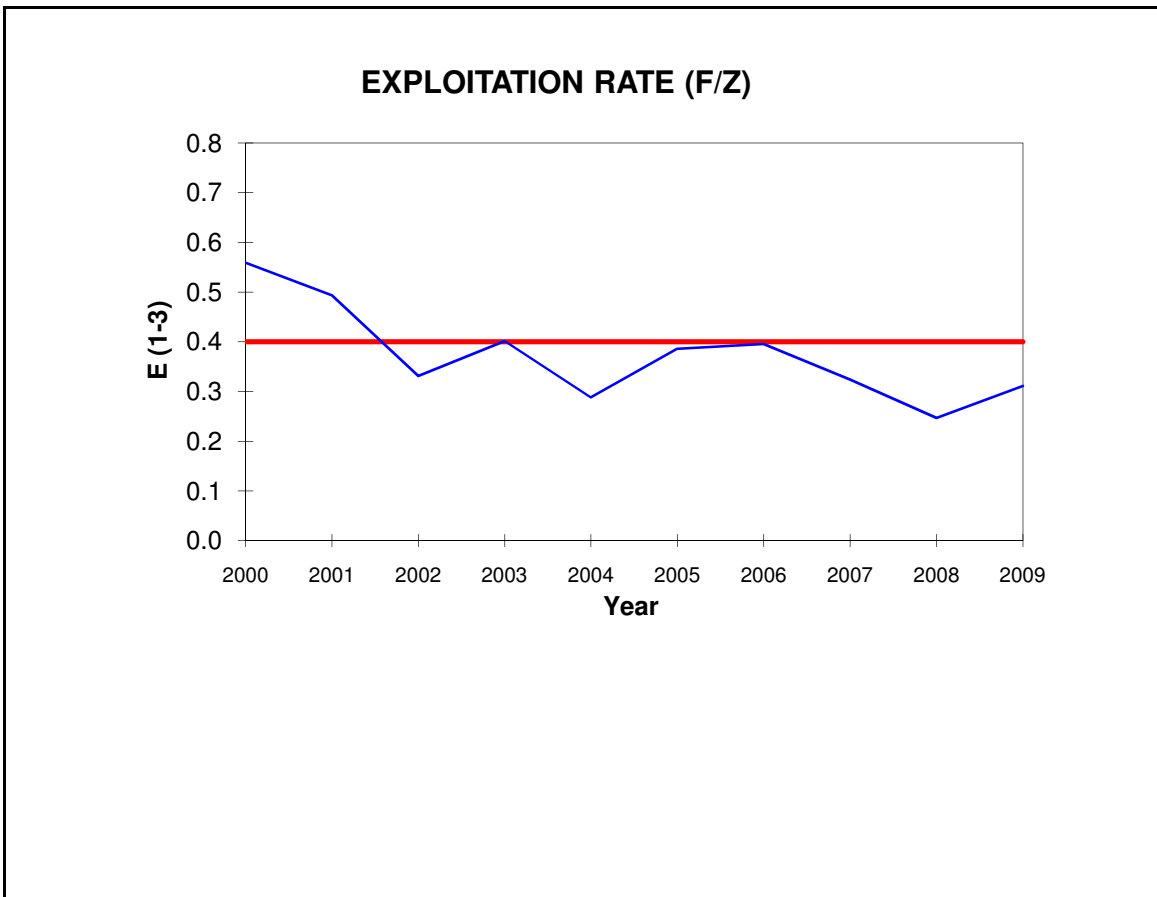
Tuning data series from acoustic surveys (ECOMED and MEDIAS) in the GSA01 is incomplete and fragmented:

- There is no survey data from 2000 to 2002.
- Surveys did not cover the GSA01 in 2007 and 2009.
- The area was only partially covered in 2003, 2006, 2008 and 2010.
- The most complete coverage was achieved in 2004 and 2005.

EXPLOITATION RATE

The annual exploitation rate  $E = F/(F+M)$  or  $F/Z$  was calculated and plotted over the years. The constant  $M$  value (0.34) was estimated as the mean of the 1-3 ages of the  $M$  vector. The values obtained were compared with the threshold  $F/Z = 0.4$  suggested as biological reference point for small pelagics (Patterson, 1992).

The trends in values of  $F/Z$  were plotted in the figure below:



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

Assessment form

Sheet D  
Diagnosis

Code: PIL0110Qui

**Indicators and reference points**

Criterion	Current value	Units	Reference Point	Trend	Comments
B					Not Reference Point defined yet
SSB					Not Reference Point defined yet
F					Not Reference Point defined yet
Y					Not Reference Point defined yet
CPUE					Not Reference Point defined yet
E=F/Z	0.31		0.4		Exploitation Rate (Patterson, 1992) (SGMED WG)

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

<b>Unidimensional</b>	<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 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;

<b>Bidimensional</b>	<b>Exploitation rate</b>		<b>Stock abundance</b>	
	<input type="checkbox"/>	No or low fishing	<input type="checkbox"/>	Virgin or high abundance
	<input type="checkbox"/>	Moderate fishing	<input type="checkbox"/>	Intermediate abundance
	<input 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 WG considers this XSA analysis as provisional and found it unacceptable as basis for advice. The main shortcoming of the analysis is the lack of reliable tuning data. The WG also would recommend that further consideration is given to the assumptions about natural mortality.

The total catch has been relatively stable along the time series (2000-2009) but the fraction of young fish seems to have decreased since 2004.

In the first years covered by the XSA analysis where the estimate of the fishing mortality is less sensitive to the survey information it appears that the fishing mortality has been in the order of 0.2 to 0.43 suggesting a moderate fishing mortality in those years. The Yield per Recruit analysis indicates  $F_{0.1}$  at 0.23.

The change in the age composition in the catches in the last three years may suggest lower recruitment than in the past.

In conclusion, the GSA01 sardine stock is considered to be fully exploited, with moderate fishing and intermediate abundance, with some concerns about the recruitment.

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

Assessment form

Sheet Z

Objectives and recommendations

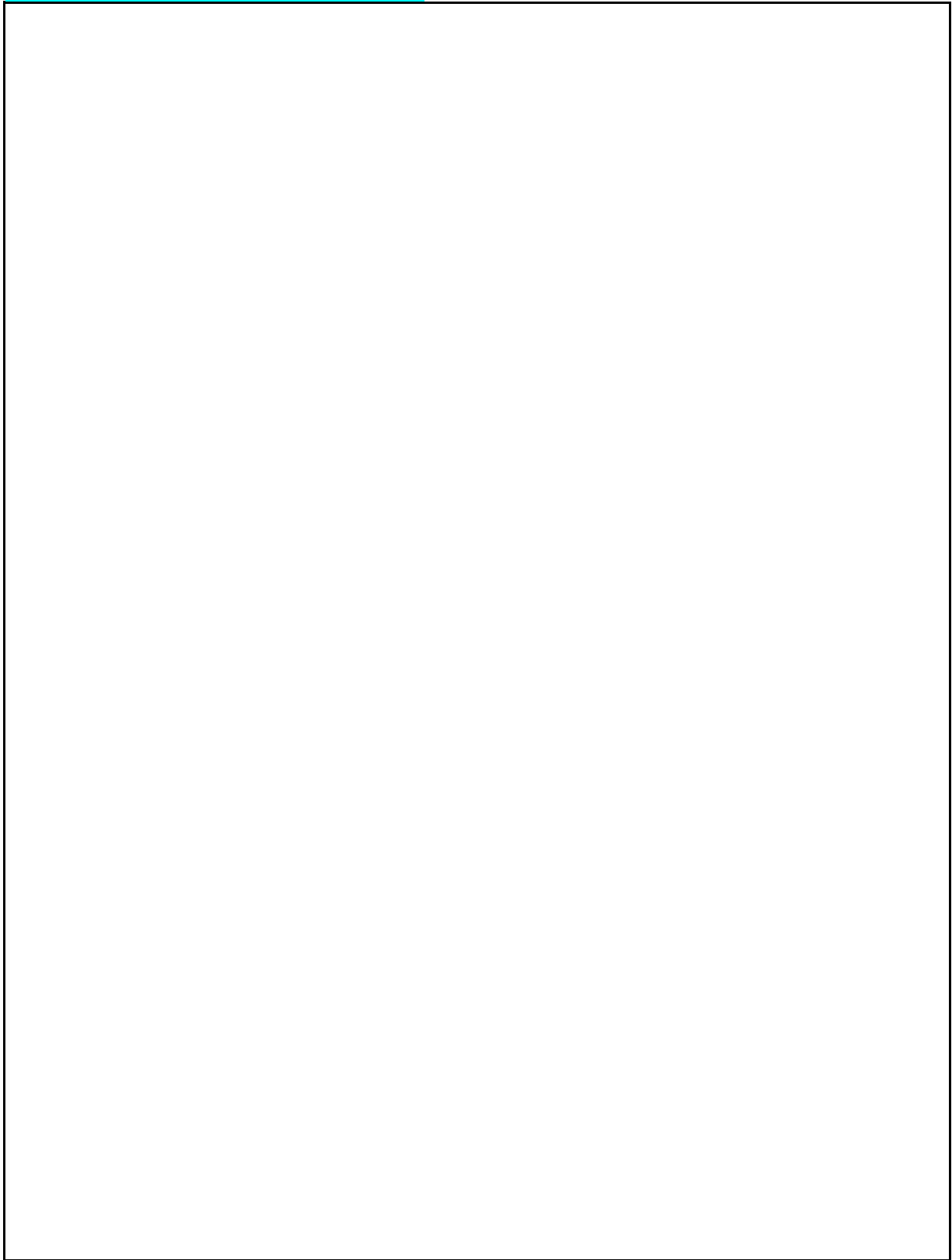
Code: PIL0110Qui

**Management advice and recommendations\***

In conclusion, the GSA01 sardine stock apparently can sustain the current level of catches. However, since the stock is probably fully exploited and there is concern about recruitment, it is recommended not to increase the fishing effort.

On the other hand, small pelagic fishery in GSA 01 is multispecies and effort on anchovy and sardine should be considered together. Therefore, the management of the sardine fisheries in GSA01 needs to account for multi-species effects, mainly the interaction with anchovy.

**Advice for scientific research\***





## Abstract for SCSA reporting

**Authors**  **Year**

**Species Scientific name**   
Source: GFCM Priority Species

Source: -

Source: -

**Geographical Sub-Area**

### Fisheries (brief description of the fishery)\*

Sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) are the main target species of the purse seine fleet in Northern Alboran GSA0, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus* spp.), mackerel (*Scomber* spp.), frigate mackerel (*Auxis rochei*), Atlantic saury (*Scomberesox saurus*) and gilt sardine (*Sardinella aurita*).

This report is exclusively focused on fishery of sardine.

**Source of management advice\***

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

Fishery assessment by VPA methods of the Spanish sardine stock GSA01 is shown. VPA Lowestoft software suite was used and XSA was the assessment method. A separable VPA was also run as exploratory analysis for both stocks. Stochastic short term projections were also produced.

Data used:  
Landings from 2000-2008 from all Fishery ports from GSA01.  
ALK 2003-2008, combined ALK for 2000-2002. Length Distributions 2003-2008, combined for 2000-2002.  
Biological sampling 2003-2008 for Maturity at age and Weight-Length relationships.  
Tuning data from acoustic survey ECOMED and Commercial Fleet off Estepona, Málaga and Adra for years 2003 to 2008.

**Stock Status\***

F - Fully exploited. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion;

**Exploitation rate**  
Moderate fishing mortality

**Stock abundance**  
Intermediate abundance

**Comments**

The WG considers this XSA analysis as provisional and found it unacceptable as basis for advice. The main shortcoming of the analysis is the lack of reliable tuning data. The WG also would recommend that further consideration is given to the assumptions about natural mortality.

The total catch has been relatively stable along the time series (2000-2009) but the fraction of young fish seems to have decreased since 2004.

In the first years covered by the XSA analysis where the estimate of the fishing mortality is less sensitive to the survey information it appears that the fishing mortality has been in the order of 0.2 to 0.43 suggesting a moderate fishing mortality in those years. The Yield per Recruit analysis indicates F0.1 at 0.23.

The change in the age composition in the catches in the last three years may suggest lower recruitment than in the past.

In conclusion, the GSA01 sardine stock is considered to be fully exploited, with moderate fishing and intermediate abundance, with some concerns about the recruitment.

### Management advice and recommendations\*

In conclusion, the GSA01 sardine stock apparently can sustain the current level of catches. However, since the stock is probably fully exploited and there is concern about recruitment, it is recommended not to increase the fishing effort.

On the other hand, small pelagic fishery in GSA 01 is multispecies and effort on anchovy and sardine should be considered together. Therefore, the management of the sardine fisheries in GSA01 needs to account for multi-species effects, mainly the interaction with anchovy.

**Advice for scientific research\***

