SAC GFCM
Sub-Committee on Stock Assessment

Date*	1	November	2010	Code*	ANE0610Bel

Authors*

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Species Scientific name*

1

Source: GFCM Priority Species

2

Source: -

3

Source: -

Geographical area*

Western Mediterranean (FAO Subarea 37.1.)

Geographical Sub-Area (GSA)*

06 - Northern Spain

Combination of GSAs 1

2

3

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

Assessment form

Sheet #0

Basic data on the assessment

Code: ANE0610Bel

Date*	1	Nov	2010	Authors*	Bellido, J.M.1, García, E.1, Quintanilla, L.2, Torres, P.2, Giráldez, A.2, Ceruso, C.1, Alemany, F.3, Iglesias, M.3

Species Scientific name*	Engraulis encrasicolus - ANE	Species common name*	Anchovy, Anchoa

Data Source

GSA*	06 - Northern Spain	Period of time*	2002-2009

Description of the analysis

Type of data*	Landings, Length and biological samplings. Tuning from Purse seiners	Data source*	Oficial statictis IEO sampling network, Acustic survey
Method of assessment*	Provisional XSA analysis - Extended Survivor Analysis	Software used*	VPA Suite. Lowestoft. 1995 & FLR Library

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 provisional XSA analysis was not accepted as a basis for advice. The main reasons were the use of a common ALK for all years, and doubts about the natural mortality.

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: 109-13 8.

De Oliveira, J.A.A., Uriante, A., and Roel, B., 2005. Potential improvements in the management of Bay of Biscay anchovy by incorporating enviromental indices as recruitmen 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.

Lleonard, 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.

Sheperd, 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 and/or ftp://cucafera.icm.csic.es/pub/scsa/

Reports from the Assessment Working Groups of the International Council for the Explorration of the Seas (ICES), particularly the small pelagics assessment working group WGMHSA. Available at 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.

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

Code: ANE0610Bel

Biology

Somatic magnitude measured (LH, LC, etc)*	Total Length	Units*	1/2 centimeter

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed			17		Reproduction season	Spring-Summer
Size at first maturity			11		Reproduction areas	Delta Ebro River
Recruitment size			8.5		Nursery areas	Rosas Bay and Delta

Parameters used (state units and information sources)

			Sex			
		Units	female	male	both	unsexed
Growth model	L∞	cm			19	
	K	year-1			0.4337	
	t0	year			-2	
	Data source	Otoliths				
Length weight relationship	a				0.0033	
	b				3.2761	

M			M vector (see comments)

sex ratio (mal/fem)	42.4/57.6

Comments

Combined ALK 2003-2009, for all the years. Length Distributions for each of the years 2002-2009, length distribution was applied to 2002 landings.

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	0.43
2	0.32
3	0.27

Comments

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Assessment form

Sheet P1
General information about the fishery

Code: ANE0610Bel

Data source*	Official Statistics, IEO Sampling Network, Acoustic	Year (s)*	2002-2009
Data aggregation (by year, average figures between years, etc.)*	By year 2002-2009		

Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ESP	06	G - Purse Seine (6-12 metres)	02 - Seine Nets	31 - Small gregarious pelagic	ANE
Operational Unit 2	ESP	06	H - Purse Seine (12-24 metres)	02 - Seine Nets	31 - Small gregarious pelagic	ANE
Operational Unit 3	ESP	06	F - Trawl (>24 metres)	02 - Seine Nets	31 - Small gregarious pelagic	ANE
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 06 G 02 31 - ANE	4	Tons	9814				
ESP 06 H 02 31 - ANE	111	Tons					
ESP 06 F 02 31 - ANE	17	Tons					
Total	132		9814				

Legal minimum size	9 cm TL

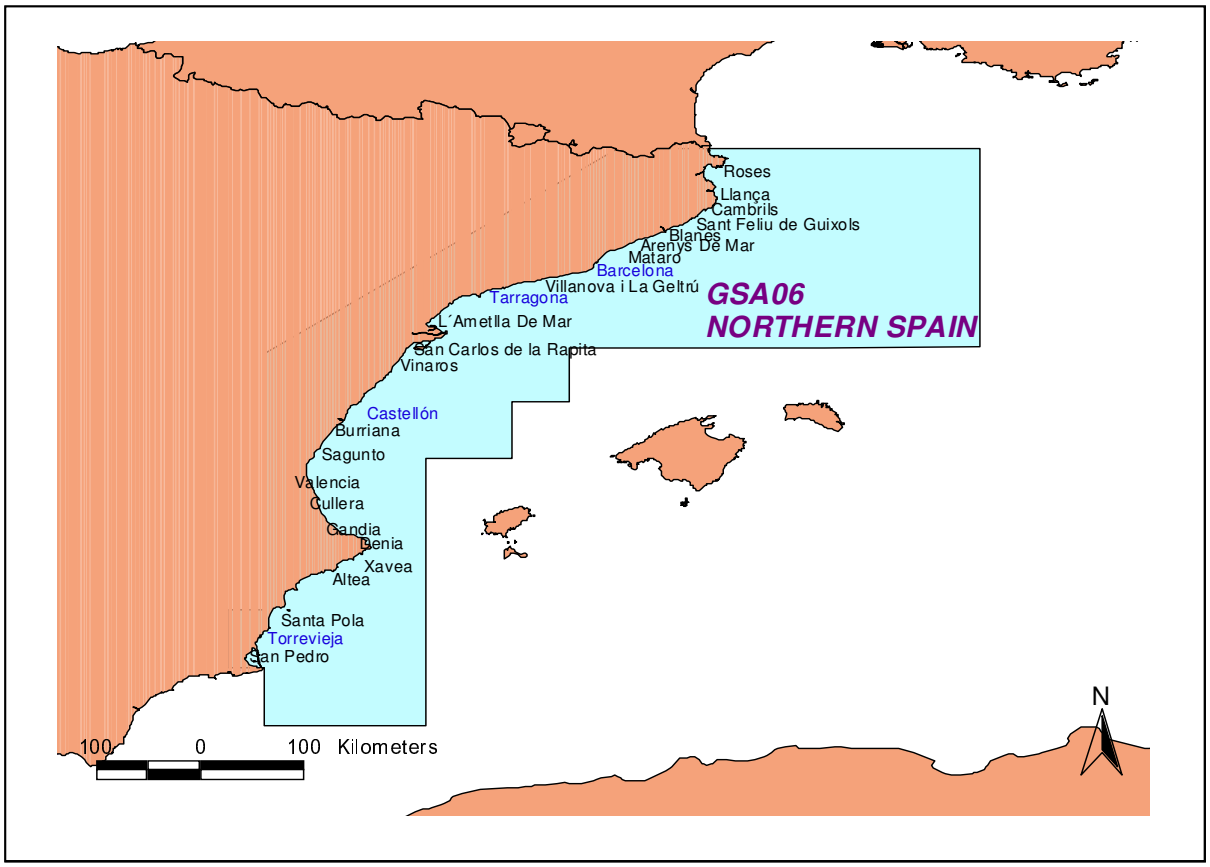
Comments

The catch (landings) is not split by Fleet segments. It comprises 9814 Tons in 2009 for the three Operational Units. Although landings are not still separated by Fleet segments we can provide a segmentation of the pelagic fleet in GSA06, with number of boats for every fleet segment:
The Fleet Segment Purse Seine (6-12 metres) comprises 4 boats in 2009
The Fleet Segment Purse Seine (12-24 metres) comprises 111 boats in 2009
The Fleet Segment Purse Seine (greater than 24 metres) comprises 17 boats in 2009

Then, and because that landing aggregation, we prefer to fill pages P2a and P2b considering the three fleet segments as an unique pelagic fleet.

Landing Ports are shown in the attached Figure. Sampling ports are highlighted in blue.Tuning data from acoustic survey ECOMED (2003-2009) and MEDIAS(2009) were used.

Comments


Roses
Llança
Cambrils
Sant Feliu de Guixols
Blanes
Arenys De Mar
Mataro
Barcelona
Villanova i La Geltrú
Tarragona
L´Ametlla De Mar
San Carlos de la Rapita
Vinaros
Castellón
Burriana
Sagunto
Valencia
Cullera
Gandia
Denia
Xavea
Altea
Santa Pola
Torrevieja
San Pedro
GSA06
NORTHERN SPAIN
100 0 100 Kilometers
N

SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet P2a** **Fishery by Operational Unit**

Data source*	Official Statistics, IEO Sampling Network	OpUnit 1*	ESP 06 G 02 31 - ANE

Time series

Year*	2002	2003	2004	2005	2006	2007
Catch	14338	8538	8097	6216	3096	2570
Minimum size	6	6	7.5	7.5	10	7
Average size Lc	13.1	13.4	13.2	14.3	13.4	14.6
Maximum size	17.5	17.5	17	18	18.5	18
Fleet	157	161	155	147	139	132

Year	2008	2009				
Catch	2558	9814				
Minimum size	6	8.5				
Average size Lc	12.8	14.36				
Maximum size	18.5	17				
Fleet	132	132				

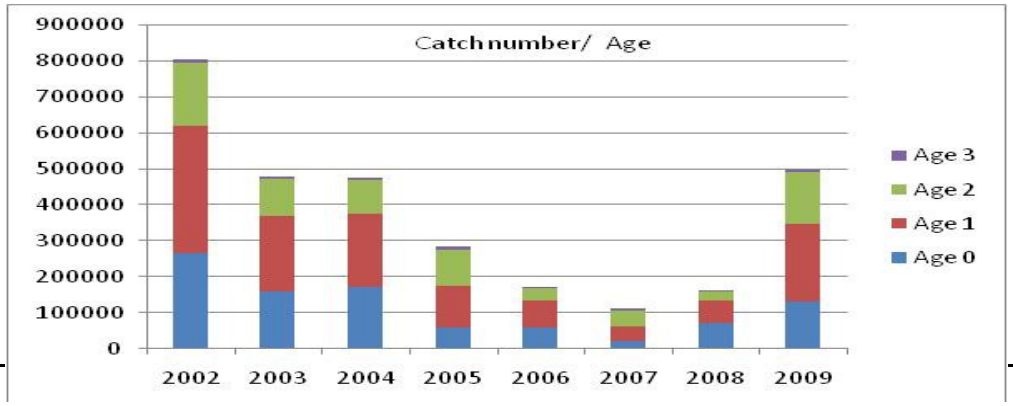
Selectivity **Remarks**

L25	
L50	
L75	
Selection factor	

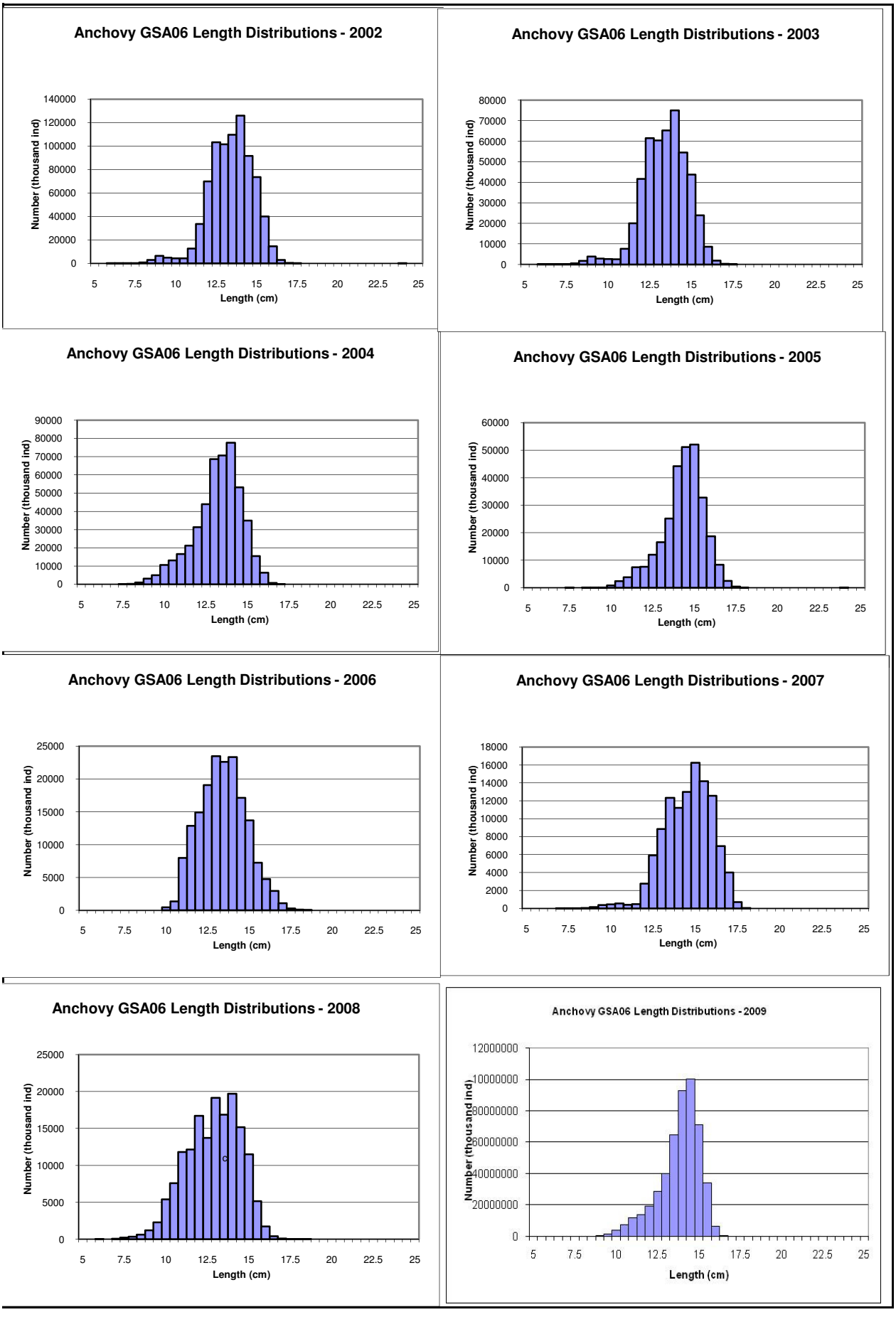
Structure by size or age

Anchovy Catch in Numbers (thousands)

	2002	2003	2004	2005	2006	2007	2008	2009
Age 0	265224	157936	171698	58810	59829	20649	71575	130223
Age 1	352327	209804	202604	114984	73228	41920	61632	217643
Age 2	175977	104791	95310	101970	37189	42399	27343	141683
Age 3	10193	6070	4567	10121	3016	6262	1454	7875



Structure by size or age



Data source*	Official Statistics, IEO Sampling Network	OpUnit 1*	ESP 06 G 02 31 - ANE

Regulations in force and degree of observance of regulations

Fishing license: fully observed
Minimum landing size 9 cm: not fully observed (Some landings under minimum size in some specific ports).
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...): not fully observed
Two months temporary fishing closures: fully observed.

Accompanying species

The most important are:
Sardine (*Sardina pilchardus*)
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: ANE0610Bel

Sex*	Both

Analysis # *	XSA

Time series

Data	Size	Age
(mark with X)	X	X

Model	Cohorts	Pseudocohorts
(mark with X)	X	

Equation used	VPA	Tunig method	XSA
# of gears	Purse seiners	Software	VPA95. Lowestoft suite & FLR Library
$F_{terminal}$	Not relevant to XSA		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	8.5	0	Recruitment	1380 millions	
Average	See page 2a		Average population	See coments below	
Maximum	17	3	Virgin population		
Critical			Turnover		

Average mortality

		Gear					
	Total						
F_1	Fbar=0.89						
F_2							
Z	See Comments						

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

Comments

Reference F is Fbar0-2 (average of ages 0 to 2 are considered the reference ages of this fishery). Following the recommendation from the Workshop on Mediterranean Stock Assessment Standardization (SG-ECA/RST/MED 09-01), a vector instead of a constant value was used. The vector was estimated using the ProdBiom method (Abella et al., 1997) based on Caddy (1991).
A separable VPA was run as exploratory analysis. Log catchability residual plots shows large residuals and difference between ages. These patterns are likely due to huge catch numbers in year 2009.
Landings increase in 2009, reaching up 9814 t, which represents a huge increase from 2008 (2558). Landings y 2009 is the second higest one in the time series behind the maximun cathc obtained in 2002 (14338 t). F0-2 in 2009 was 0.89,slightly larger than 2008 (0.4). F has generally decreased during the time series. Recruitment in 2009 (1380 millions) decreases compared to 2008 (2030 millions) and generally seems to follow the trend in SSB. Both Total Biomass (38,830 t) and Spawning Stock Biomass in 2009 (26,480 t) increased from the lowest value observed 2006.

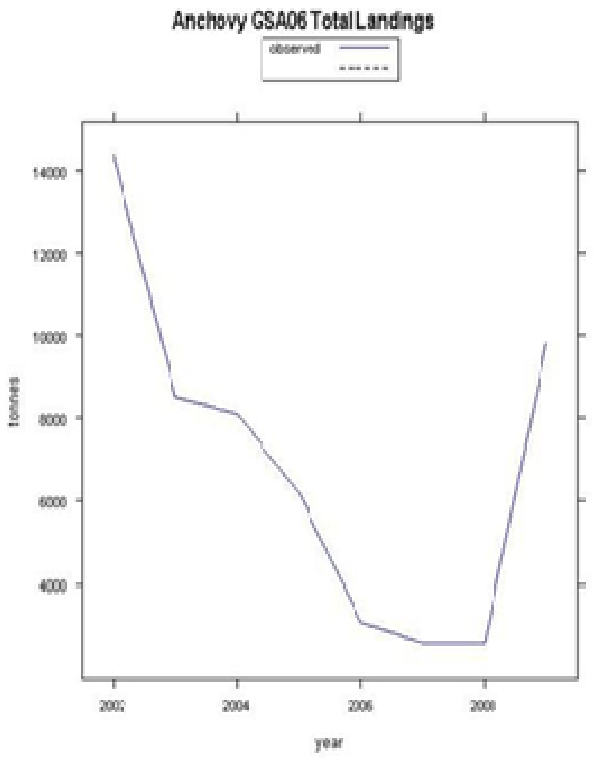
SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet A2** **Indirect methods: data**

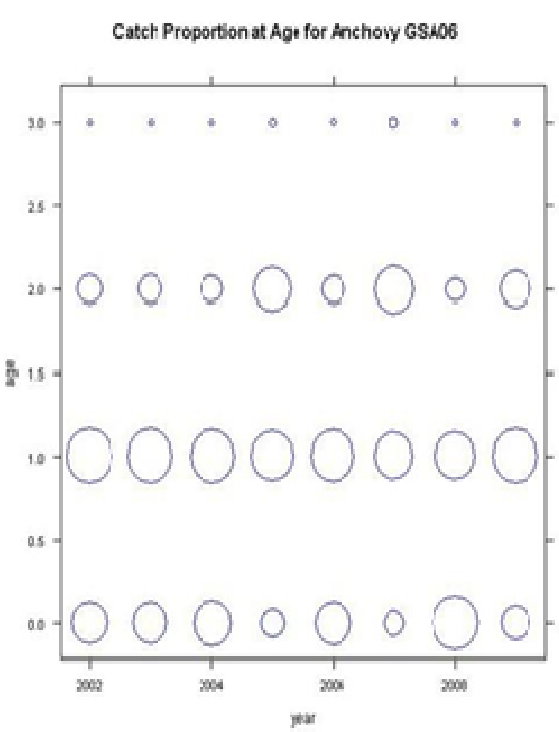
Code: ANE0610Bel

Sex*	Both	Gear*	Purse seiners	Analysis # *	XSA

Data	Input data for XSA

Data





Input Parameters GSA06

- **Growth Parameters:**

  Linf = 19 k = 0.4237 t_0 = -1.88

- **Length-weight relationship:**

  a = 0.0033 b = 3.27

- **Natural Mortality Vector PRODBIOM (Abella *et al.*1997):**

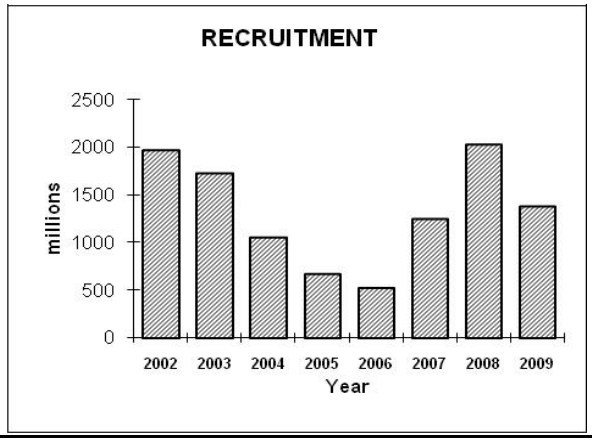
Age	0	1	2	3	Mean(0-3)	Mean(0-2)
M	1.17	0.43	0.32	0.27	0.55	0.64

- **Maturity at Age**

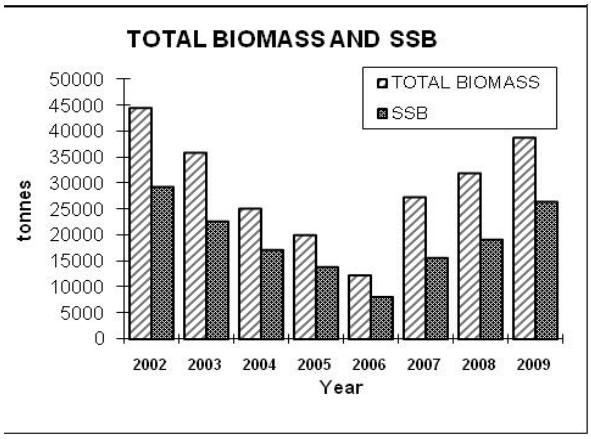
Age	0	1	2	3
PropMat	0.50	0.89	1.00	1.00

Sex*	Both	Gear*	Purse Seiners	Analysis #*	XSA

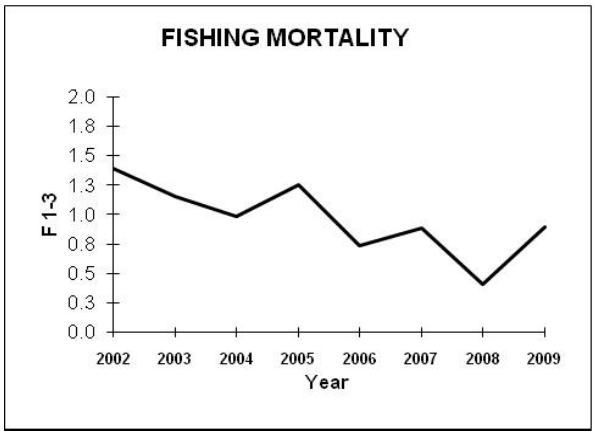
Population in figures



Population in biomass



Fishing mortality rates

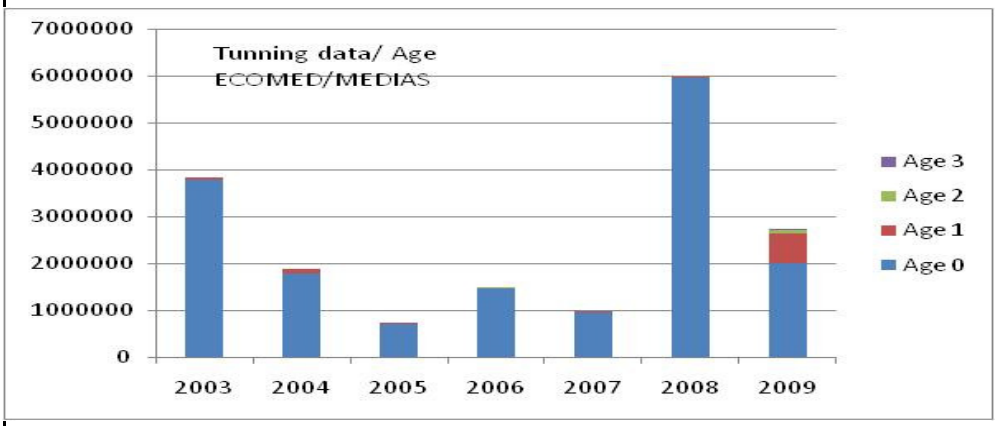


Other assessment methods

Acoustic survey data

Anchovy GSA06 – survey (thousands)

	2003	2004	2005	2006	2007	2008
Age 0	3778218	1777202	700493	1461320	963351	5962287
Age 1	58677	92036	40034	37761	7384	9207
Age 2	0	0	0	646	0	0
Age 3	0	0	0	0	0	0



SAC GFCM - Sub-Committee on Stock Assessment (SCSA)	
Assessment form	**Sheet D** **Diagnosis**

Code: ANE0610Bel

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

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

Lacking a reliable analytic assessment, the advice is based on evidence in the fishery and survey data. The catches have had a strong downwards trend throughout the time series (which goes back to 2008. The exception is 2009, where the catches increased markedly. In the length composition in the catches, the balance between small and large fish has been relatively stable, except in 2009, where the peak in the distribution is at 14 cm, and the distribution stops abruptly above that.
The survey appear only to reflect the recruitment (age 0 abundance). According to the survey, the recruitment has declined gradually since 2003, but with a strong year class in 2008 and an intermediate year class in 2009.
This evidence points in the direction of the recruitment as the main driving force in the population dynamics, where the stock and catches have declined as a result of a declining recruitment. There are no clear evidence of an expansion of the fishery and exploitation level. The stock biomass in itself is not known, but it seems likely that it has declined in line with the decline in the catches and biomass.
The lenght distribution in the 2009 catches raises some concern, as the large fish are poorly represented in the catch that year. Hence, it is unclear how this fishery has depeleted the spawning biomass.

In this situation, a precautionary approach to the management would be to avoid depleting the spawning stock to levels below the recent years, since a lower spawning biomass may not be able to respond to favorable environmental conditions.

Code: ANE0610Bel

Management advice and recommendations*

With a moderate exploitation rate , the stock abundance in 2009 should increase, and ensure sufficient spawning fish to continue the improvement in recruitment since 2008.

As this fishery is highly dependent on the strength of the recruitment, the present gains has to be linked to the future and evolution of the recruitment level.Unless the recruitment levels increase in the near future, this fishery may be exploited at above a level which is believed to be sustainable in the long term, with no potencial room for further expansion and a higher risk of stock depletion/collapse.

Taking into account the possible link between GSA06 and GSA07, which includes parallell changes in the ecosystem in the most recent years, it is also advised to harmonize management measures in the two areas, to ensure that they are restricctive in both areas.

Advice for scientific research*

Comments*

Conclussions - Assessment
Landings have decreased gradually from about 14000 tons in 2002 to about 2500 tons in 2008 but increased to almost 10000 tons in 2009.There are no prominent trend in the length distributions in the catches. The acustic survey apparently only covers ages 0. According to the survey, the recruitment has fluctuated but with a declining trend. The 2008 year class appears to be strong.

Conclusions - Management considerations:

As this fishery is highly dependent on the strength of the recruitment, the present gains has to be linked to the future and evolution of the recruitment level.Unless the recruitment levels increase in the near future, this fishery will being exploited at a level which may not be sustainable in the long term. There is no potencial room for further expansion of the fishery.

Abstract for SCSA reporting

Authors Bellido, J.M.1, García, E.1, Quintanilla, L.2, Torres, P.2, Giráldez, A.2, Ceruso, C.1, Alemany, F.3, Iglesias, M.3

Year 2010

Species Scientific name Engraulis encrasicolus - ANE

Source: GFCM Priority Species

Source: -

Source: -

Geographical Sub-Area 06 - Northern Spain

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 Spain GSA06, 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 anchovy.

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 GSA06 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 2002-2009 from all Fishery ports from GSA06.
Combined ALK 2003-2009, for all the years. Length Distributions 2002-2009, length distribution was applied to 2002 landings.
Biological sampling 2003-2009 for Maturity at age and Weight-Length relationships.
Tuning data from acoustic survey ECOMED (2003-2009) and MEDIAS(2009) were used.

Stock Status*

Exploitation rate	**Stock abundance**
Uncertain / Not assessed	Low abundance

Comments

Lacking a reliable analytic assessment, the advice is based on evidence in the fishery and survey data. The catches have had a strong downwards trend throughout the time series (which goes back to 2008. The exception is 2009, where the catches increased markedly. In the length composition in the catches, the balance between small and large fish has been relatively stable, except in 2009, where the peak in the distribution is at 14 cm, and the distribution stops abruptly above that.
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This evidence points in the direction of the recruitment as the main driving force in the population dynamics, where the stock and catches have declined as a result of a declining recruitment. There are no clear evidence of an expansion of the fishery and exploitation level. The stock biomass in itself is not known, but it seems likely that it has declined in line with the decline in the catches and biomass. The lenght distribution in the 2009 catches raises some concern, as the large fish are poorly represented in the catch that year. Hence, it is unclear how this fishery has depeleted the spawning biomass.

In this situation, a precautionary approach to the management would be to avoid depleting the spawning stock to levels below the recent years, since a lower spawning biomass may not be able to respond to favorable environmental conditions.

Management advice and recommendations*

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As this fishery is highly dependent on the strength of the recruitment, the present gains has to be linked to the future and evolution of the recruitment level.Unless the recruitment levels increase in the near future, this fishery may be exploited at above a level which is believed to be sustainable in the long term, with no potencial room for further expansion and a higher risk of stock depletion/collapse.

Taking into account the possible link between GSA06 and GSA07, which includes parallell changes in the ecosystem in the most recent years, it is also advised to harmonize management measures in the two areas, to ensure that they are restricctive in both areas.

Advice for scientific research*