

SAC GFCM Sub-Committee on Stock Assessment

Date* **5** **October** **2009** **Code*** **ANE0609Tor**

Authors* Torres, P1*, Giráldez, A.1, Bellido, J.M.2, Quintanilla, L.1, Ceruso, C.2, Alemany, F.3, Iglesias, M.3

Affiliation* 1 Instituto Español de Oceanografía. Centro Oceanográfico de Málaga. Puerto pesquero S/N. 29640 Fuengirola. Málaga. Spain.

- Species Scientific name***
- 1** *Engraulis encrasicolus* - *ANE*
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

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Assessment form

Sheet #0

Basic data on the assessment

Code: ANE0609Tor

Date*	5	Oct	2009	Authors*	Torres, P1*, Giráldez, A.1, Bellido, J.M.2, Quintanilla, L.1, Ceruso, C.2, Alemany, F.3, Iglesias, M.3
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Species Scientific name*	Engraulis encrasicolus - ANE	Species common name*	Anchovy, Anchoa
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Data Source

GSA*	06 - Northern Spain	Period of time*	2002-2008
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Description of the analysis

Type of data*	Landings, Length and biological samplings. Tuning from Purse seiners	Data source*	Official Statistics, IEO Sampling Network, Acoustic Survey
Method of assessment*	XSA - Extended Survivor Analysis	Software used*	VPA Suite. Lowestoft. 1995

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.

Fishery assessment by VPA methods of the Spanish anchovy stock GSA06 is reported. 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.

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 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.

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 Exploration 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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Sheet B
Biology of the species

Code: ANE0609Tor

Biology

Somatic magnitude measured (LH, LC, etc)*				Total Length	Units*	1/2 centimeter
Sex	Fem	Mal	Both	Unsexed		
Maximum size observed			18.5		Reproduction season	Spring-Summer
Size at first maturity			11		Reproduction areas	Delta Ebro River
Recruitment size					Nursery areas	Rosas Bay and Delta

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L ∞	cm			19	
	K	year-1			0.3419	
	t0	year			-2.321	
	Data source	Otoliths				
Length weight relationship	a				0.004	
	b				3.1945	

M			M vector (see comments)
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sex ratio (mal/fem)	42.4/57.6
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Comments

Combined ALK 2003-2008, for all the years. Length Distributions 2002-2008, length distribution was applied to 2002 landings.

Biological sampling 2003-2008 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

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Sheet P1

General information about the fishery

Code: ANE0609Tor

Data source*	Official Statistics, IEO Sampling Network, Acoustic	Year (s)*	2002-2008
Data aggregation (by year, average figures between years, etc.)*	By year 2002-2008		

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	5		2558				
ESP 06 H 02 31 - ANE	111	0					
ESP 06 F 02 31 - ANE	14	0					
Total	130		2558				

Legal minimum size	9 cm TL
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Comments

The catch (landings) is not split by Fleet segments. It comprises 2558 Tons in 2008 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 5 boats in 2008

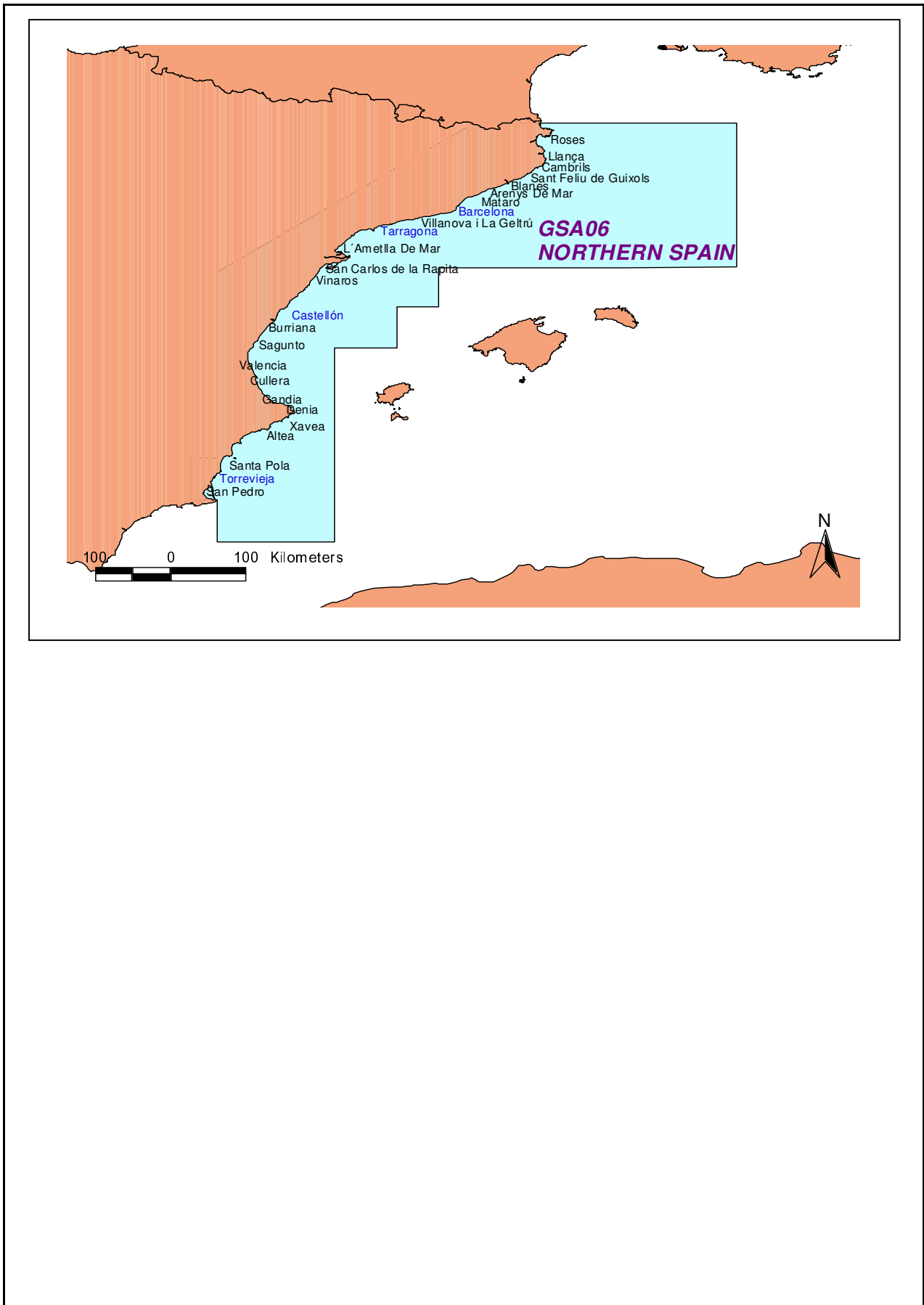
The Fleet Segment Purse Seine (12-24 metres) comprises 111 boats in 2008

The Fleet Segment Purse Seine (greater than 24 metres) comprises 14 boats in 2008

Then, and because that landing aggregation, we prefer to fill pages P2a and P2b considering the three 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. Tuning data from acoustic survey ECOMED.

Comments



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Sheet P2a
Fishery by Operational Unit

Code: ANE0609Tor

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

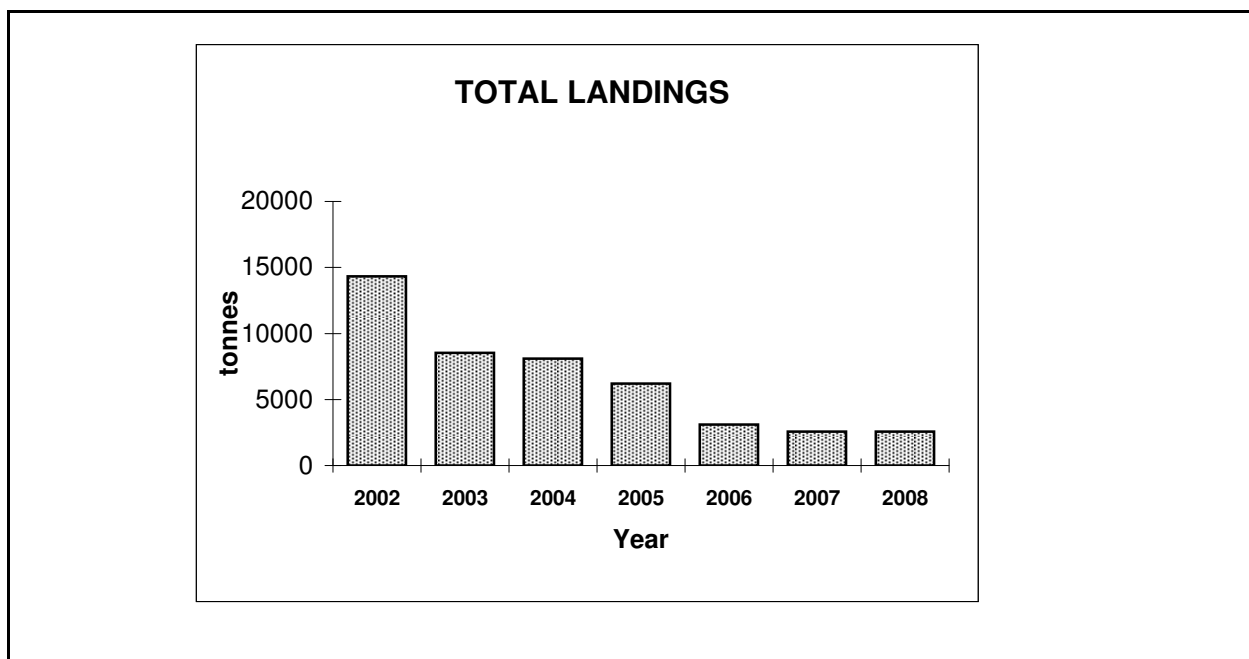
Year	2008					
Catch	2558					
Minimum size	6					
Average size Lc	12.8					
Maximum size	18.5					
Fleet	132					

Selectivity

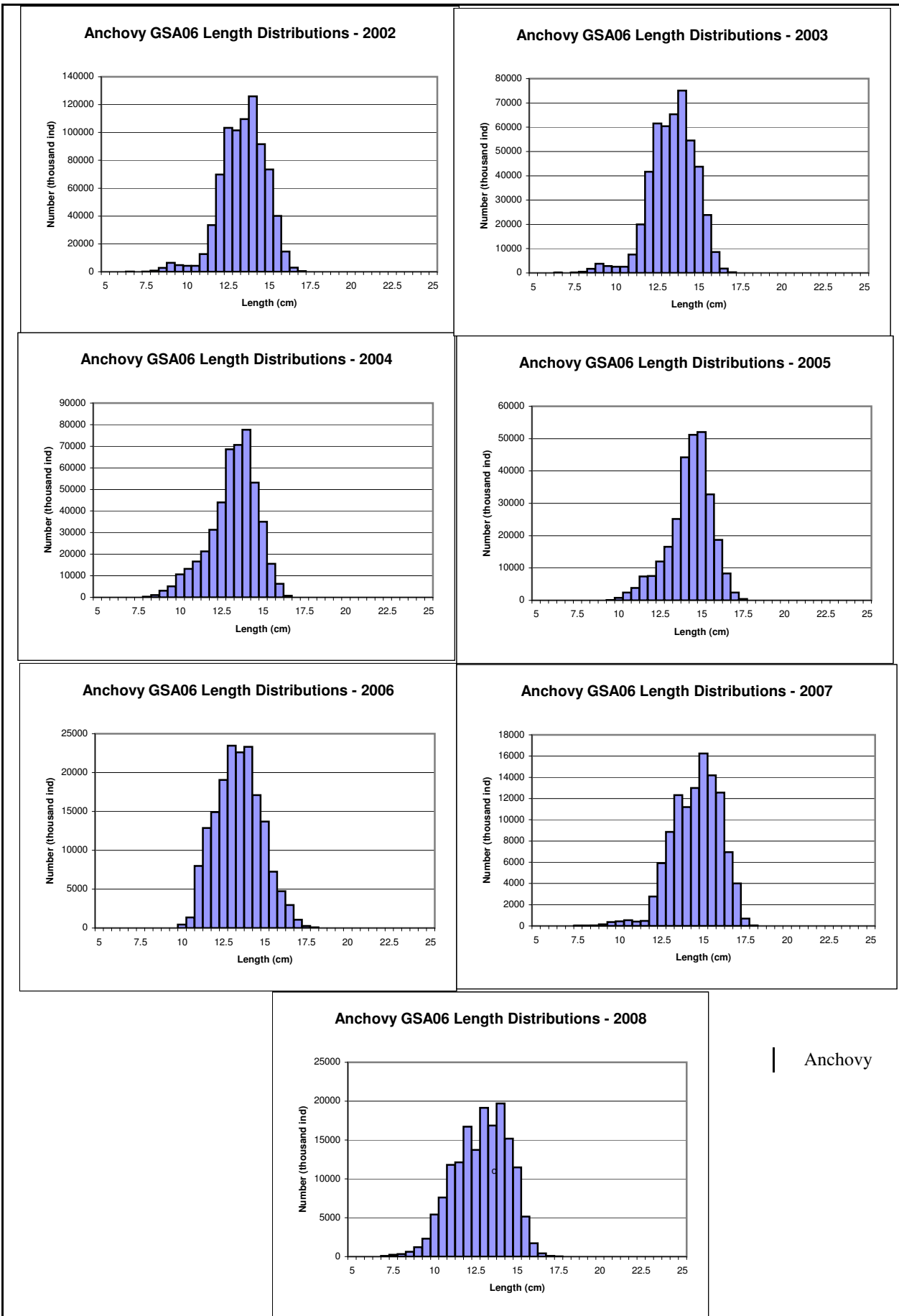
Remarks

L25		
L50		
L75		
Selection factor		

Structure by size or age



Structure by size or age



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Sheet P2a
Fishery by Operational Unit

Code: ANE0609Tor

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Data source*		OpUnit 2*	ESP 06 H 02 31 - ANE
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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

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: ANE0609Tor

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

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Assessment form

Sheet G
Indirect methods. Global model

Code: ANE0609Tor

Analysis #*

Page 1 /

Data source* Gear*

Model characteristic

Type of model*	<input type="text"/>	Fitting criterion	<input type="text"/>
Software	<input type="text"/>	Bibliographical source	<input type="text"/>

Data

Year	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Catch	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Effort	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
CPUE	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Year	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Catch	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Effort	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
CPUE	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Adjustment

RMS

Results

Carryng capacity	<input type="text"/>	a	<input type="text"/>
Growth rate	<input type="text"/>	b	<input type="text"/>
Catchability	<input type="text"/>	<input type="text"/>	<input type="text"/>
MSY	<input type="text"/>	<input type="text"/>	<input type="text"/>
EMSY	<input type="text"/>	TACMSY	<input type="text"/>
E0.1	<input type="text"/>	TAC0.1	<input type="text"/>
Ecurrent	<input type="text"/>	<input type="text"/>	<input type="text"/>

Comments

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Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: ANE0609Tor

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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	VPA95. Lowestoft suite
F _{terminal}	Not relevant to XSA		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	6	0	Recruitment	837 millions	
Average	See page 2a		Average population	See coments below	
Maximum	18.5	3	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear				
F ₁	Fbar=1.13					
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).

Age	0	1	2	3
F	0.17	0.92	2.3	1.15
M	1.17	0.43	0.32	0.27

Separable VPA results show no unusual pattern of Log catchability residuals and no particular conflicts between ages. XSA main settings were Fbar 0-2; Age 1 for q stock-size independent and age 2 for q independent of age.

Landings decrease in 2008, reaching up 2558 t, which represents the lowest landings of the assessed time series (see Fig. 1). Fishing mortality is at a moderate-high level (F08=1.13), showing a rather plane pattern from 2002 onwards. Recruitment in 2008 (R08=837 millions) is double to 2007 (445 millions) following a little rising trend. The trend of the recruitments is so important as they can affect seriously to the stock health. Both Total Biomass (TB=13010 t) and Spawning Stock Biomass (SSB= 7753 t) in 2008 are also next to the lowest of the time series.

See also figures in page VPA

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Assessment form

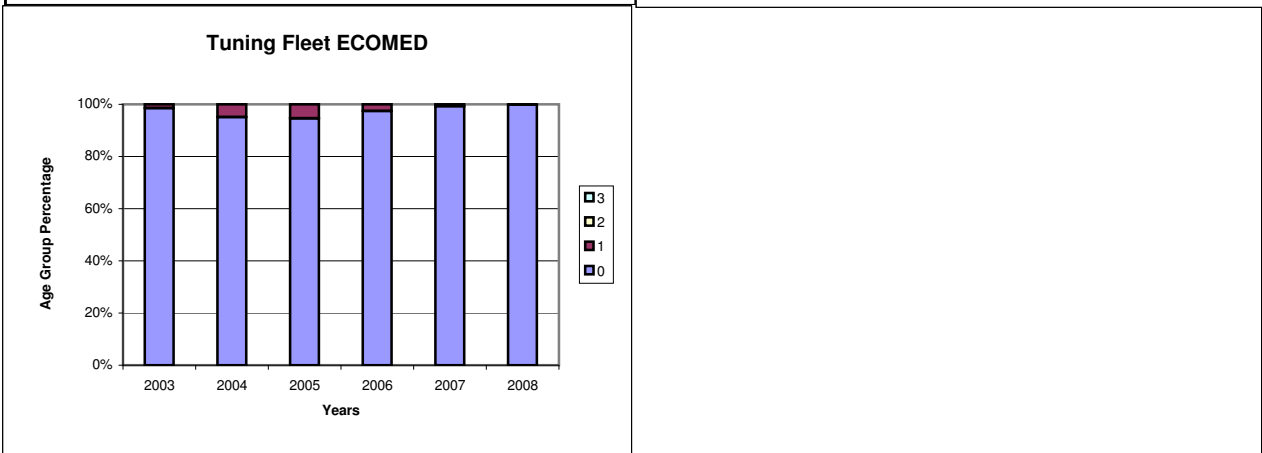
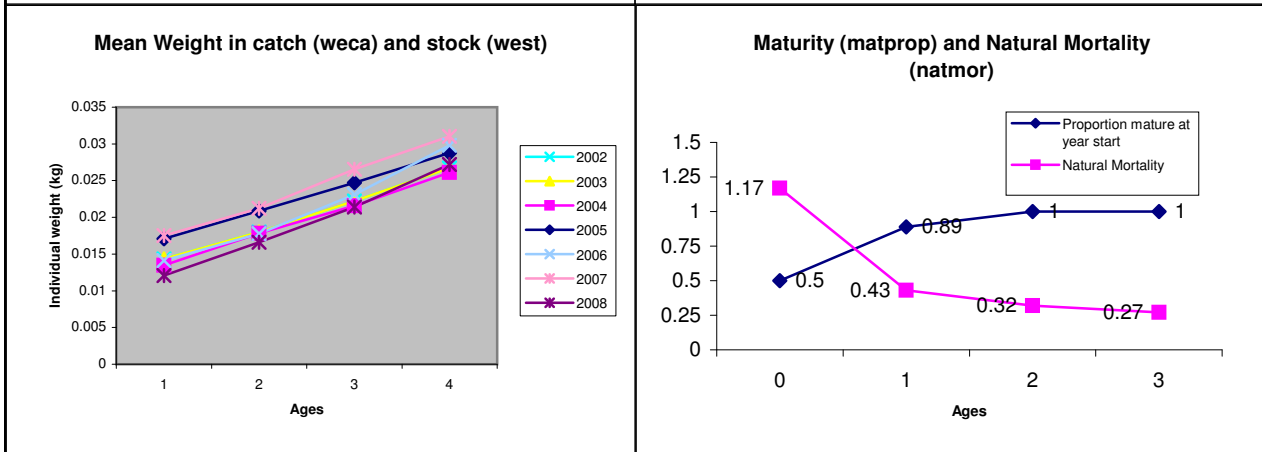
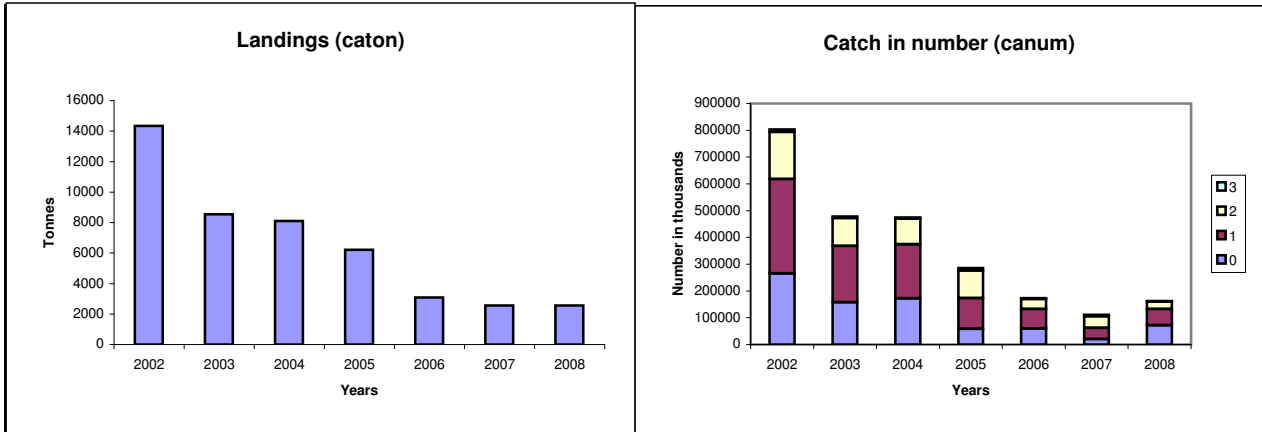
Sheet A2
Indirect methods: data

Code: ANE0609Tor

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

Data	Input data for XSA
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Data



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Assessment form

Sheet A3

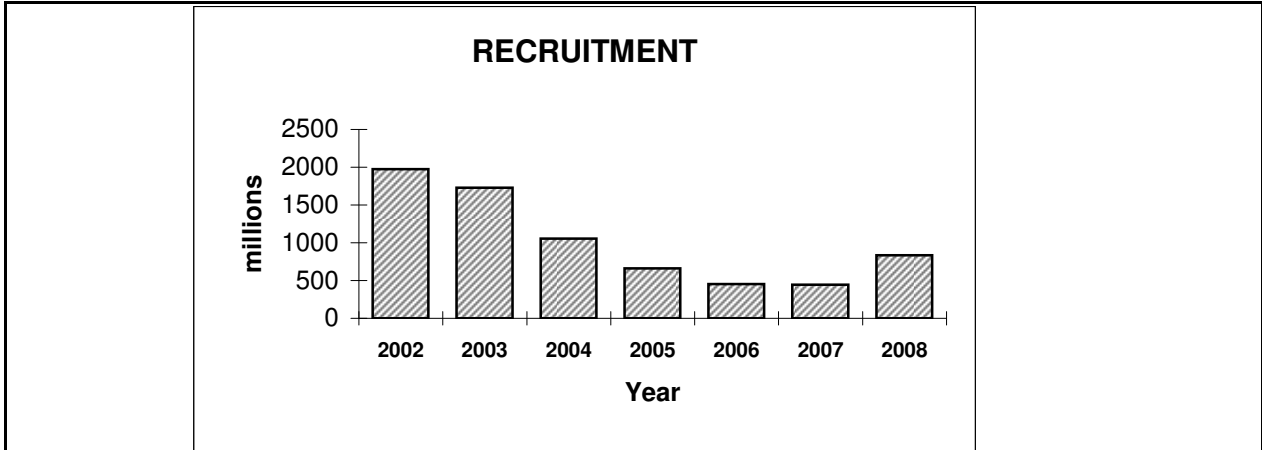
Indirect methods: VPA results

Code: ANE0609Tor

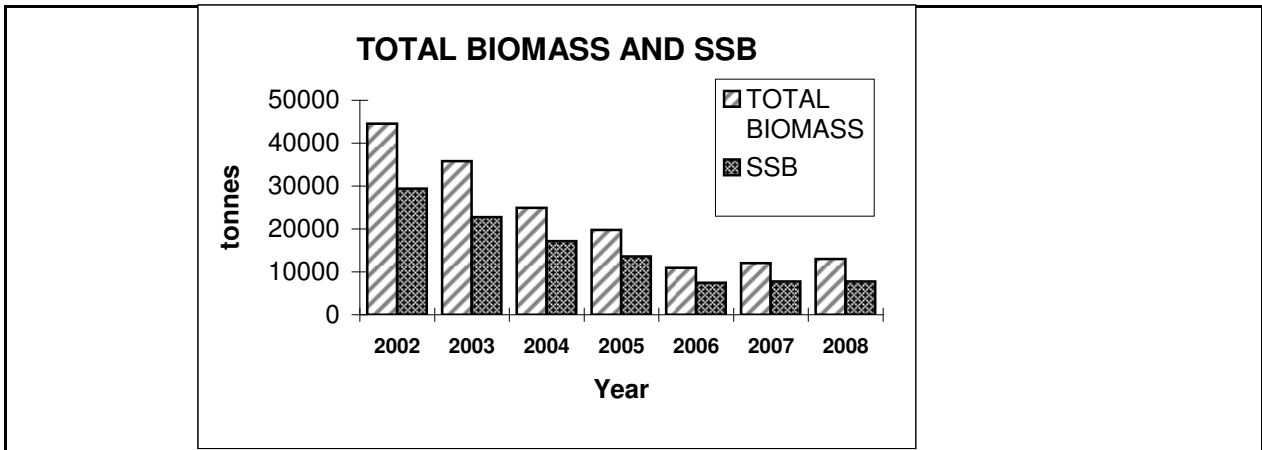
Page 1 / 1

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

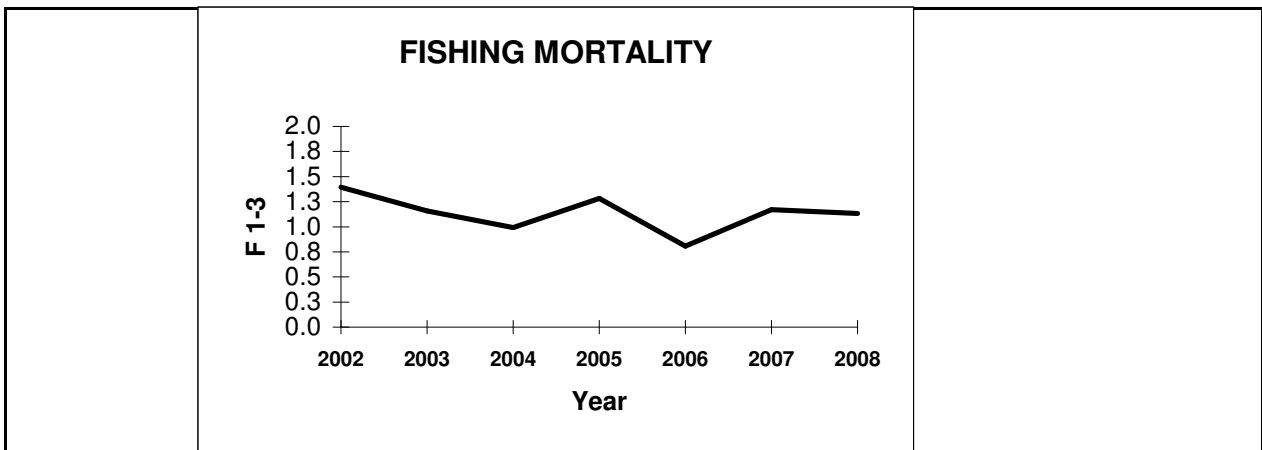
Population in figures



Population in biomass



Fishing mortality rates



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Assessment form

Sheet other

Code: ANE0609Tor

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Other assessment methods

Short Terms Deterministic Projections for three years (2009 to 2011).

MFDP software (Multi-Fleet Deterministic Projections).

Table below shows the management options from the short term catch prediction. Assuming statu quo F (Fbar06-08=1.04) and recruitment percentil 0.1 time series (RP02-08=449 millions). We realise this option is more conservative but the most realistic and robust as recruitment has been fluctuating. Landings are predicted to be close to 3,152 t in 2009 and 2,907 t in 2010. Total biomass will be 11,540 t in 2009 and 9,756 t in 2011, what account for a decrease on stock numbers. SSB will also decrease from 7,795 t to 6,223 t from 2009 to 2011.

Hence this exploitation pattern to maintain F statu quo 2009-11 will produce a lost and continuing the decreasing trend, observed during the last years.

In this situation it is particularly important to pay special attention to recruitment levels as they could prompt sudden increase or drops in a near future.

2009							
Biomass	SSB	FMult	FBar	Landings			
11540	7795	1	1.0374	3152			
2010							
Biomass	SSB	FMult	FBar	Landings	2011 Biomass	SSB	
10402	6869	0	0	0	12385	8806	
.	6869	0.1	0.1037	467	11933	8359	
.	6869	0.2	0.2075	876	11546	7977	
.	6869	0.3	0.3112	1236	11210	7646	
.	6869	0.4	0.415	1555	10919	7359	
.	6869	0.5	0.5187	1840	10663	7108	
.	6869	0.6	0.6224	2095	10438	6888	
.	6869	0.7	0.7262	2327	10239	6693	
.	6869	0.8	0.8299	2537	10061	6519	
.	6869	0.9	0.9336	2730	9901	6364	
.	6869	1	1.0374	2907	9756	6223	
.	6869	1.1	1.1411	3070	9625	6096	
.	6869	1.2	1.2449	3223	9505	5981	
.	6869	1.3	1.3486	3365	9395	5875	
.	6869	1.4	1.4523	3498	9294	5777	
.	6869	1.5	1.5561	3623	9200	5687	
.	6869	1.6	1.6598	3742	9113	5604	
.	6869	1.7	1.7635	3854	9031	5526	
.	6869	1.8	1.8673	3960	8955	5453	
.	6869	1.9	1.971	4062	8883	5385	
.	6869	2	2.0748	4158	8816	5321	

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Sheet D
Diagnosis

Code: ANE0609Tor

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	<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;

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 type="checkbox"/>	Intermediate abundance
	<input type="checkbox"/>	High fishing mortality	<input type="checkbox"/>	Depleted
	<input type="checkbox"/>	Uncertain / Not assessed	<input type="checkbox"/>	Uncertain / Not assessed

Comments

No reference points for anchovy can be suggested at this point. Further research is aimed to produce Reference Points and Harvest Control Rules for the anchovy GSA06 fishery.

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Sheet Z

Objectives and recommendations

Code: ANE0609Tor

Management advice and recommendations*

Regarding suggestion for management options, this fishery is considered as overexploited. Although the exploitation rate (fishing mortality) is at a moderate level, the stock abundance in 2008 remains at low level (almost the lowest of the time series 2002-2008) and continues the decreasing trend apparent from the beginning of the time series, from 14340 t in 2002 to 2560 t in 2008. Unless the recruitment levels increase in the near future, this fishery will be 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.

Advice for scientific research*

No reference points for anchovy can be suggested at this point. Further research is aimed to produce Reference Points and Harvest Control Rules for the anchovy GSA06 fishery.

Comments*

Conclusions - Assessment:

Landings in 2008 were 2,558 t, showing a slight decrease from that of 2007 (2,570 t). The time series shows a decreasing trend and currently it is almost at the lowest point of the time series.

Fishing mortality is at a moderate-high level ($F_{07}=1.13$), showing a rather plane pattern from 2002 onwards.

Recruitment in 2008 ($R_{08}=837$ millions) increases from that of 2007 (445 millions). The trend of the recruitments is so important as they can affect seriously to the stock health.

Both Total Biomass in 2008 ($TB=13,010$ t) and Spawning Stock Biomass in 2008 ($SSB=12,014$ t) show a slight recovery, although both TB and SSB are still at a rather low level.

Conclusions – Catch Forecasting:

Assuming statu quo F ($F_{bar06-08}=1.30$) and conservative recruitment levels ($RP_{02-08} = 449$ millions):

- Landings are predicted to be close to 3,152 t in 2009 and 2,907 t in 2010.
- Total biomass will be 11,540 t in 2009, 10,402 t in 2010 and 9,756 t in 2011, what account for a decrease on stock numbers.
- SSB will also decrease from 7,795 t to 6,223 t from 2009 to 2011.

Hence this exploitation pattern to maintain F statu quo 2009-2011 will produce a slight loss and continuing the decreasing trend observed during the last years.

In this situation it is particularly important to pay special attention to recruitment levels as they could prompt sudden increases or drops in a near future.

Conclusions - Management considerations:

This fishery is considered as overexploited. Unless the recruitment levels increase in the near future, this fishery will be 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.

Further work:

- Reference points.
- Harvest Control Rules.