SAC GFCM
Sub-Committee on Stock Assessment

Date*	5	October	2009		Code*	ANE0109Gir

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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)*

01 - Northern Alboran Sea

Combination of GSAs

1
2
3

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

Data Source

GSA*	01 - Northern Alboran Sea	Period of time*	2002-2008

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 GSA01 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.

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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Biology

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

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed			17.5		Reproduction season	Spring-Summer
Size at first maturity			11		Reproduction areas	Málaga Bay
Recruitment size					Nursery areas	Málaga Bay

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L∞	cm			19	
	K	year-1			0.34191	
	t0	year			-2.32099	
	Data source	Otoliths				
Length weight relationship	a				0.00401	
	b				3.19449	

M			M vector (see comments)

sex ratio (mal/fem)	44/56

Comments

Combined ALKs 2003-2008 for all the years. Length Distributions 2003-2008. Length distrib 2003 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	0.44
2	0.32
3	0.27

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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	01	G - Purse Seine (6-12 metres)	02 - Seine Nets	31 - Small gregarious pelagic	ANE
Operational Unit 2	ESP	01	H - Purse Seine (12-24 metres)	02 - Seine Nets	31 - Small gregarious pelagic	ANE
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 - ANE	28		178				
ESP 01 H 02 31 - ANE	103	0					
Total	131		178				

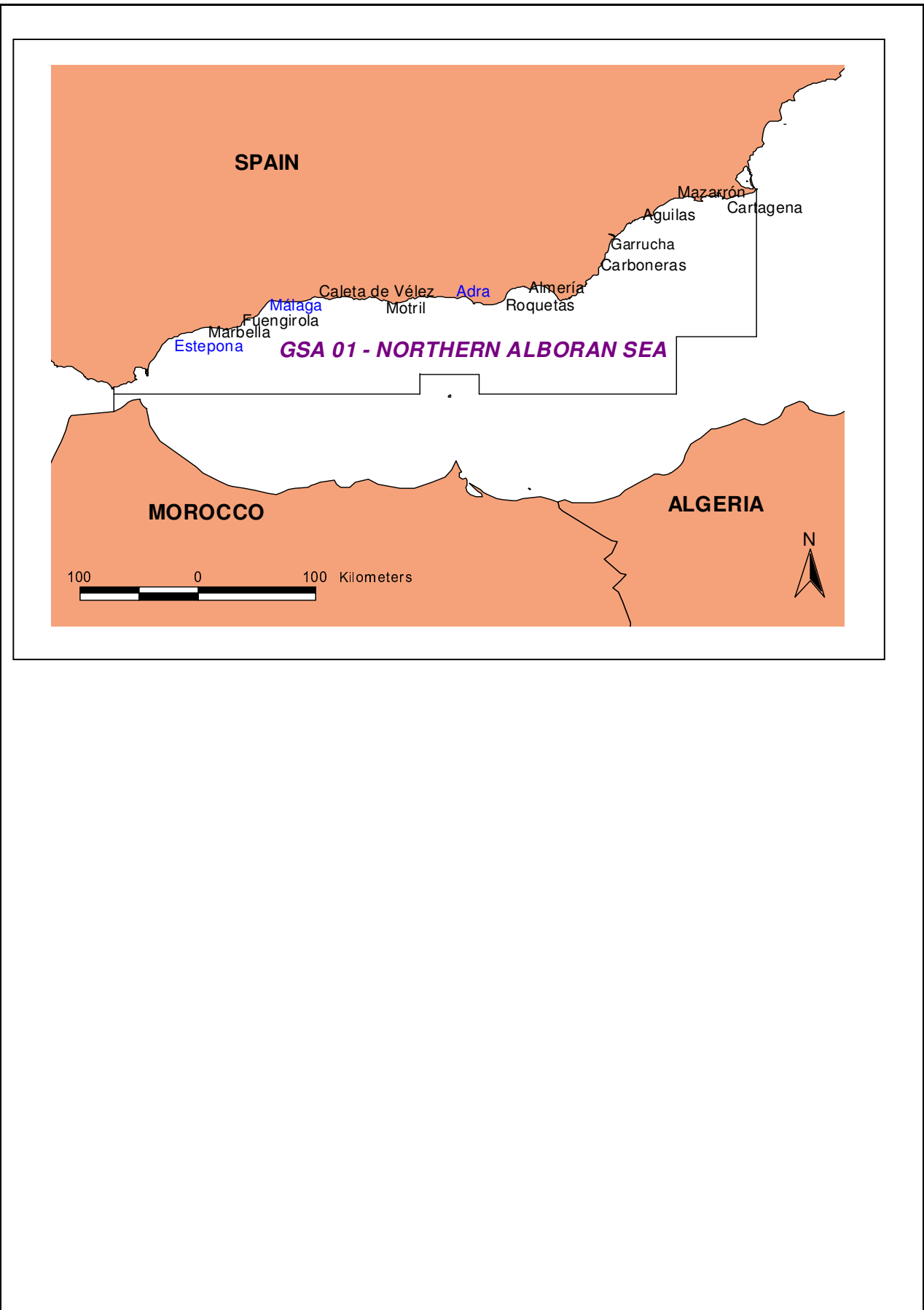| Legal minimum size	9 cm TL

Comments

The catch (landings) is not split by Fleet segments. It comprises 178 Tons in 2008 for the two Operational Units.

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.

Tuning data from acoustic survey ECOMED for years 2003 to 2008.

Comments

SPAIN

Mazarrón
Cartagena
Aguilas
Garrucha
Carboneras
Caleta de Vélez   Adra   Almería
Málaga   Motril   Roquetas
Fuengirola
Marbella
Estepona   *GSA 01 - NORTHERN ALBORAN SEA*

MOROCCO   ALGERIA

N

100   0   100   Kilometers

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Assessment form

Sheet P2a
Fishery by Operational Unit

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Data source*	Official Statistics, IEO Sampling Network	OpUnit 1*	ESP 01 G 02 31 - ANE

Time series

Year*	2002	2003	2004	2005	2006	2007
Catch	3268	245	746	518	637	245
Minimum size	5.5	5.5	6.5	8.5	7	6.5
Average size Lc	10	10	11.6	12.5	13.3	11.3
Maximum size	17	17	18.5	16	17.5	18
Fleet	187	184	168	167	160	149

Year	2008					
Catch	178					
Minimum size	7					
Average size Lc	11.8					
Maximum size	17.5					
Fleet	135					

Selectivity

Remarks

L25	
L50	
L75	
Selection factor	

Structure by size or age
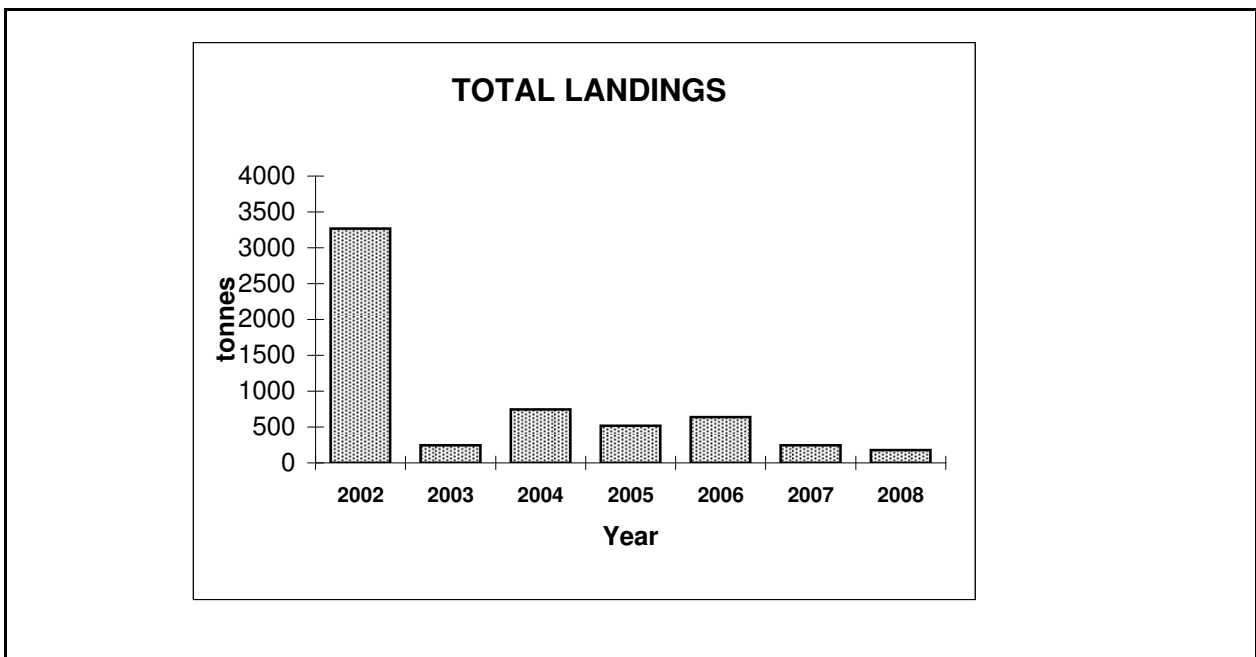
TOTAL LANDINGS

Structure by size or age

Anchovy GSA01 Length Distributions - 2002

Anchovy GSA01 Length Distributions - 2003

Anchovy GSA01 Length Distributions - 2004

Anchovy GSA01 Length Distributions - 2005

Anchovy GSA01 Length Distributions - 2006

Anchovy GSA01 Length Distributions - 2007

Anchovy GSA01 Length Distributions - 2008
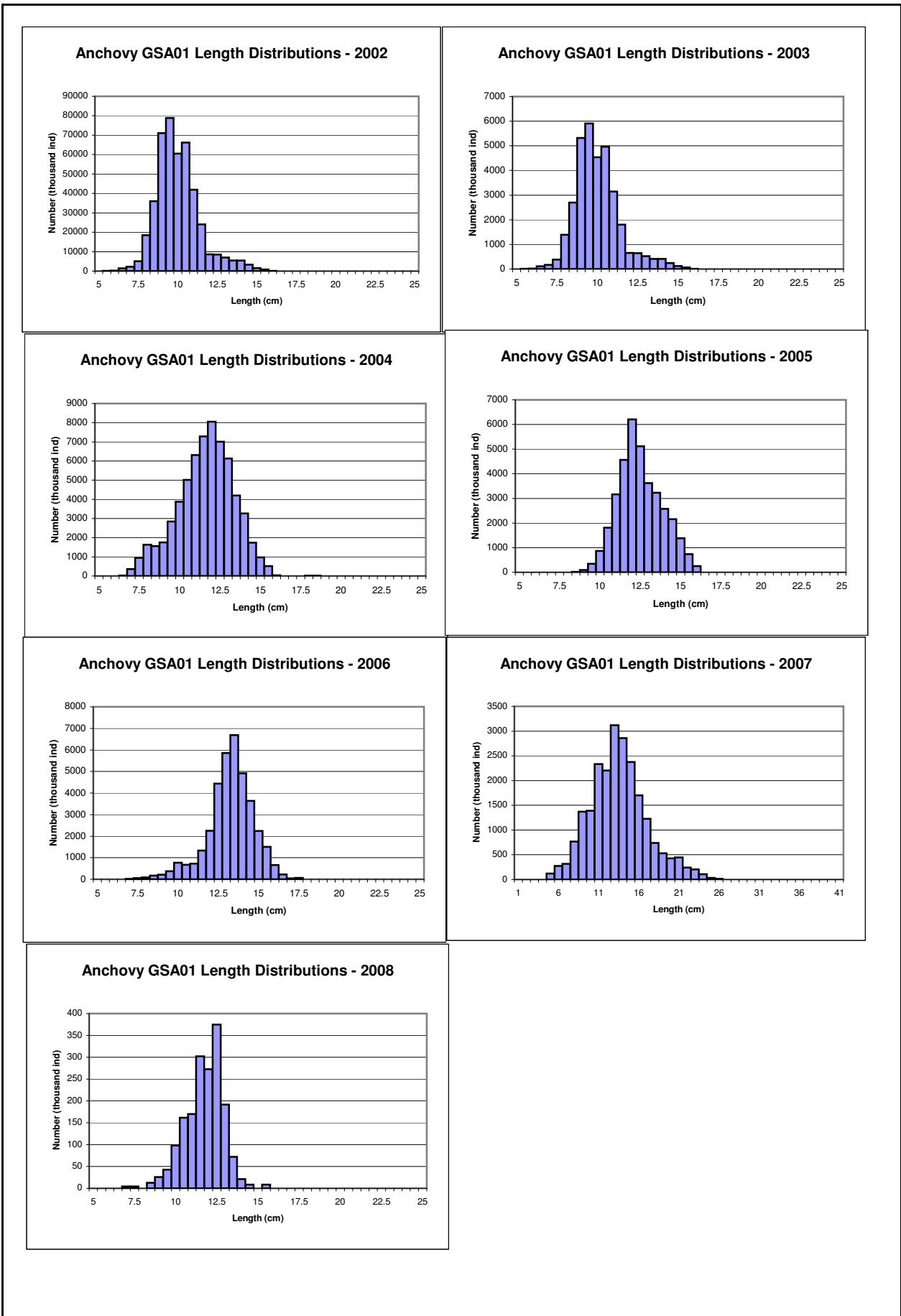
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Assessment form

Sheet P2b
Fishery by Operational Unit

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Data source*	Official Statistics, IEO Sampling Network		OpUnit 1*	ESP 01 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
Temporary fishing closures (March and April): 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 A1

Indirect methods: VPA, LCA

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
$F_{terminal}$	Not relevant to XSA		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	7	0	Recruitment	26 millions	
Average	See page 2a		Average population	See coments below	
Maximum	17.5	3+	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F_1	Fbar=1.24						
F_2							
Z	See Comments						

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

Comments

Reference F is Fbar0-3 (average of ages 0 to 3, which are considered the reference ages of this fishery). Following the recommendation from the Workshop on Mediterranean Stock Assessme a Natural Mortality vector with declining value of M with age has been considered instead of a constant value. The vector was estimated using the ProdBiom method (Abella et al., 1997) based on Caddy (1991).

Age	0	1	2	3
F	0.38	1.15	2.17	1.25
M	1.17	0.43	0.32	0.27

Separable VPA results show the pattern of Log catchability residuals. Some conflict between ages seem to appear. Fleet behaviour and fishery movements could affect the catchability pattern. XSA main settings were Fbar 0-3; Age 1 for q stock-size independent and age 2 for q independent of age.

In 2002 were caugth 3268 t. Since then levels catches are low (below 800 t). The year 2008 the landings were 178 t, the lowest value of the series. There is not a trend clear in fishing mortality showing a similar level between 2003 and 2008. Recruitment in 2008 is similar previous years. Both Total biomass in 2008 (TB=497 t) and Spawning Stock Biomass in 2008 (SSB=329t) remains a low lewels. (See also figures in page VPA)

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

Data	Input data for XSA

Data
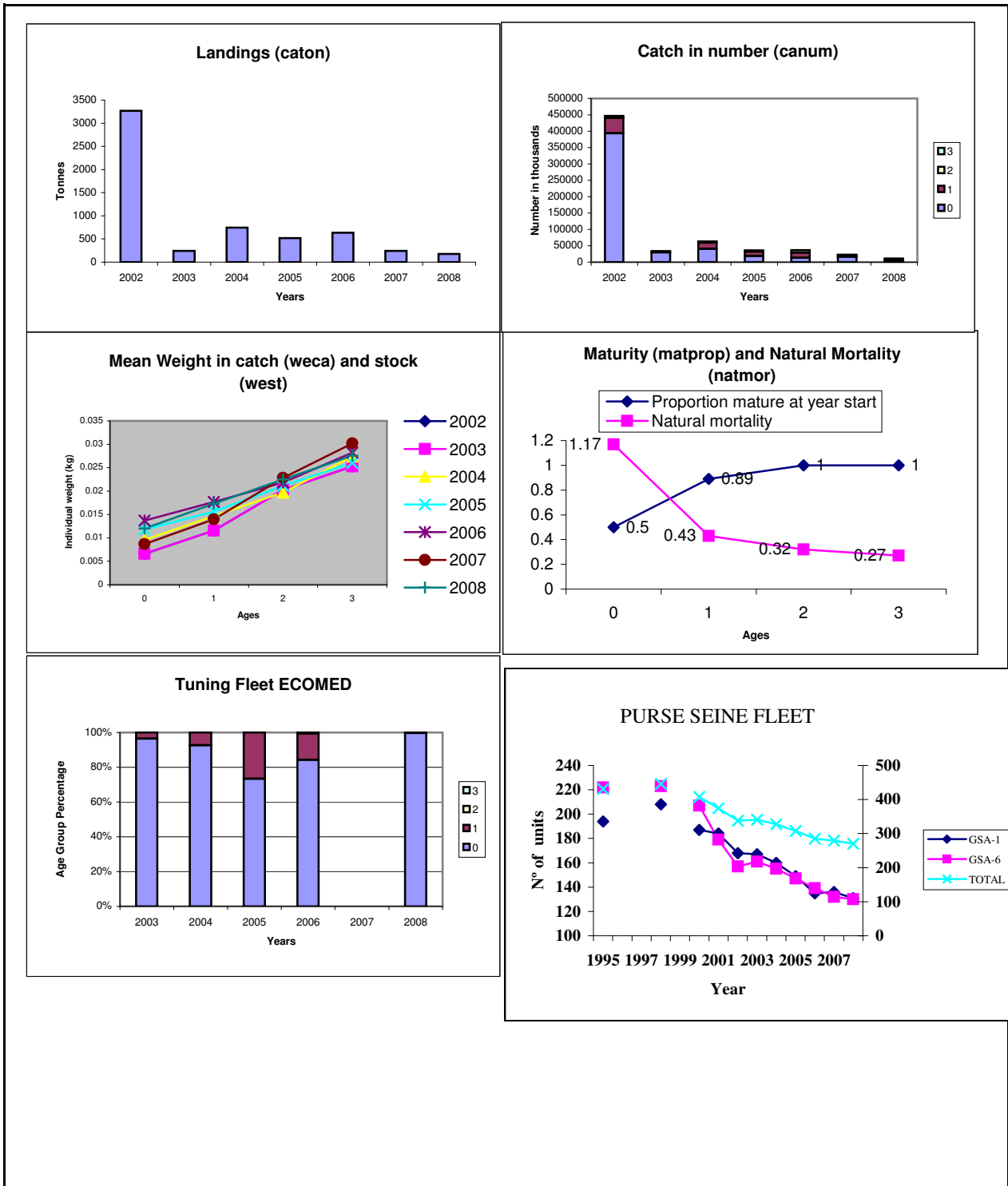
Landings (caton)

Catch in number (canum)

Mean Weight in catch (weca) and stock (west)

Maturity (matprop) and Natural Mortality (natmor)

Tuning Fleet ECOMED

PURSE SEINE FLEET

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Sex*	Both	Gear*	Purse Seiners	Analysis #*	XSA

Population in figures

RECRUITMENT
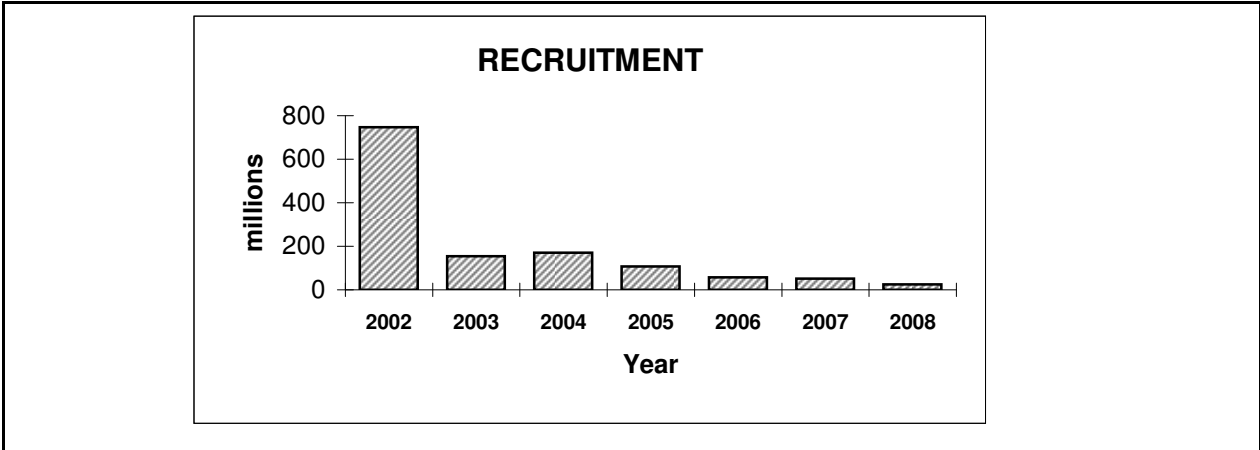
Population in biomass
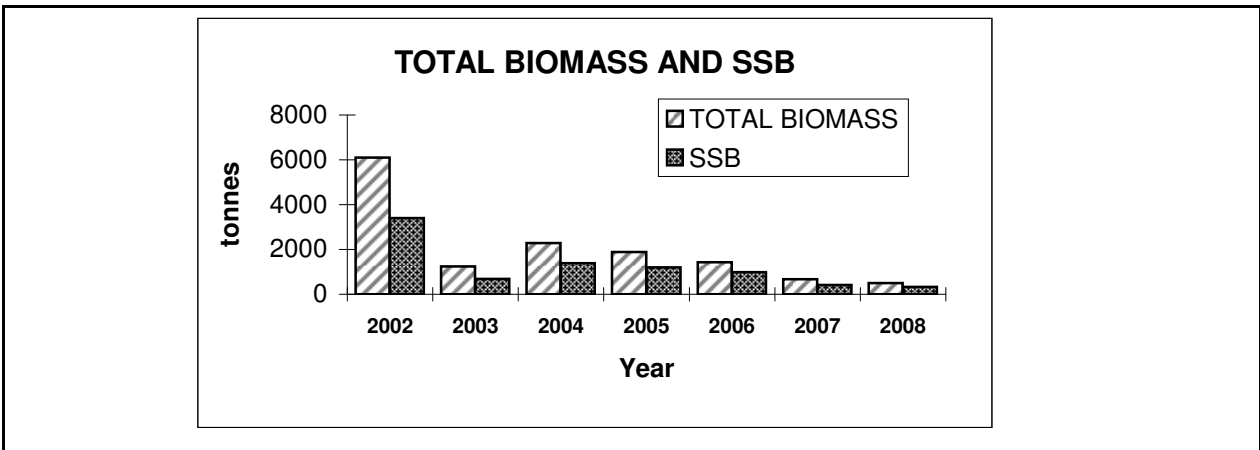
TOTAL BIOMASS AND SSB

Fishing mortality rates
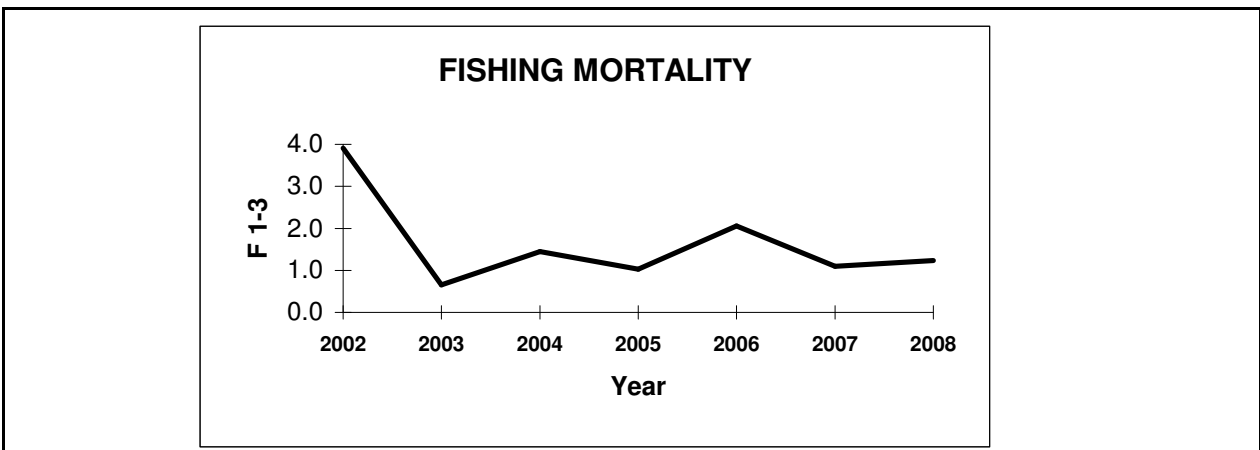
FISHING MORTALITY

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=1.46) and the recruitment is similar to the recruitment observed in 2007 and 2008 (Rlow=41 millions). We realise this option is more conservative but the most realistic and robust as recruitment has been continuously decreasing reaching their lowest values in last two years. Landings are predicted to be 152 t in 2009 and 139 t in 2010. Total biomass will decrease from 427 t in 2009 to 404 t in 2010 and SSB will also decrease from 268 t in 2009 to 246 t in 2011.

Then this exploitation pattern of maintaining F statu quo 2009-11, with scenarios of low recruitment rates, could prompt a decline of the fishery with SBB scenarios under current Bloss. 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.

2009 Biomass	SSB	FMult	FBar	Landings
427	268	1	1.2327	152

2010 Biomass	SSB	FMult	FBar	Landings	2011 Biomass	SSB
408	249	0	0	0	523	359
.	249	0.1	0.1233	20	505	342
.	249	0.2	0.2465	38	489	326
.	249	0.3	0.3698	55	474	312
.	249	0.4	0.4931	70	461	300
.	249	0.5	0.6164	84	449	288
.	249	0.6	0.7396	97	438	278
.	249	0.7	0.8629	108	429	269
.	249	0.8	0.9862	120	420	260
.	249	0.9	1.1095	130	412	253
.	249	1	1.2327	139	404	246
.	249	1.1	1.356	148	397	240
.	249	1.2	1.4793	157	391	234
.	249	1.3	1.6026	165	385	228
.	249	1.4	1.7258	172	380	223
.	249	1.5	1.8491	179	375	219
.	249	1.6	1.9724	186	371	215
.	249	1.7	2.0956	192	367	211
.	249	1.8	2.2189	198	363	207
.	249	1.9	2.3422	204	359	204
.	249	2	2.4655	209	356	201

Input units are thousands and kg - output in tonnes

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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;

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

Comments

No reference points for anchovy can be suggested at this point.

Code: ANE0109Gir

Management advice and recommendations*

This fishery is considered as overexploited. Unless the recruitmen levels increase in the near future, this fishery will being exploited at above a level which is bekieved to be sustainable in the log term, with no potencial room for further expansion an higher risk of stock depletion.

Advice for scientific research*

No reference points for anchovy can be suggested at this point. Further years will come a Time series extension suitable to suggest relevant Reference Points as well as Harvest Control Rules for this fishery.

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Assessment form

Sheet C
Comments

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Comments*

Conclussions - Assessment:

Landings in 2008 were 178 t, showing a slight decrease from that of 2007 (245 t). There is not trend in the evolution of catchs. Since 2003, the catch mantein at low levels.

Fishing mortality is at a moderate-high level (F08=1.23), showing a rather stable trend.

Recruitment in 2007 decreases from that of previous years (R07=52 millions), showing the lowest value of the time series.

Both Total biomass in 2008 (TB=497 t) and Spawning Stock Biomass in 2008 (SSB=329 t) decreased slighthy with respect to 2007. The highest value of SSB was in 2002 (6095 t)

Conclusions – Catch Forecasting:

statu quo F (Fbar06-08=1.46) and (Rlow=41 mill):

landings are predicted to be 152 t in 2009 and 139 t in 2010 t.
Total biomass will decrease from 427 t in 2009 to 404 t in 2010
SSB will also decrease from 268 t in 2009 to 249 t in 2010.

This exploitation pattern of maintaining F statu quo 2008-10, with scenarios of low recruitment rates, could prompt a decline of the fishery with SBB scenarios under current Bloss.

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 being expolited at above a level which is believed to be sustainable in the long term, with no potencial room for further expansion and hiher risk of stock depletion.

Further work:

Reference points.
Harvest Control Rules.