SAC GFCM
Sub-Committee on Stock Assessment

Date*	25	November	2009		Code*	PIL1709Doc

Authors*

Document prepared by the AdriaMed working group for small pelagics coordinated by Santojanni A. and Cingolani N.
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Species Scientific name*

1 *Sardina pilchardus - PIL*

Source: GFCM Priority Species

2

Source: -

3

Source: -

Geographical area*

Northern and central Adriatic Sea (southern limit: Gargano Promontory).

Geographical Sub-Area (GSA)*

17 - Northern Adriatic

Combination of GSAs	1	
	2	
	3	

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Species Scientific name*	Sardina pilchardus - PIL	Species common name*	Sardine

Data Source

GSA*	17 - Northern Adriatic	Period of time*	1975-2008

Description of the analysis

Type of data*	Catch at age and abundance index for tuning.	Data source*	
Method of assessment*	Virtual Population Analysis (VPA) with Laurec-Shepherd tuning.	Software used*	Darby C.D., Flatman S. 1994.

Sheets filled out

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

Comments, bibliography, etc.

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

Gislason H., N. Daan, J.C. Rice, J.G. Pope. 2008. Does natural mortality depend on individual size? ICES CM 2008/F:16.

Cardinale M., A. Abella, V. Bartolino, F. Colloca, J.M. Bellido, A. Di Natale, J.L. Bigot, F. Fiorentino, M. Garcia Rodriguez, M. Giannoulaki, G. Petrakis, L. Gil de Sola, G. Pilling, P. Martin, L.F. Quintanilla, M. Murenu, G.C. Osio, A. Santojanni, P. Sartor, M.T. Spedicato, V. Ticina, H.J. Rätz, A. Cheilari. 2008. Report of the SGMED-08-04 Working group on the Mediterranean, Part IV. Editors: Cardinale M., H.J. Rätz, A. Cheilari. EUR - Scientific and Technical Research Series. 728 pp.

Santojanni A. 2009. Comments on "Is anchovy (Engraulis encrasicolus, L.) overfished in the Adriatic Sea?" by Klanjscek and Legovic [Ecol. Model. 201 (2007): 312-316]. Ecological Modelling, 220: 430-433.

Code: PIL1709Doc

Biology

Somatic magnitude measured (LH, LC, etc)*	Total length.	Units*	cm

Sex	Fem	Mal	Both	Unsexed		
Maximum size observed					Reproduction season	
Size at first maturity					Reproduction areas	
Recruitment size					Nursery areas	

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L∞					
	K					
	t0					
	Data source					
Length weight relationship	a					
	b					

M					

sex ratio (mal/fem)	

Comments

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M at age (in years) estimated by Gislason's method:
Age      M
0        0.75
1        0.68
2        0.58
3        0.53
4        0.49
5        0.47
6        0.43
7        0.42
8        0.42
9        0.41
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Code: PIL1709Doc

Data source*		Year (s)*	1975-2008
Data aggregation (by year, average figures between years, etc.)*	Catch data are relative to the total fleet (Italy, Croatia, Slovenia).		

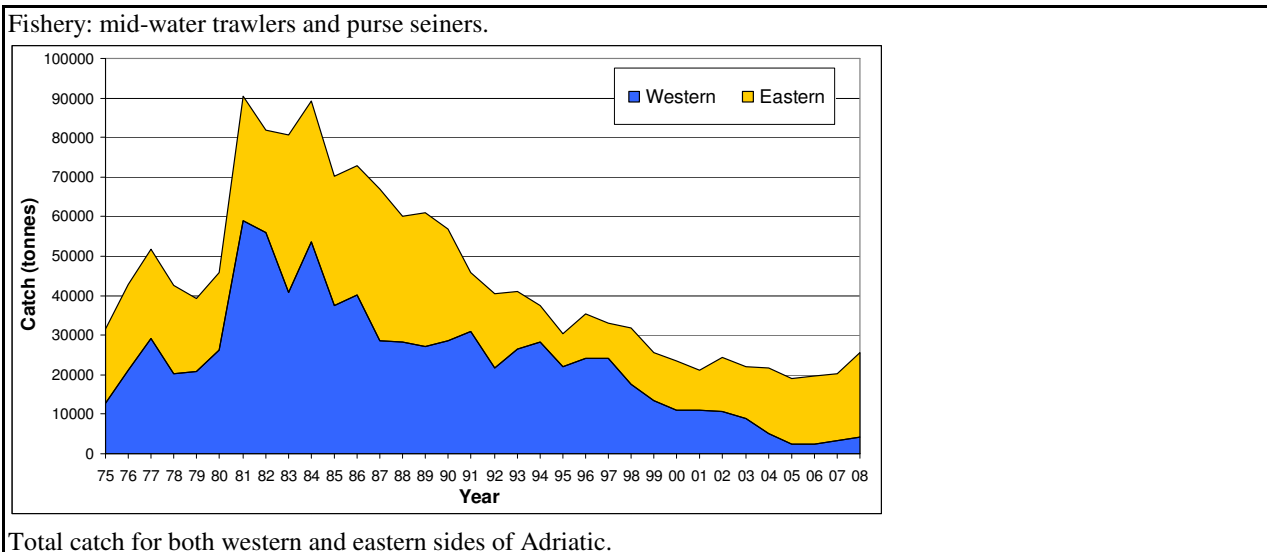**Fleet and catches (please state units)**

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*						
Operational Unit 2						
Operational Unit 3						
Operational Unit 4						
Operational Unit 5						

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
Total							

Legal minimum size	

Comments

Fishery: mid-water trawlers and purse seiners.

Total catch for both western and eastern sides of Adriatic.

Code: PIL1709Doc
Page 1 / 1

Sex*	M+F

Analysis # *	**VPA**

Time series

Data	Size	Age
(mark with X)		x

Model	Cohorts	Pseudocohorts
(mark with X)	x	

Equation used		Tunig method	Laurec-Shepherd
# of gears		Software	Darby C.D., Flatman S. 1994.
$F_{terminal}$			

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum			Recruitment		
Average			Average population		
Maximum			Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F_1							
F_2							
Z							

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

Comments

Tuning on abundance (number) at age derived from echo-surveys carried out in both western and eastern sides of Adriatic (since year 2004).

Code: PIL1709Doc

Sex*	M+F	Gear*	mid-water trawlers and purse seiners.	Analysis # *	VPA

Data	

Data

Total catch at age (thousands).							
Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6+
1975	7585	169567	168809	133637	111767	57349	101185
1976	32674	325425	262716	240229	178982	50674	49174
1977	38311	390846	286255	293502	225872	66399	63126
1978	56203	237503	191355	241149	206344	77865	86317
1979	17371	223353	211007	210192	167858	58922	70146
1980	34213	191096	239748	274783	220395	74540	83558
1981	90126	900152	558533	455718	351636	115444	129101
1982	67953	830415	523066	375817	286187	98067	118146
1983	54307	835931	533989	337134	252708	90895	117826
1984	45549	944959	619572	342244	248612	94093	130938
1985	13544	542745	622565	343080	217535	59584	71576
1986	3982	202553	402509	497431	404964	145442	168290
1987	88835	533147	298747	465766	368575	109178	113598
1988	19605	211508	492882	253874	354199	289823	136351
1989	7739	242067	806193	351688	219265	149582	70539
1990	3004	149813	661602	422933	231691	118764	52015
1991	1109	51418	417914	427739	266029	104863	30532
1992	8577	52194	295811	379281	225554	92045	34310
1993	35680	127134	242700	327819	249316	119111	47053
1994	24216	129380	247673	272042	195019	103236	44028
1995	8404	41136	160331	241258	193086	101514	46134
1996	27103	105687	157413	225860	227896	144333	72568
1997	25272	114328	174086	218736	195818	117145	55102
1998	42932	146871	173147	202282	177559	107280	51867
1999	70321	153580	119382	132549	129604	90379	53378
2000	91446	227543	189318	96714	52050	37405	41908
2001	64787	206423	324603	99569	26133	13715	13810
2002	100550	205041	453768	131496	22790	9400	8138
2003	35091	198099	444112	142622	14551	3676	2080
2004	11544	229349	437905	188641	12553	1724	1063
2005	26670	79693	274008	196415	63490	11662	2621
2006	65837	69530	193385	242056	86982	23361	551
2007	116311	76402	228352	211308	80496	41446	1209
2008	121442	182371	276715	195238	129803	29236	24779

Sex*	M+F	Gear*	mid-water trawlers and purse seiners.	Analysis #*	**VPA**

Population in figures

Number of fish at sea (* 10-4).

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	267426	289824	398693	522236	690221	813888	680869	617944	598820	1E+06	2E+06	1E+06
1	178330	124628	134024	183615	240556	321691	377710	319265	291121	281072	639490	756225
2	148059	82403	52984	57277	77299	107557	148730	177580	145823	141934	137551	318647
3	111757	70155	33554	21001	18461	20174	27928	51252	67701	61697	65332	60360
4	67854	49400	26254	9991	5290	3658	2524	6074	16241	25248	18488	22792
5	38138	26664	16825	6401	2244	1288	567	470	2760	5158	8876	5276
6+	17638	12682	9787	7067	2227	1101	316	285	610	120	255	4405

Population in biomass
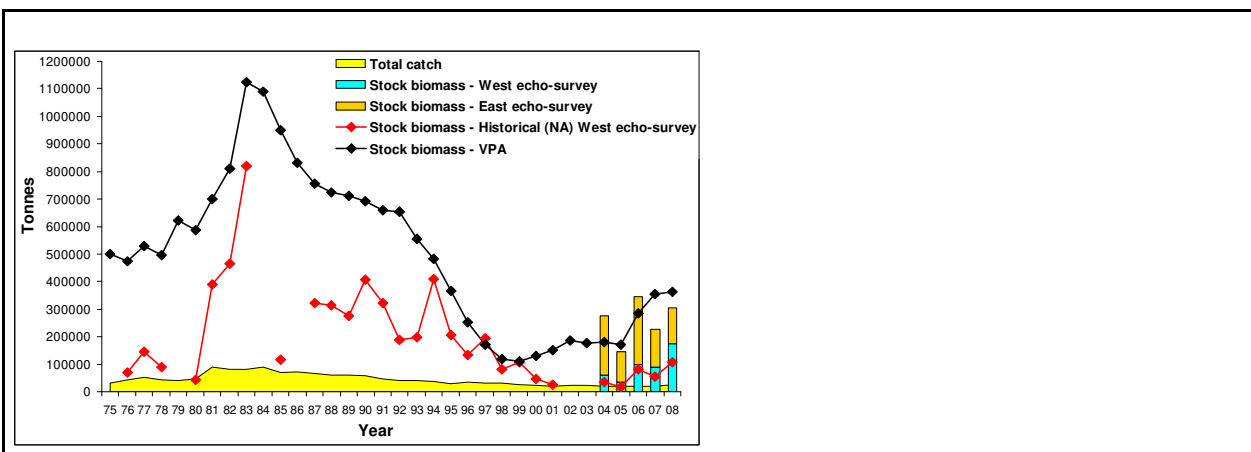
Fishing mortality rates

	1975 - 08	1999 - 08	2006 - 08
Age 0	**0.01**	**0.01**	**0.01**
Age 1	**0.07**	**0.09**	**0.03**
Age 2	**0.22**	**0.41**	**0.19**
Age 3	**0.40**	**0.80**	**0.57**
Age 4	**0.55**	**0.89**	**0.83**
Age 5	**0.62**	**1.10**	**0.91**
Age 6+	**0.62**	**1.10**	**0.91**

Average fishing mortality at age for three different time intervals from VPA.
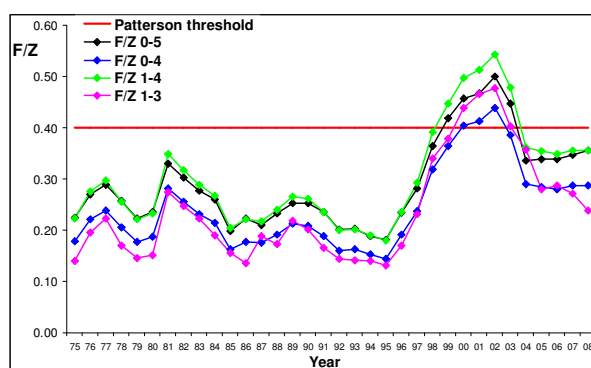
Exploitation rate F/Z over years from VPA.

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Assessment form

Sheet Y
Indirect methods: Y/R

Code: PIL1709Doc

Sex	

Analysis #	

# of gears		Software	

Parameters used

Vector F	
Vector M	
Vector N	

Model characteristics

Results

	Total	Gear			
Current YR					
Maximum Y/R					
Y/R 0.1					
F_{max}					
$F_{0.1}$					
Current B/R					
Maximum B/R					
B/R 0.1					

Comments

Code: PIL1709Doc

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB					
F					
Y					
CPUE					
F/Z					

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

☐	? - (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;

(Unidimensional)

Bidimensional

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

Code: PIL1709Doc

Management advice and recommendations*

The recent exploitation rate F/Z is under the Patterson's threshold 0.4. However, this pattern is less evident than in the case of anchovy (see ad hoc form) and, what is more, the values of F/Z were around/over the threshold in the time interval 1999-2003. In particular, since the end of the 1990s, the values of F were estimated as quite high for the oldest age classes. Thus, the sardine stock could be considered as fully exploited.

In addition, a strong decline of stock biomass occurred after the peak in the first half of the 1980s. This decline was continuous till the end of the 1990s. Then, a partial recovery was observed. Finally, in comparison with previous assessments, more conservative natural mortality rates (i.e. M = 0.5 for all age classes) were not used in the present analysis.

It should be noted that Adriatic small pelagic fishery is multispecies and effort on anchovy cannot be separated from effort on sardine, so that most of the management decisions should be taken considering both species.

In conclusion, it is recommended not to increase the fishing effort in next future.

Advice for scientific research*

To use more extensively Integrated Catch Analysis (ICA); at the present time trials were done.