

SAC GFCM Sub-Committee on Stock Assessment

Date*

1	October	2010
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Code*

SOL1710G.

Authors* G. Scarcella*, O. Giovanardi**, N. Vrgoc***, B. Marceta****, G. Fabi*, F. Grati*, S. Raicevich**, P. Polidori*, F. Domenichetti*, L. Bolognini*, I. Celic**, L. Sabatini**

Affiliation* * CNR-ISMAR Ancona; ** ISPRA Chioggia; *** IOF Split; **** FRIS Ljubljana.

- Species Scientific name***
- 1** *Solea vulgaris* - *SOL*
Source: GFCM Priority Species
 - 2**
Source: -
 - 3**
Source: -

Geographical area* Adriatic Sea

Geographical Sub-Area (GSA)* 17 - Northern Adriatic

Combination of GSAs 1
2
3

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

Assessment form

Sheet #0

Basic data on the assessment

Code: SOL1710G.

Date*	1	Oct	2010	Authors*	G. Scarcella*, O. Giovanardi**, N. Vrgoc***, B. Marceta****, G. Fabi*, F. Grati*, S. Raicevich**, P. Polidori*, F. Domenichetti*, L. Bolognini*, I. Celic**, L. Sabatinj**
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Species Scientific name*	Solea vulgaris - SOL	Species common name*	Common sole
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Data Source

GSA*	17 - Northern Adriatic	Period of time*	2005-2009
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Description of the analysis

Type of data*	Catch data from experimental surveys; size composition of the catches of commercial fleets; commercial	Data source*	ISMAR, ICRAM, IOF, FRIS, IREPA, FISHSTAT FAO, Fish markets, fisherman associations, MiPAF, ISMAEA, SoleMon
Method of assessment*	XSA; SURBA; VIT and Yield per recruit	Software used*	Lowestoft package, FLR, SURBA, VIT

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	Other	D	Z	C
1	1	4	2	---	3	1	2	1	1	1	1	---

Comments, bibliography, etc.

Branch T.A., Kirkwood G.P., Nicholson S.A., Lawlor B., Zara S.J. 2000. Yield version 1.0, MRAG Ltd, London, U.K.

Caddy J.F. 1991. Death rates and time intervals: is there an alternative to the constant natural mortality axiom?. Rev. Fish Biol. Fish. 1: 109–138.

Caddy J.F., Abella A.J. 1999. Reconstructing reciprocal M vectors from length cohort analysis (LCA) of commercial size frequencies of hake, and fine mesh trawl surveys over the same grounds. Fish. Res. 41: 169–175.

Cadima E.L. 2003. Fish Stock Assessment Manual. FAO Fish. Tec. Paper, 393.

Darby C.D., Flatman S. 1994. Virtual Population Analysis: Version 3.1 (Windows/DOS) User Guide. Information Technology Series, No. 1. Lowestoft: MAFF, Directorate of Fisheries Research; 85 pp.

Gayanilo F.C.Jr., Sparre P., Pauly D. 2005. FAO-ICLARM Stock Assessment Tools II (FiSAT II). Needle C.L. 2005. SURBA 3.0: Technical Manual (first draft) FRS Marine Laboratory; 10 pp.

Gramolini R., Mannini P., Milone N., Zeuli V. 2005. AdriaMed Trawl Survey Information System (ATrIS): User manual. AdriaMed Technical Documents No 17, GCP/RER/010/ITA/TD-17. 141 pp.

Kirkwood G.P., Auckland R., Zara S.J. 2001a. Length Frequency Distribution Analysis (LFDA), Version 5.0. MRAG Ltd, London, UK.

Hilborn R. and Walters C.J. 1992. Quantitative Fisheries Stock Assessment. Choice, Dynamics, and Uncertainty. Chapman and Hall Eds. New York, USA. 570.

Comments, bibliography, etc.

Pilling G. M., Kell L. T., Hutton T., Bromley P. J., Tidd A. N., Bolle L. J. 2008. Can economic and biological management objectives be achieved by the use of MSY-based reference points? A North Sea plaice (*Pleuronectes platessa*) and sole (*Solea solea*) case study. – *ICES Journal of Marine Science*, 65: 1069–1080.

Pauly, D., 1990. Length-converted catch curves and the seasonal growth of fishes. *ICLARM Fishbyte*, 8(3): 33-38.

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Assessment form

Sheet B
Biology of the species

Code: SOL1710G.

Biology

Somatic magnitude measured (LH, LC, etc)*		TL		Units*	cm
Sex	Fem	Mal	Both	Unsexed	
Maximum size observed	40	38.5			Reproduction season
Size at first maturity	25.8				Reproduction areas *
Recruitment size			17- 20		Nursery areas **

Parameters used (state units and information sources)

		Units	Sex			
			female	male	both	unsexed
Growth model	L ∞	cm			39.6	
	K	1/year			0.44	
	t0	year			-0.46	
	Data source	SoleMon Project (2004-2009)				
Length weight relationship	a				0.007	
	b				3.0638	
	M				***	
	sex ratio (mal/fem)	0.85				

Comments

* Northern Adriatic: within meridians 13°00' and 14°20' E and parallels 44°10' and 45°20' N

** Marine coastal areas, estuarine and lagoon systems along the Italian coast of the central and northern Adriatic Sea

*** The vector of natural mortality by age was calculated from Caddy's (1991) method, using the PROBIOM Excel spreadsheet (Abella et al., 1997):

Age 0: 0.7; Age 1: 0.35; Age 2: 0.28; Age 3: 0.25; Age 4: 0.23; Age 5+: 0.22

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Assessment form

Sheet P1

General information about the fishery

Code: SOL1710G.

Data source*	CNR ISMAR Ancona; ICRAM Chioggia; IOF Split; FRIS Ljubljana	Year (s)*	2005-2009
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Data aggregation (by year, average figures between years, etc.)*	by year
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Fleet and catches (please state units)

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	ITA	17	E - Trawl (12-24 metres)	98 - Other Gear	33 - Demersal shelf species	SOL
Operational Unit 2	ITA	17	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	SOL
Operational Unit 3	HRV	17	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	SOL
Operational Unit 4	SVN	17	C - Minor gear with engine (6-12 metres)	07 - Gillnets and Entangling Nets	33 - Demersal shelf species	SOL
Operational Unit 5						

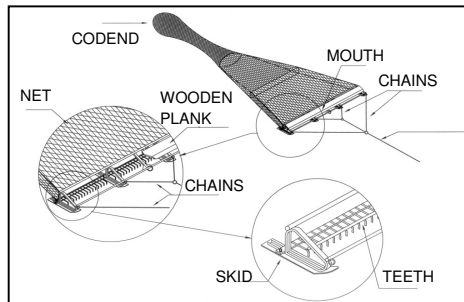
Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
ITA 17 E 98 33 - SOL	124	Tons	Solea solea	a officinalis, Squ		equivalvis, Anad	essel x Da
ITA 17 C 07 33 - SOL	469	Tons	Solea solea	melidonichthys luc		pecten irregulari	essel x Da
HRV 17 C 07 33 - SOL		Tons	Solea solea				
SVN 17 C 07 33 - SOL		Tons	Solea solea				
Total	593						

Legal minimum size	20 cm
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Comments

Operational Unit 1: from censuses carried out at the landing sites the Italian rapido trawl fleets operating in GSA 17 was made up by 155 vessels in 2005 and 124 vessels in 2006. Their Loa ranged from 9 to 30 m, the GRT ranged from 4 to 100 and the engine power from 60 to 1000 HP. each vessel can tow from 2 to 4 rapido trawls depending on its dimensions. The gear used by Operational Unit 1 is the rapido trawl, a specific gear used for the catch of flatfish and other benthic species (e.g. cuttlefish, mantis shrimp, etc.). It resembles a toothed beam-trawl and is made of an iron frame provided with 3-5 skirts and a toothed bar on its lower side. These gears are usually towed at a greater speed (up to 10-13 km h-1) in comparison to the otter trawl nets; this is the reason of the name "rapido", the Italian word for "fast".

Comments



Scheme of rapido trawl used in GSA 17

Operational Unit 2: the fleet using set nets in GSA 17 was composed by 475 vessels in 2005 and by 469 vessels in 2006. Their Loa ranged from 5.0 to 12.0 m, their GRT from 1.0 to 10.0 and their engine power from 10 to 200 HP.

Operational Unit 3: landings of 200 t of *S. solea* per year have been suggested from croatian fishery. In 2009, 150 tons were considered a good estimation on the base of the Croatian fishery data presented in the report of the 12th session of the Scientific Advisory Committee (GFCM: XXXIV/2010/Inf.9). The length frequency distributions from 2005 to 2009 of the Croatian catches derived from the demography of common sole observed in the hauls performed close to the eastern waters during the SoleMon survey.

Operational Unit 4: landings of *S. solea* per year have been collected in the framework of the Data Collection Programme since 2005. The length frequency distributions from 2005 to 2008 of the Slovenian catches derived from the demography of common sole observed in the hauls performed close to the eastern waters during the SoleMon survey.

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Assessment form

Sheet P2a
Fishery by Operational Unit

Code: SOL1710G.

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Data source*	CNR ISMAR Ancona	OpUnit 1*	ITA 17 E 98 33 - SOL
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Time series

Year*	2005	2006	2007	2008	2009	
Catch	1866	1721	1469	1984	1810	
Minimum size	13.50	12.50				
Average size Lc	22.20	21.40				
Maximum size	34.50	36.00				
Fleet	155	124	94	94	94	

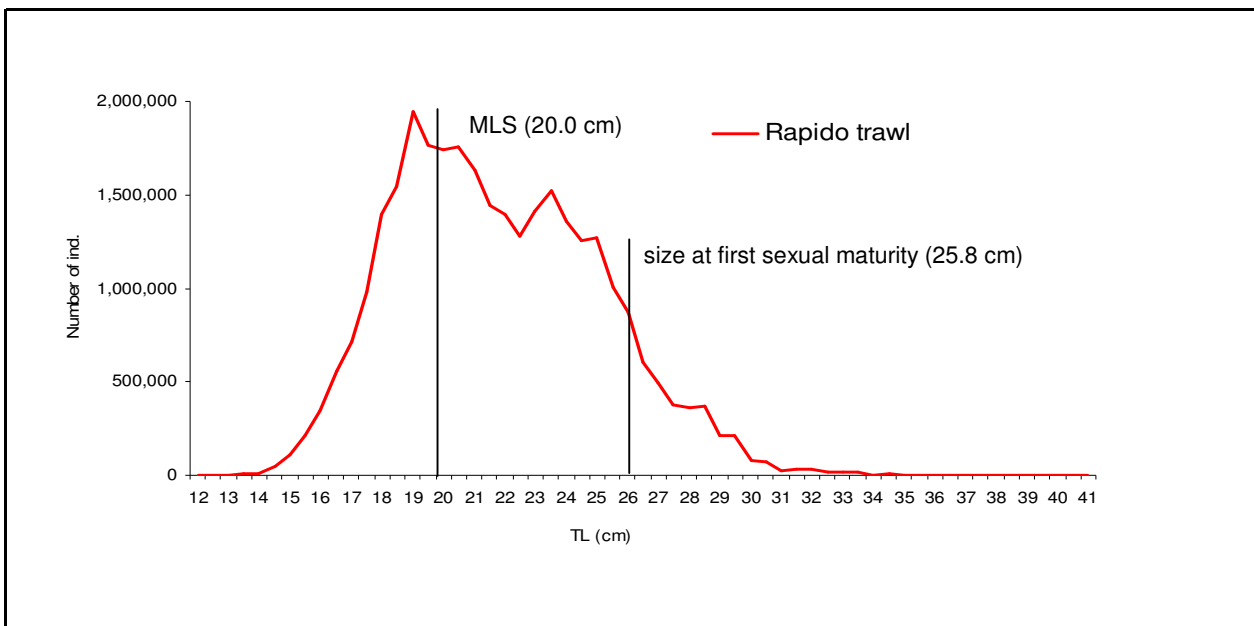
Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25	12.40	They correspond to 40.2 mm diamond mesh in the codend. The parameters have been derived from selectivity parameters given by Ferretti and Froggia (1975)
L50	14.55	
L75	16.72	
Selection factor	3.62	

Structure by size or age



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Assessment form

Sheet P2a
Fishery by Operational Unit

Code: SOL1710G.

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Data source*	CNR-ISMAR Ancona	OpUnit 2*	ITA 17 C 07 33 - SOL
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Time series

Year*	2005	2006	2007	2008	2009	
Catch	201.5	287	204	200	175	
Minimum size	14.5	15.5				
Average size Lc	22.4	22.4				
Maximum size	37	34				
Fleet	475	469	469	469	469	

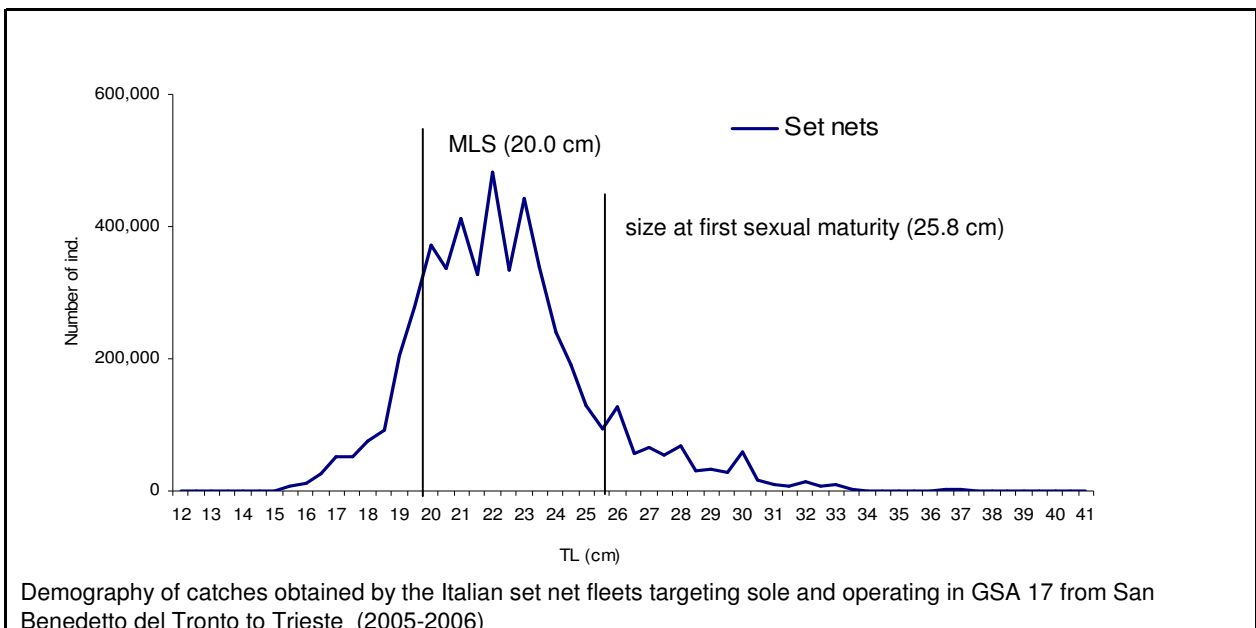
Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25		64 mm mesh : L50 left = 19.1; L100 = 21.7; L50 right = 24.4 72 mm mesh : L50 left = 21.4; L100 = 24.3; L50 right = 27.3
L50		
L75		
Selection factor		

Structure by size or age



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Assessment form

Sheet P2a
Fishery by Operational Unit

Code: SOL1710G.

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Data source*	IOF Split	OpUnit 3*	HRV 17 C 07 33 - SOL
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Time series

Year*	2005	2006	2007	2008	2009	
Catch	200	200	200	200	150	
Minimum size						
Average size Lc						
Maximum size						
Fleet						

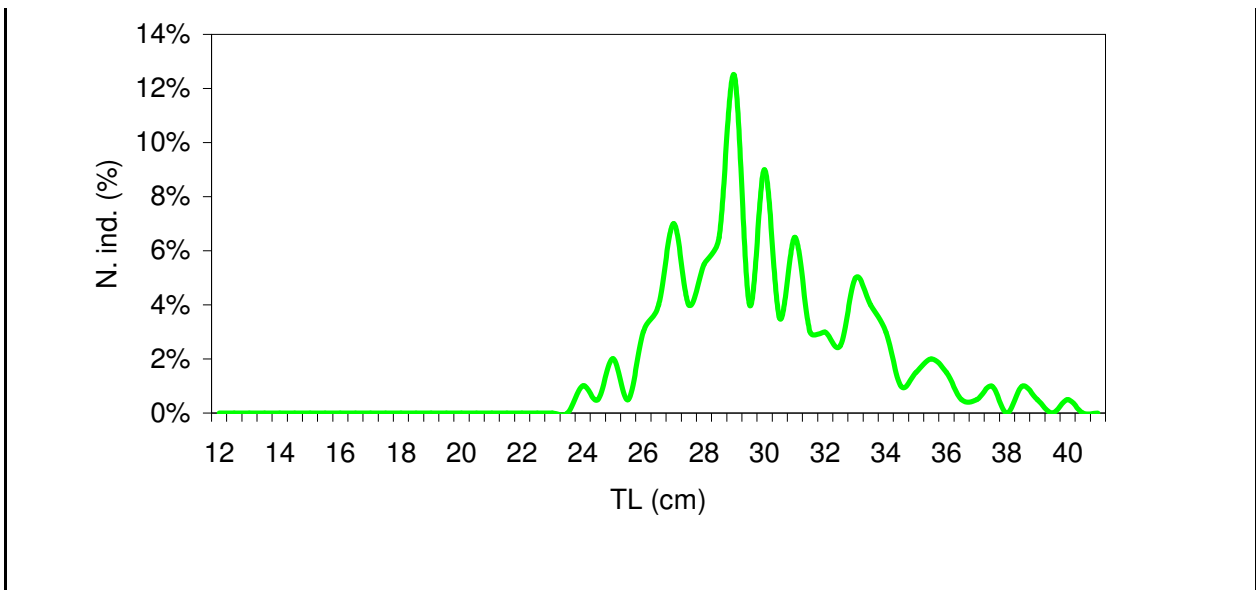
Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

Selectivity

Remarks

L25		
L50		
L75		
Selection factor		

Structure by size or age



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Assessment form

Sheet P2a
Fishery by Operational Unit

Code: SOL1710G.

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Data source*	FRIS Ljubljana	OpUnit 4*	SVN 17 C 07 33 - SOL
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Time series

Year*	2005	2006	2007	2008	2009	
Catch	12.9	11.1	17.4	14.2	21.1	
Minimum size						
Average size Lc						
Maximum size						
Fleet		51	54			

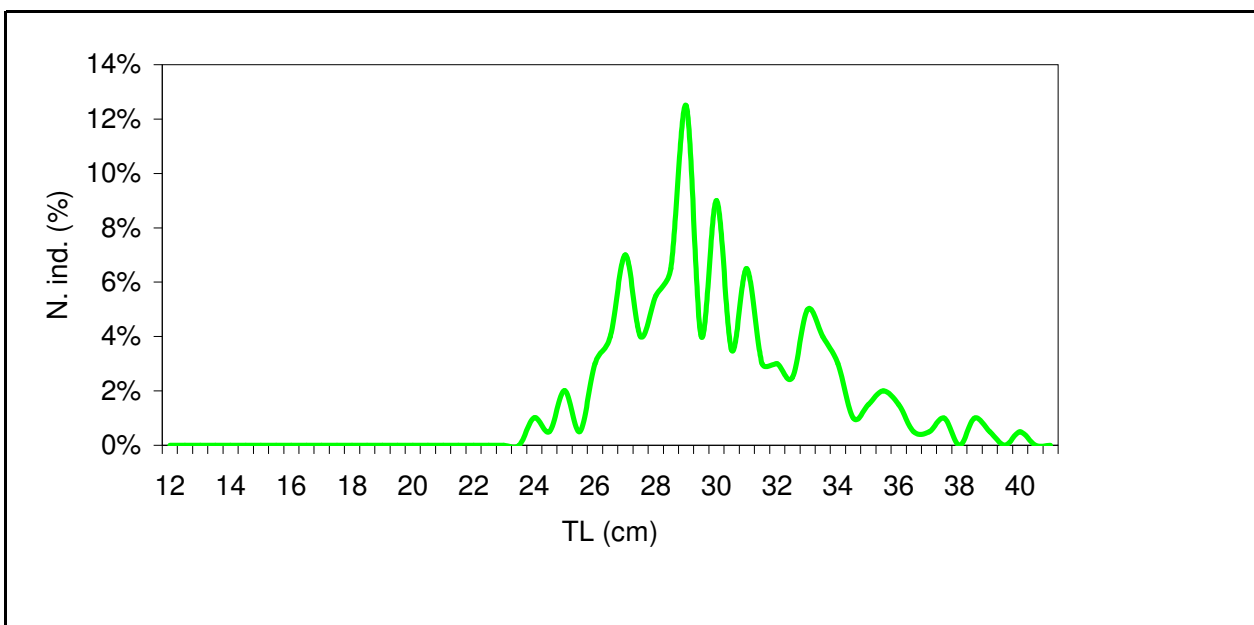
Year						
Catch						
Minimum size						
Average size Lc						
Maximum size						
Fleet						

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: SOL1710G.

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Data source* CNR - ISMAR Ancona

OpUnit 1*

ITA 17 E 98 33 - SOL

Regulations in force and degree of observance of regulations

Minimum mesh size (40 mm): observed. The mesh size used by rapido trawlers is usually around 48 mm, hence larger than the legal minimum mesh size.

Minimum landing size for sole (20 cm): not observed. The rapido trawl catches include a relevant portion (>40% in number of individuals) of undersized specimens (see graphic in sheet P2a1).

Fishing ban inside the 3 miles offshore: partially observed. Rapido trawlers often fish illegally in this area.

Accompanying species

Sepia
Squilla
Melice
Aequi
Pecten
Trigla

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: SOL1710G.

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Data source*	CNR - ISMAR Ancona	OpUnit 2*	ITA 17 C 07 33 - SOL
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Regulations in force and degree of observance of regulations

Minimum mesh size (16 mm stretched): observed. The mesh size used by set netters targeting sole range from mm, hence larger than the legal minimum mesh size.

Minimum landing size for sole (20 cm): not always observed. The set net catches include a portion (16% in number of individuals) of undersized specimens (see graphic in sheet P2a2).

Maximum length of nets x vessel x day (5,000 m): not always observed.

Accompanying species

Squilla
Melice
Trigla

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Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: SOL1710G.

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Sex* Both

Analysis # * XSA

Time series

Data	Size	Age
(mark with X)		X

Model	Cohorts	Pseudocohorts
(mark with X)	X	

Equation used		Tunig method	
# of gears		Software	Lowestoft package
F _{terminal}			

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum		0	Recruitment	48974	
Average			Average population		3936
Maximum		5+	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F ₁	1.35						
F ₂							
Z							

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

Comments

F1 = Fbar 0-4

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Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: SOL1710G.

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Sex* Both

Analysis # * SURBA

Time series

Data	Size	Age
(mark with X)		X

Model	Cohorts	Pseudocohorts
(mark with X)	X	

Equation used		Tuning method	
# of gears		Software	SURBA
F _{terminal}			

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum		0	Recruitment	31,270	
Average			Average population		4570
Maximum		5+	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F ₁	0.92						
F ₂							
Z							

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

Comments

F1 = Fbar 0-4

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Assessment form

Sheet A1
Indirect methods: VPA, LCA

Code: SOL1710G.

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Sex* Both

Analysis # * VIT

Time series

Data	Size	Age
(mark with X)		x

Model	Cohorts	Pseudocohorts
(mark with X)	x	

Equation used		Tuning method	
# of gears	Mean catch at age 2007-2009	Software	VIT
F _{terminal}	0.1		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum		0	Recruitment	47558887.52	
Average			Average population		#####
Maximum		5	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F ₁	0.61						
F ₂	0.71						
Z	0.95						

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

Comments

F1= mean F
F2= mean F (0-4)

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Assessment form

Sheet A2
Indirect methods: data

Code: SOL1710G.

Sex*	Both	Gear*	All	Analysis # *	XSA, SURBA and VIT
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Data source	Catch at age from commercial landing (matrix Ca,y (N. ind.)) and CPUE from survey data at start of the ye
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Data

XSA

Catch (x 1000)

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
2190	12914	3163	150	14	10
2629	15155	1674	169	23	11
3813	11211	1826	202	42	16
5779	15681	1888	197	43	16
4957	15203	2262	210	46	24

Survey indices

N/km²

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
162.018	86.266	39.279	11.766	3.484	2.207
90.719	174.558	49.366	9.212	2.115	1.181
191.886	146.295	74.901	17.993	1.395	0.58
128.066	114.785	57.629	10.623	5.419	0.6
177.1	83.3	47.5	6.5	1.98	0.39

	0	1	2	3	4	5+
Catch weigh	0.024	0.104	0.207	0.304	0.380	0.522
Stock weigh	0.024	0.104	0.207	0.304	0.380	0.522
Maturity ogiv	0.00	0.16	0.76	0.96	0.99	1.00
M	0.70	0.35	0.28	0.25	0.23	0.22

Proportion of F before spawning 0.7

Proportion of M before spawning 0.8

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Assessment form

Sheet A3

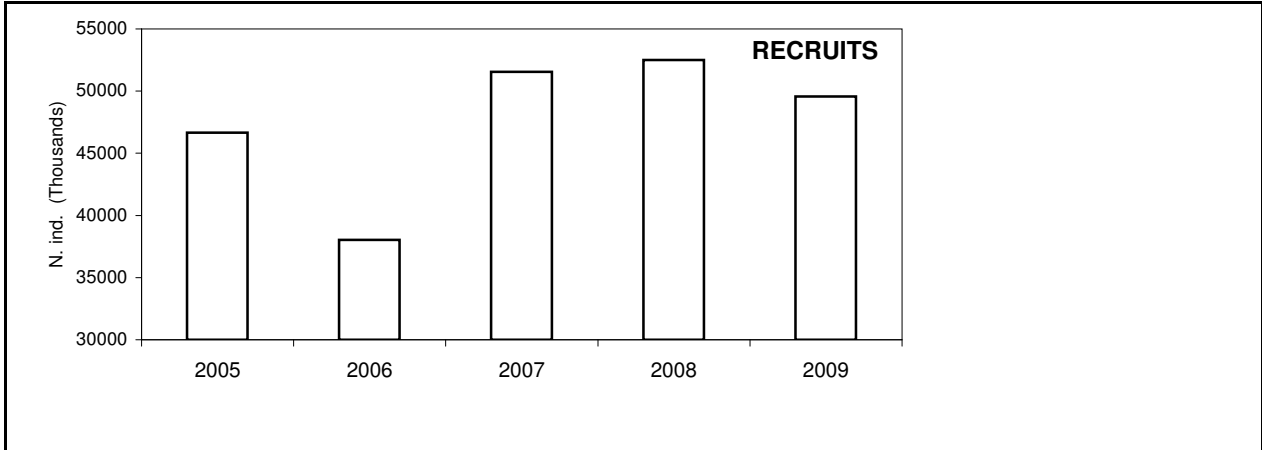
Indirect methods: VPA results

Code: SOL1710G.

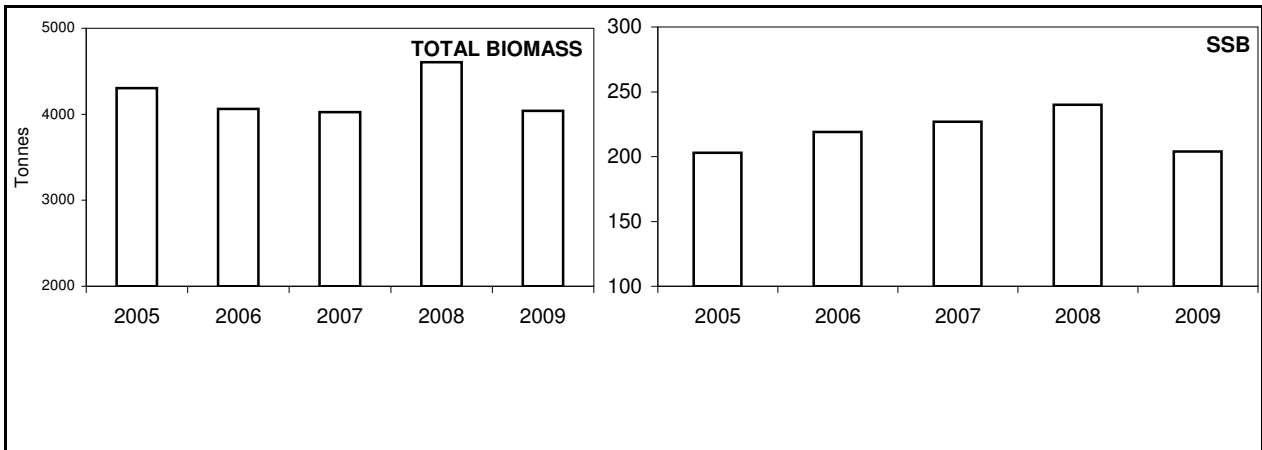
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Sex*	Both	Gear*	All	Analysis #*	XSA
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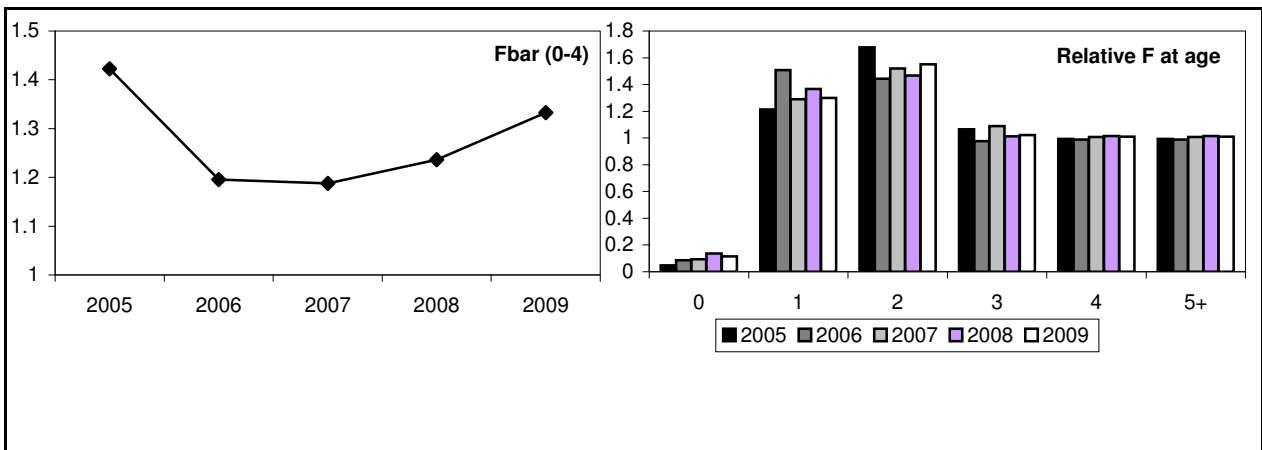
Population in figures



Population in biomass



Fishing mortality rates



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Assessment form

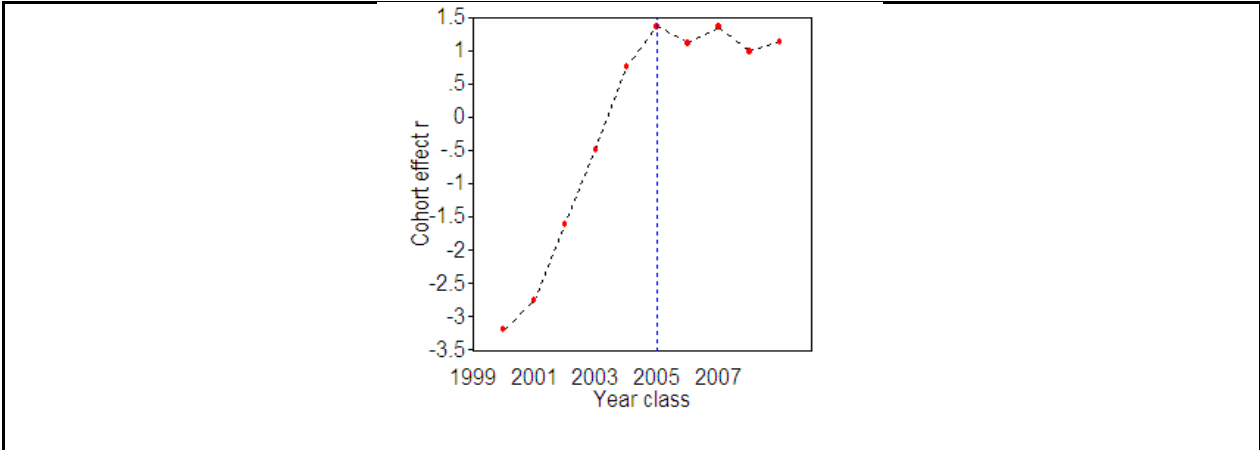
Sheet A3
Indirect methods: VPA results

Code: SOL1710G.

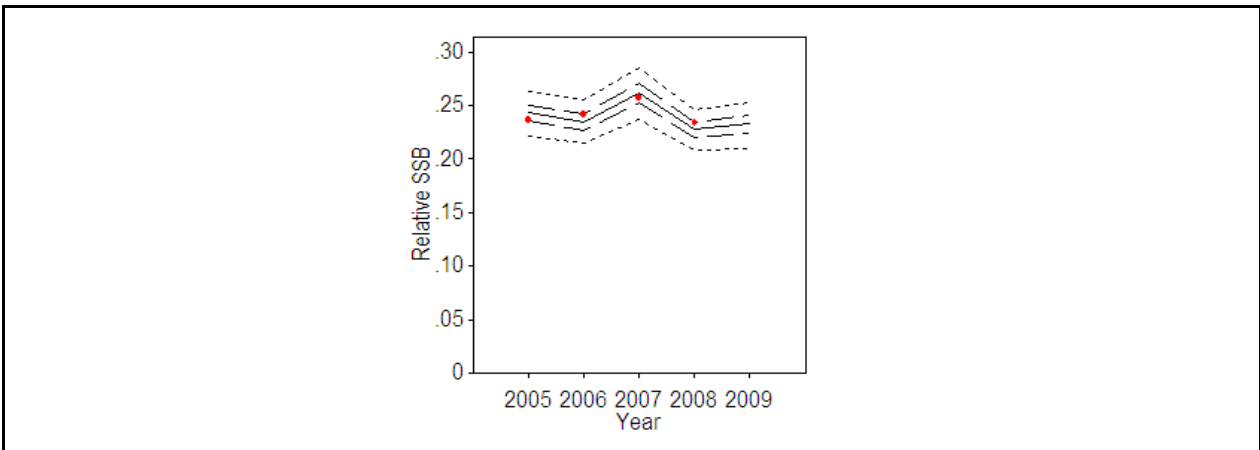
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Sex*	Both	Gear*	All	Analysis #*	SURBA
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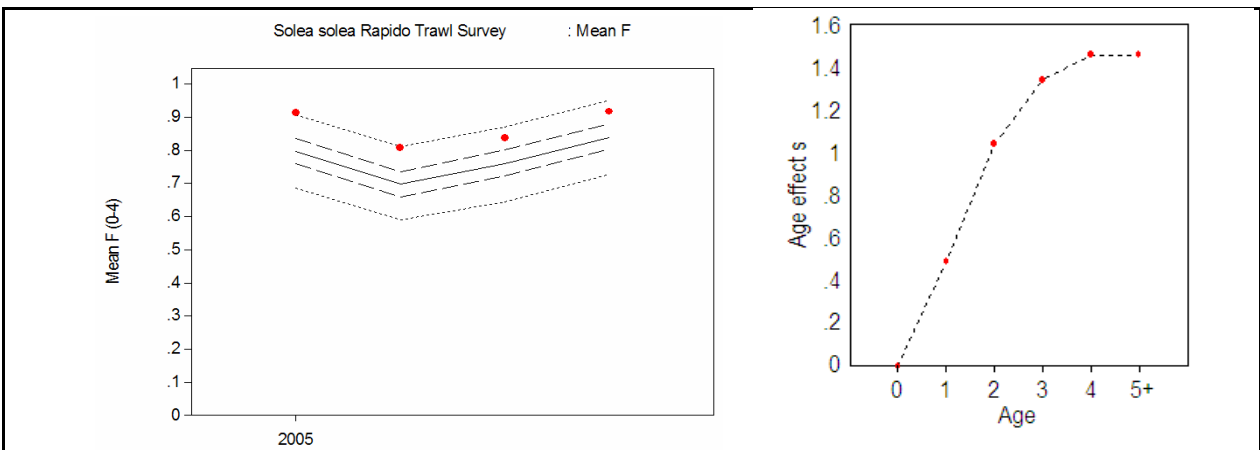
Population in figures



Population in biomass



Fishing mortality rates



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

Assessment form

Sheet A3
Indirect methods: VPA results

Code: SOL1710G.

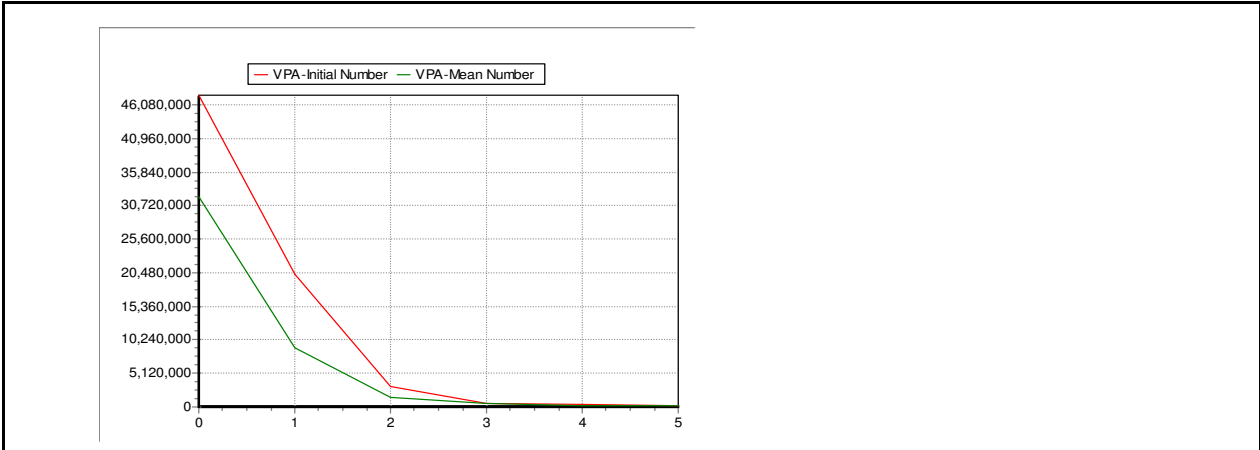
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Sex*

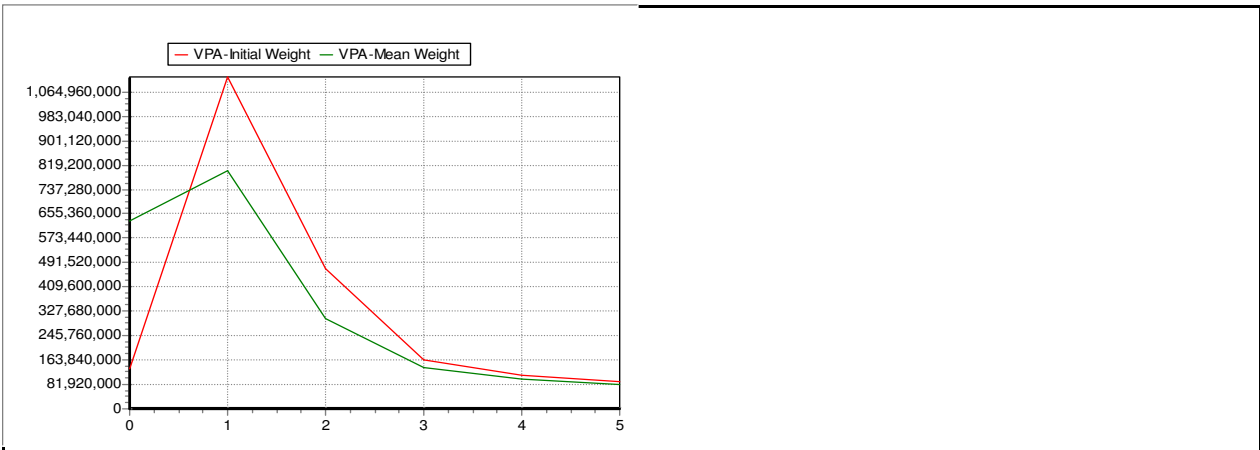
Gear*

Analysis #*

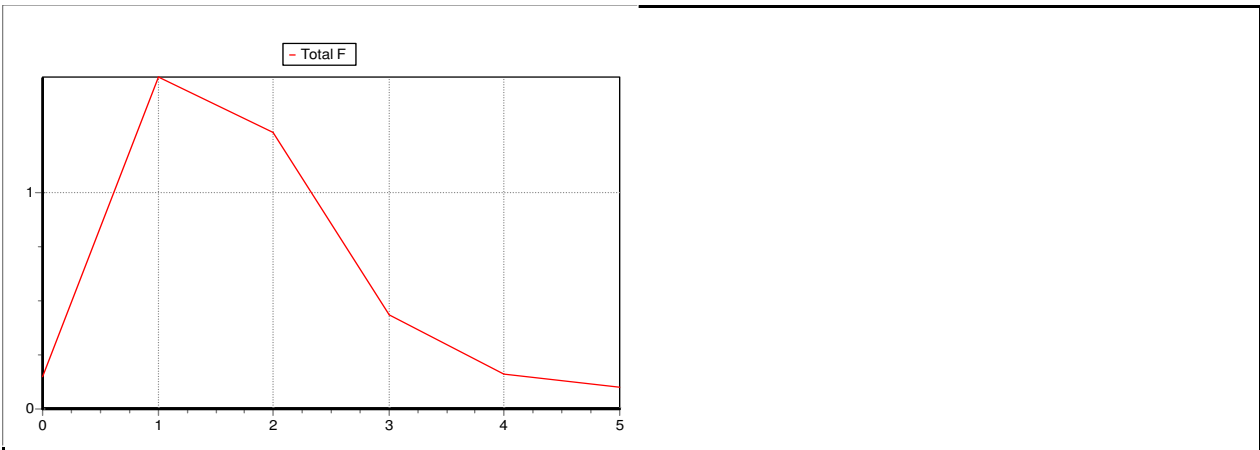
Population in figures



Population in biomass



Fishing mortality rates



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

		Code: SOL1710G.	
Sex	Both	Analysis #	Y/R

# of gears	All	Software	Yield 1.0
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Parameters used

Vector F	
Vector M	
Vector N	
	Linf: 39.6 cm, k: 0.44, t0: -0.46; a: 0.007, b: 3.0638;
	Beverton-Holt model (CV: 0.31), Steepness: 0.75 and 0.9 (Pilling <i>et al.</i> 2008) Age maturity: 1

Model characteristics

Results

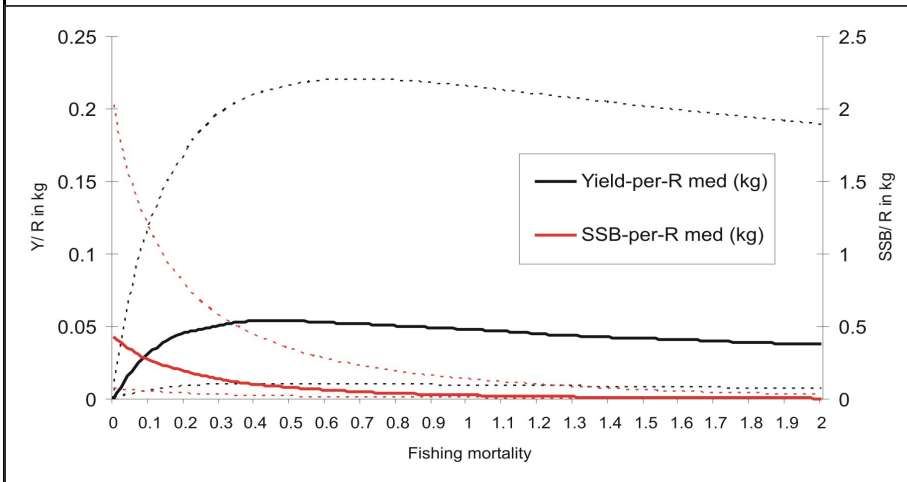
	Total	Gear			
Current YR					
Maximum Y/R					
Y/R 0.1					
F _{max}					
F _{0.1}					
Current B/R					
Maximum B/R					
B/R 0.1					

Comments

	YR VIT	YR YIELD	YR XSA
F0.1	0.29	0.26	0.19
Fmax	0.42	0.46	0.35

Comments

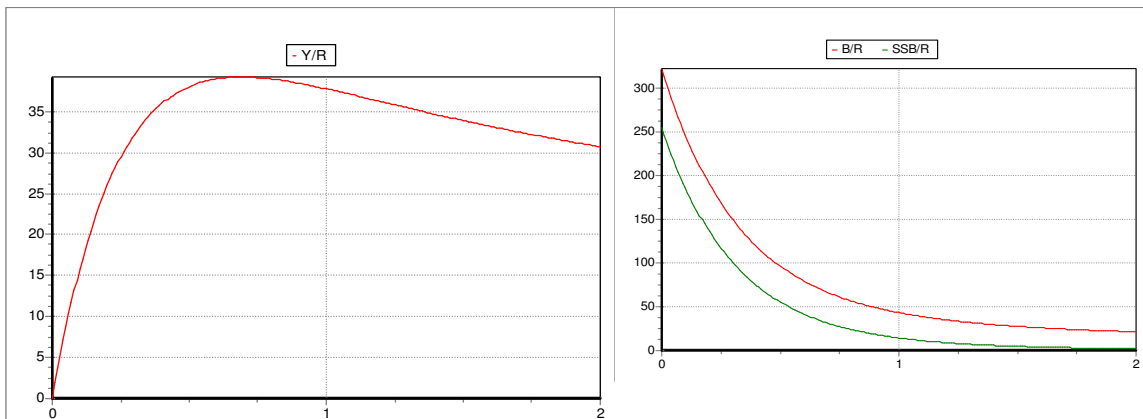
based	value	RP	value	Results with steepnes of	0.9
Y/R _{max}	0.054	F _{max}	0.46		
Y/R _{ref}	0.051	F _{ref}	0.32		
Y/R _{0.1}	0.048	F _{0.1}	0.26		



Searching for biological reference points (BRP) through 1000 simulation produced the median values reported in tables considering two different values of steepness. Y/Rmax, Fmax and Y/Rref, Fref, the two latter corresponding to Y/R and F at SSB/initial SSB = 0.30, were assumed as limiting reference points. Whereas Y/R0.1 and F0.1, should be considered as target reference points.

RPs suggest an overfishing situation for the stock considering F current (1.33 from XSA) is much higher than the limit and target RPs F.

The effect of several bad recruitment years in a row has been evaluated only considering steepness of 0.9 using the transient analysis of SSB. A fishing mortality rate of 0.24 will result in a probability of 10% of the SSB falling below 20% of its unexploited level at least once in 20 years.

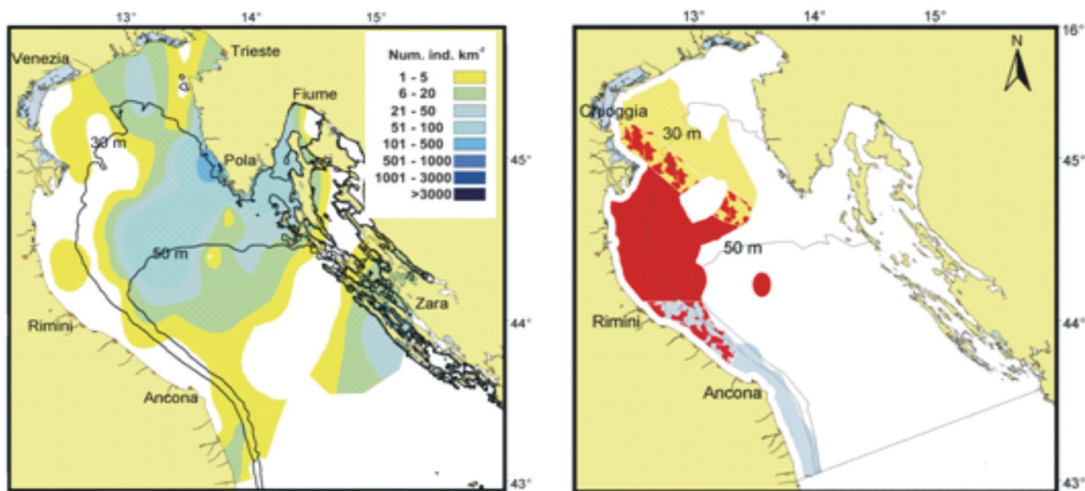


Y/R

Factor	Y/R	B/R	SSB
0.0	0.0	322.4	254.4
0.5	37.9	98.3	56.9
0.7	39.2	67.6	32.1
1.0	37.8	43.2	14.1
2.0	30.7	21.2	2.1

Other assessment methods

Figure 1. Spatial distribution of spawning females in fall (left) and fishing grounds of the Italian rapido trawl fleets (right; in yellow Chioggia rapido trawl fleet; in red Rimini rapido trawl fleet; in light blue Ancona rapido trawl fleet).



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

Assessment form

Sheet D
Diagnosis

Code: SOL1710G.

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B	4038	Ton		=	
SSB	204	Ton		-	
F	1.33		0.26	+	(F0.1 target reference point: 0.26)
Y					
CPUE					

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

Comments**XSA results**

State of exploitation: Exploitation decreased from 2005 to 2006, was constant in 2006-2007 and increased in 2008-2009. The most recent estimate of fishing mortality (F_{0-4}) is 1.33, the highest values of relative F are for ages 1 and 2.

State of the juveniles (recruits): Recruitment varied without any trend in the years 2005-2009, reaching a minimum in 2006.

State of the total biomass and adult biomass: The total biomass regularly decreased from 2005 to 2007 and increased in 2008 reaching the maximum value, but decreased again in 2009. The SSB reached the minimum value in 2005, was constant in 2006 and 2007, increased in 2008 and decreased in 2009.

SURBA

The results of the SURBA model are in general accordance with the previous method providing the same perception of the state of the stock (F 2008: 0.92).

VIT

The VIT model was also applied considering the short data series. A smaller value of current F (0.61) was calculated.

The group underline that the series is really short for assessing with XSA and SURBA. A general agreement was made about using VIT results for the recommendations.

Moreover, the group underlines the need to include in the future assessments biological samples data from the eastern fishery as well as to extend the rapido trawl survey inside the 12 nm from the Croatian coast, as was performed in 2005 and 2006. Such requirements could be attained in the framework of ADRIAMED regional project.

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

Assessment form

Sheet Z

Objectives and recommendations

Code: SOL1710G.

Management advice and recommendations*

Considering the results, it can be concluded that the resource is over-exploited. A reduction of F of 50-80%, especially by rapido trawling, would be recommended, also taking into account that the exploitation is mainly orientated towards juveniles and the success of recruitment seems to be strictly related to environmental conditions (Domenichetti et al., 2009). Hence, in the case of both increasing fishing effort and yearly bad recruitment, there could be a high risk of stock depletion.

Advice for scientific research*

A two-months closure for rapido trawling inside 11 km off-shore along the Italian coast, after the biological fishing ban (August), would be advisable to reduce the portion of juvenile specimens in the catches.

For the same reason, specific studies on rapido trawl selectivity are necessary. In fact, it is not sure that the adoption of a larger mesh size would correspond to a decrease of juvenile catches, considering that the mesh opening currently used by the Italian rapido trawlers is larger (48 mm or more) than the legal one. The same uncertainty regards the adoption of a square mesh.

SSB was practically constant over the 5 years, maybe because, as observed during the SoleMon project, in late fall - winter the main spawning area is only partially exploited by Italian fleets (Figure 1). The safeguard of such area (identified by the rapido trawl survey) to prevent a possible future exploitation might be crucial for the sustainability of the Adriatic sole stock.

Moreover, considering the results presented at the GFCM meetings since 2005, it can be concluded that the rapido trawl survey is a very efficient tool for providing useful data for the stock assessment, spatial distribution and biological informations of sole and other benthic species that in the following working group will be analyzed. From this point of view the prosecution of such survey is strongly advisable also with the support of the regional projects (e.g. ADRIAMED).

Abstract for SCSA reporting

Authors G. Scarcella*, O. Giovanardi**, N. Vrgoc***, B. Marceta****, G. Fabi*, F. Grati*, S. Raicevich**, P. Polidori*, F. Domenichetti*, L. Bolognini*, I. Celic**, **Year** 2010

Species Scientific name Solea vulgaris - SOL
Source: GFCM Priority Species

Source: -

Source: -

Geographical Sub-Area 17 - Northern Adriatic

Fisheries (brief description of the fishery)*

Sole (*Solea solea*) is one of most important target species of rapido trawl and set net fleets in GSA 17. The stock is shared between the Adriatic countries (Italy, Croatia and Slovenia). The Italian fleets exploit this resource with rapido trawl and set nets (gill nets and trammel nets), while only trammel net is used in the countries of the eastern coast. More than 90% of catches come from the Italian side.

Landings fluctuated between 1,000 and 2,300 t in the period 1996-2006 (data source: FAO-FishStat, IREPA-SISTAN time series, ISMEA).

Source of management advice*

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

The assessment of sole stock was performed for the period 2005-2009 by means of XSA tuned with abundance indexes from SoleMon trawl surveys and SURBA model carried out with the same data set. Considering the short data series also a VIT model was run for the catch period 2007-2009.

Underestimation of small specimens in catches due to the gear selectivity was corrected using the selectivity parameters given by Ferretti and Frogliá (1975). Several projects carried out in of GSA17 highlighted that the discard of sole both by rapido trawl and set net fisheries is negligible as the damaged specimens are also commercialized. At the moment data on sole are not available from the croatian side of Adriatic sea considering in the statistics sole is inside "mixed flatfish" category. A landing of 200 tons yearly of Solea solea has been suggested for croatian part, mainly from set-netters, from 2005 to 2008. Instead 150 tons have been reported in the report of the 12th session of the Scientific Advisory Committee (GFCM: XXXIV/2010/Inf.9).

Also landings from Slovenia are considered in the data.

Assuming a natural mortality vector (Ma) from Caddy's method (1991) (PROBIOM Excel spreadsheet; Caddy and Abella, 1999) and abundance-at-age (start year) from survey data. Yield-per-recruit (Y/R) analysis (Yield version 1.0, MRAG: Branch et al., 2000) was applied to estimate the reference points.

Stock Status*

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Exploitation rate

High fishing mortality

Stock abundance

Intermediate abundance

Comments

XSA results
State of exploitation: Exploitation decreased from 2005 to 2006, was constant in 2006-2007 and increased in 2008-2009. The most recent estimate of fishing mortality (F0-4) is 1.33, the highest values of relative F are for ages 1 and 2.
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