SAC GFCM
Sub-Committee on Stock Assessment

| Date* | 25 | October | 2011 | | Code* | | SOL1711G. |

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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

Code: SOL1711G.

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Species Scientific name*	Solea vulgaris - SOL	Species common name*	Common sole

Data Source

GSA*	17 - Northern Adriatic	Period of time*	2005-2010

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	4	---	4	1	4	1	3	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).
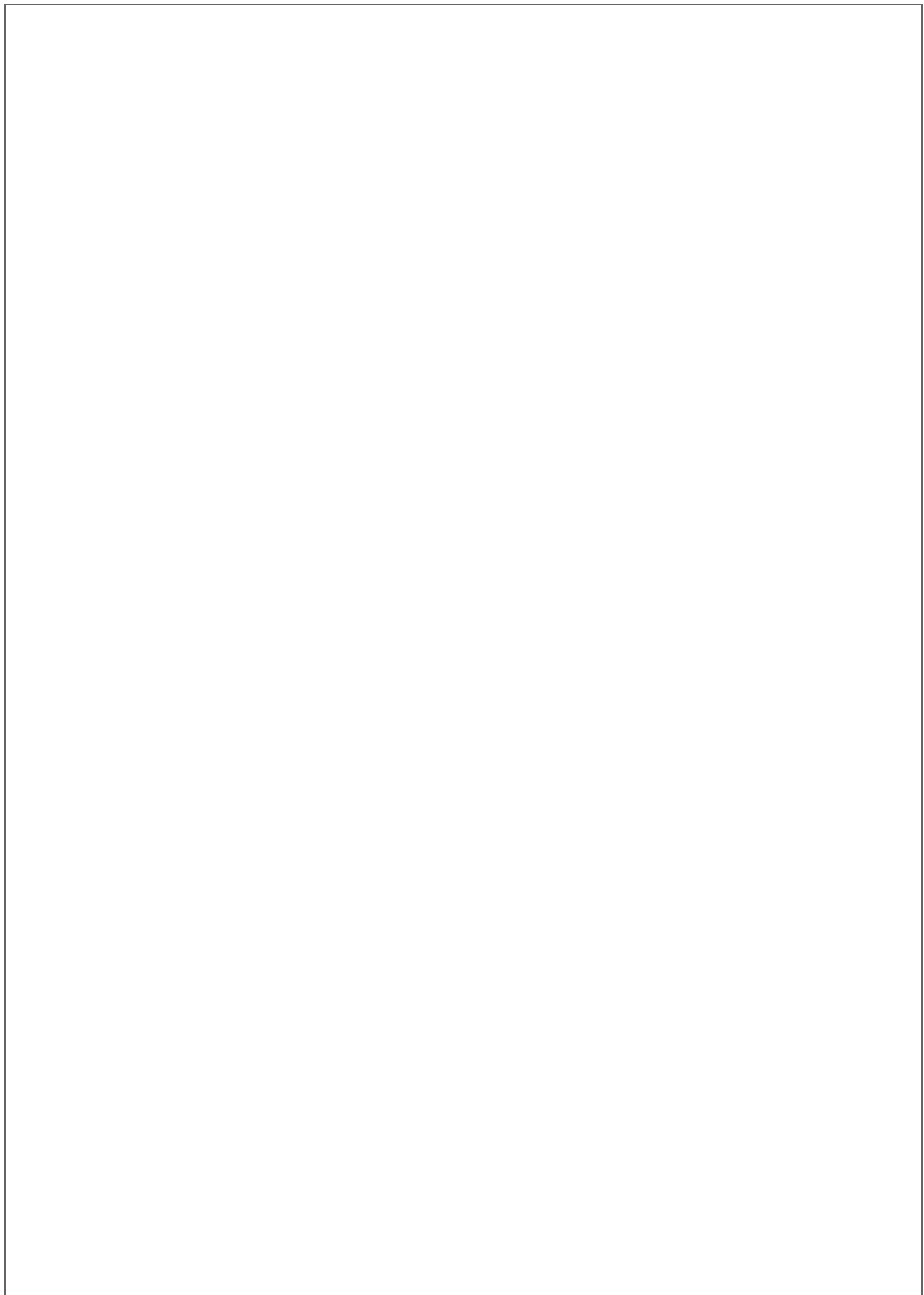
Needle C.L. 2005. SURBA 3.0: Technical Manual (first draft) FRS Marine Laborary; 10 pp.

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., Aukland 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 Assessemnt. Choice, Dynamics, and Uncertainity. Chapman and Hall Eds. New York, USA. 570.

Pilling G. M., Kell L. T., Hutton T., Bromley P. J., Tidd A. N., Bolle L. J. 2008. Can economic and biological

Comments, bibliography, etc.

Code: SOL1711G.

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

Comments

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Code: SOL1711G.

Data source*	CNR ISMAR Ancona; ICRAM Chioggia; IOF Split; FRIS Ljubljana	Year (s)*	2005-2009

Data aggregation (by year, average figures between years, etc.)*	by year

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, Squi		equivalvis, Anad	essel x Da
ITA 17 C 07 33 - SOL	469	Tons	Solea solea	elidonichthys 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

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 skids 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".
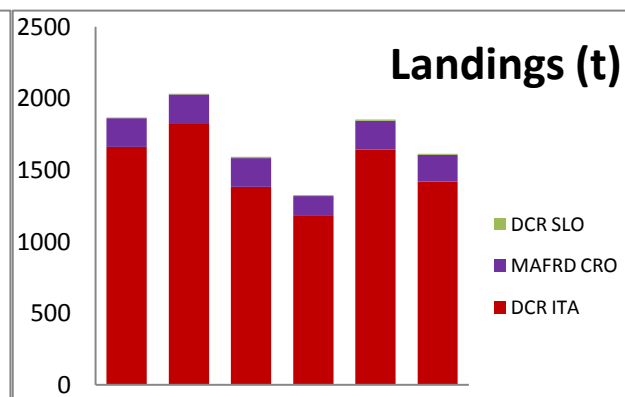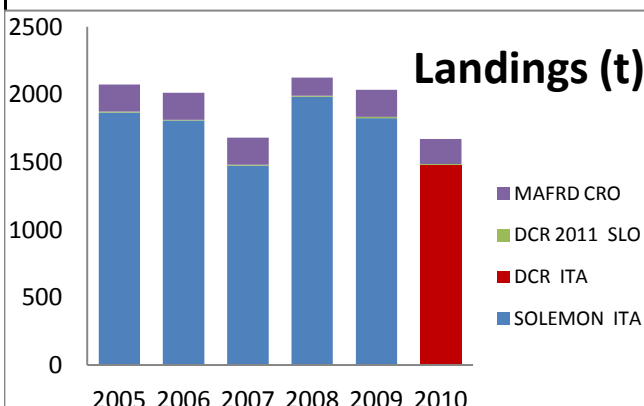
Comments
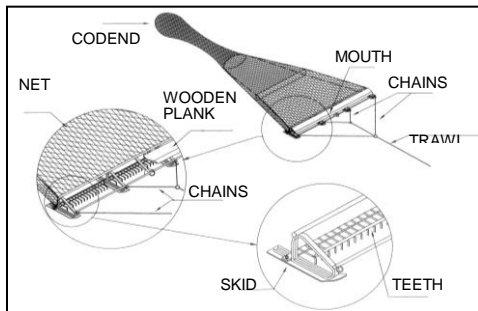
Scheme of rapido trawl used in GSA 17

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 2008, 133 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 2010 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.

In the period 2005-2009 common sole landings estimated in the framework of SoleMon project for Italy were quite similar to the official statistic submitted in the data call 2011. Sole landings in GSA 17 fluctuated between 1,300 to about 2,000 tons and although the time series is short, the general shape suggests a stable trend . The eastern part of the basin contributes for about the 10% of the total landings, with on average 8 tons from Slovenia (2011 official data call) and 200 tons from Croatia (MAFRD CRO ; ie. Ministry of agriculture, fisheries and rural development).
Rapido trawl landings were traditionally dominated by small sized specimens; they are basically composed by 1 and 2 year old individuals. Set net fishery lands mostly the same portion of the population, while the otter trawl fishery, exploiting wider fishing grounds, shows a different size distribution of the landings . In the eastern part of the basin common sole is exploited mainly by set netters (using trammel net), the catch composition, as suggested by preliminary data collection started in 2010 by Croatian colleagues in the framework of Adriamed FAO regional project, is dominated by adult (Primo project - Monitoring of commercial coastal fisheries in the RC - IOF- Split) .

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SCSA Assessment Forms

2005 2006 2007 2008 2009 2010

2005 2006 2007 2008 2009 2010

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

Time series

Year*	2005	2006	2007	2008	2009	2010
Catch	1866	1721	1469	1984	1810	900
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

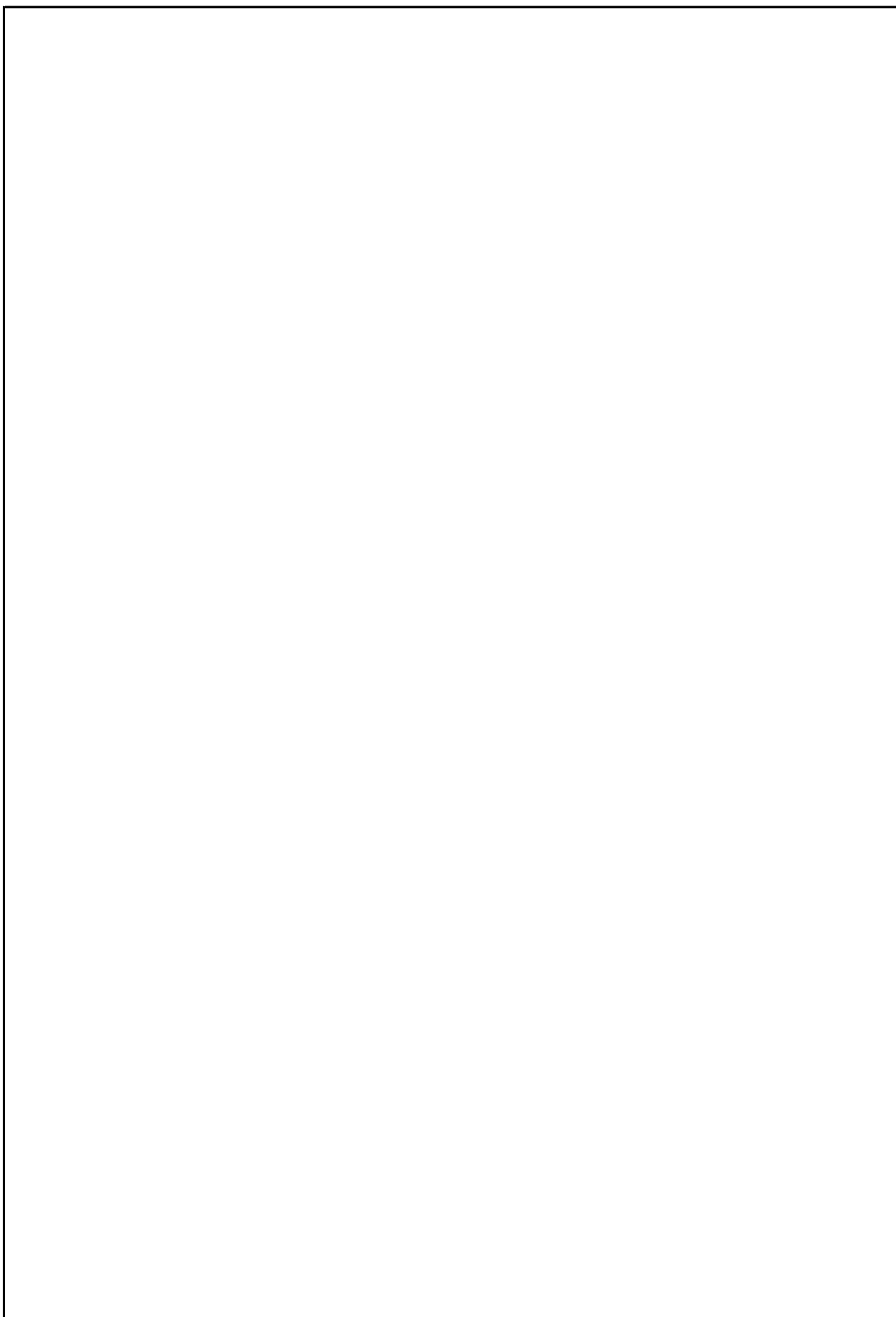|	
L25	12.40
L50	14.55
L75	16.72
Selection factor	3.62
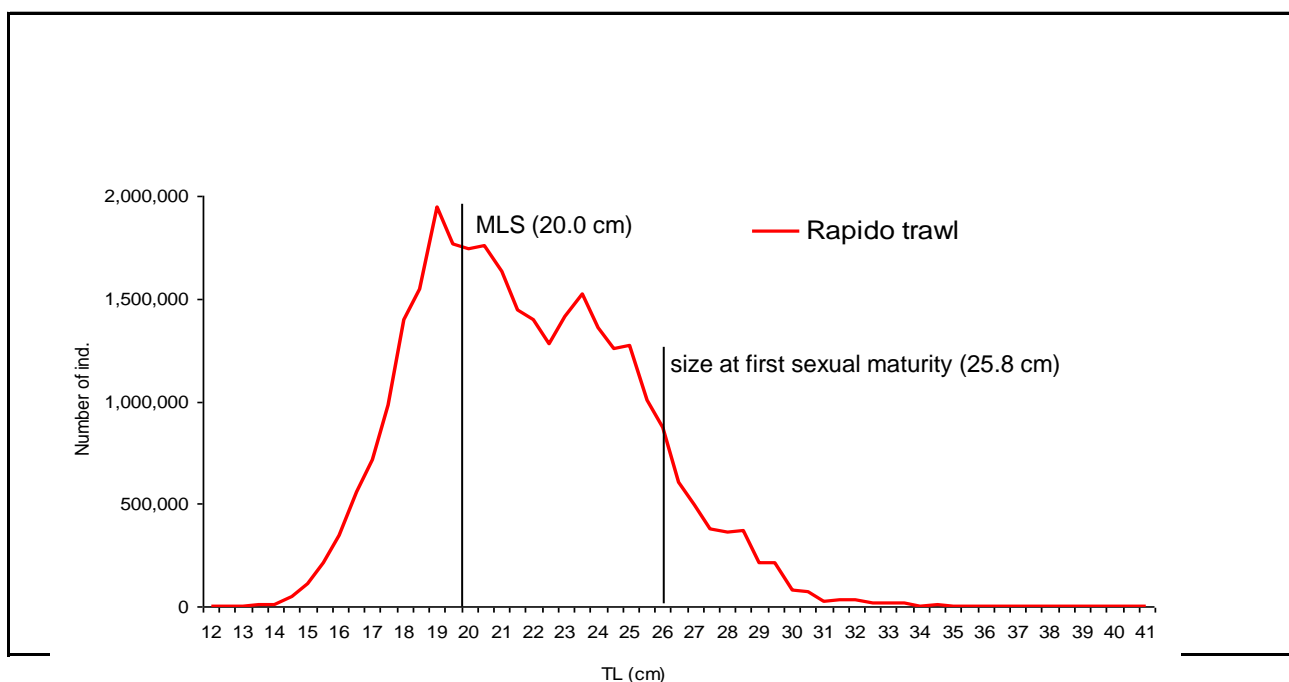
Remarks

They correspond to 40.2 mm diamond mesh in the codend. The parameters have been derived from selectivity parameters given by Ferretti and Froglia (1975)

Structure by size or age

Structure by size or age

Structure by size or age

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

Time series

Year*	2005	2006	2007	2008	2009	2010
Catch	201.5	287	204	200	175	520
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

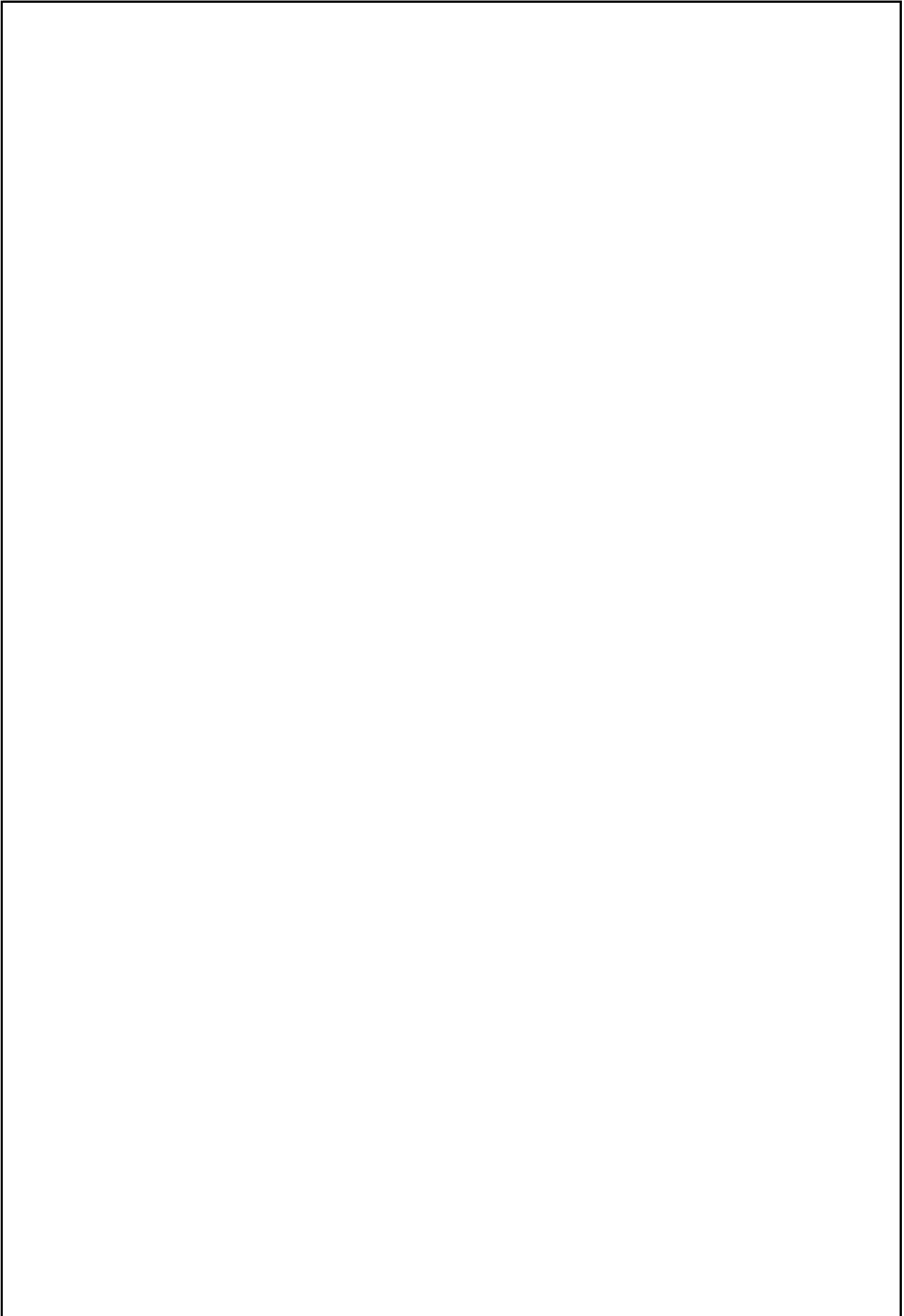| L25	
L50	
L75	
Selection factor	

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

Structure by size or age
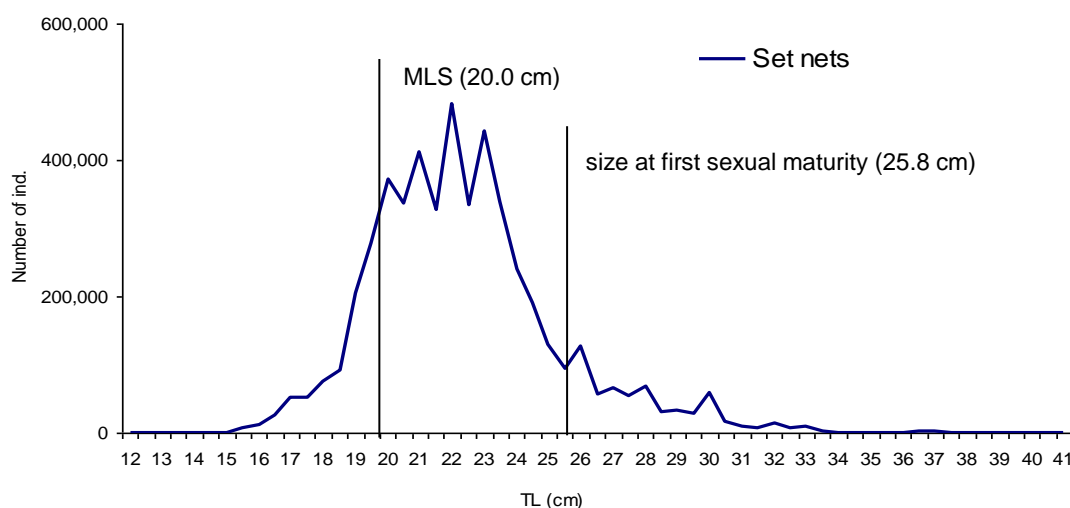
Demography of catches obtained by the Italian set net fleets targeting sole and operating in GSA 17 from San Benedetto del Tronto to Trieste (2005-2006)

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Data source*	MAFRD CRO - IOF SPLIT	OpUnit 3*	HRV 17 C 07 33 - SOL

Time series

Year*	2005	2006	2007	2008	2009	2010
Catch	200	200	200	133	200	185
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
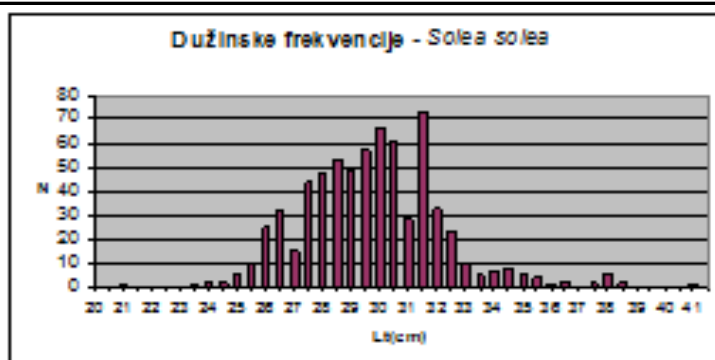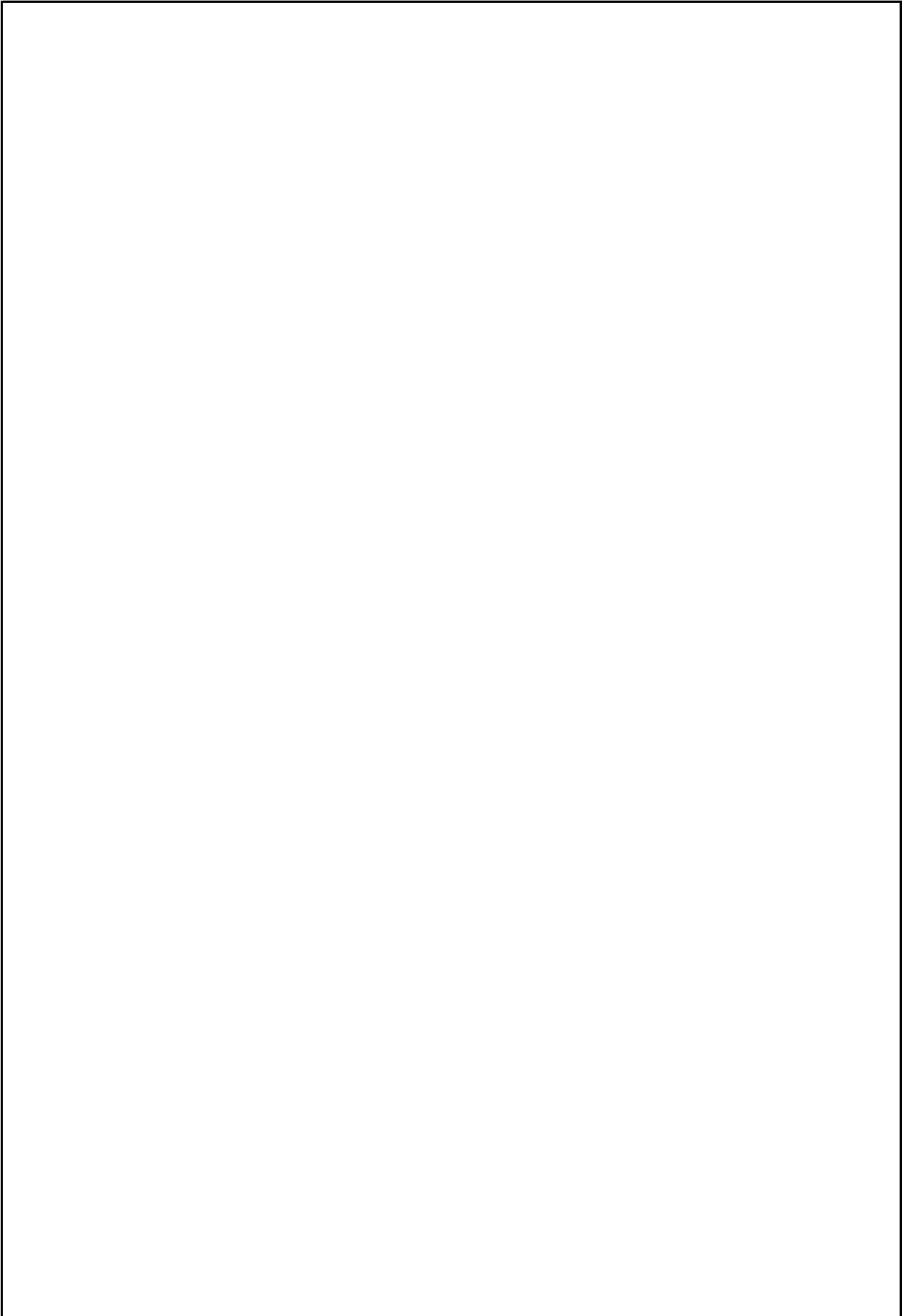
Assessment form

Data source*	SLOVENIAN DCR 2011 - FRIS Lubljana	OpUnit 4*	SVN 17 C 07 33 - SOL

Time series

Year*	2005	2006	2007	2008	2009	2010
Catch	6	5	8	7	10	8
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

SCSA Assessment Forms

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Assessment form

Sheet P2b

Fishery by Operational Unit

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Data source*	CNR ISMAR - ISPRA CHIOGGIA - DCR	OpUnit 1*	ITA 17 E 98 33 - SOL

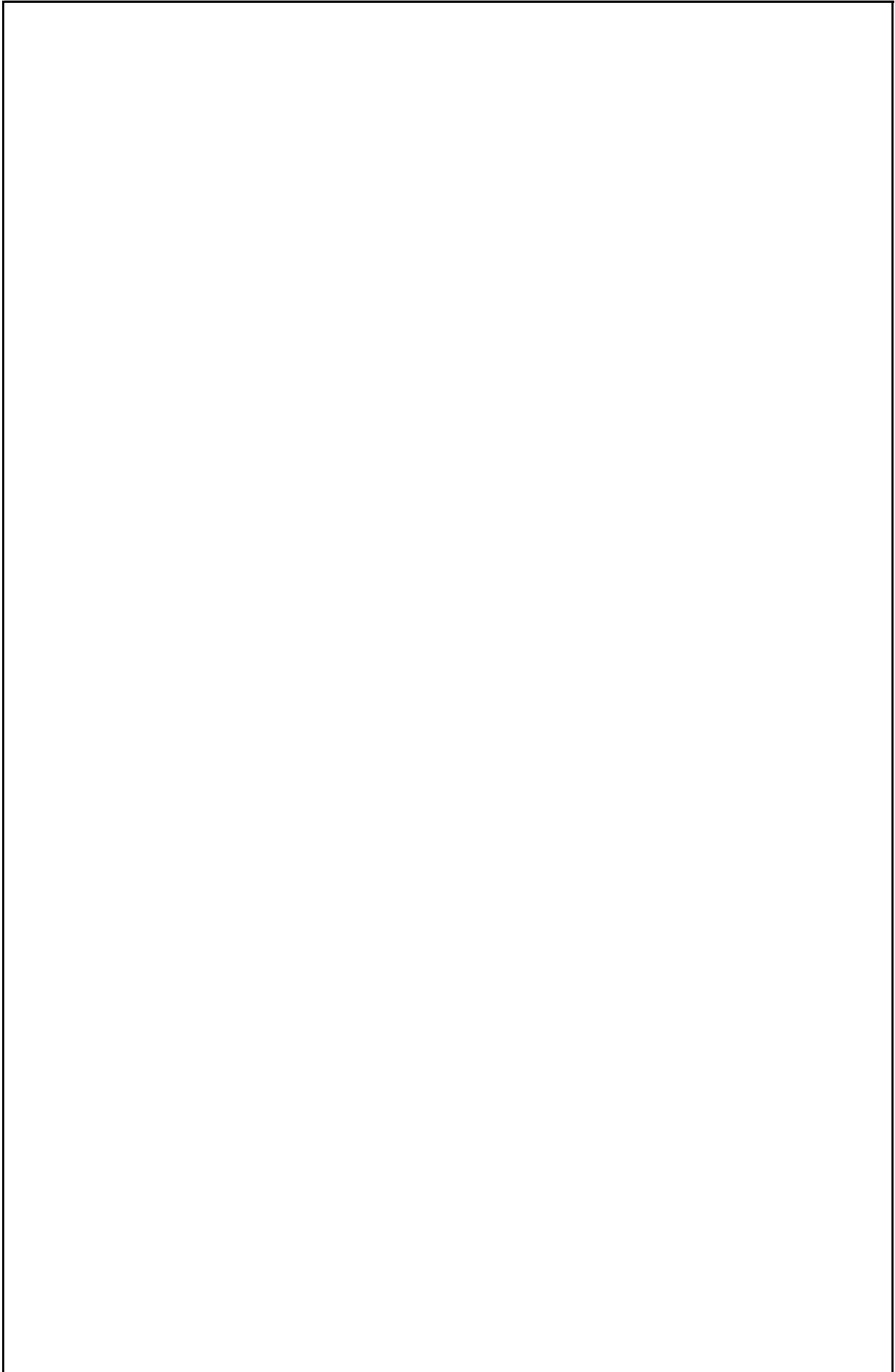### Regulations in force and degree of observance of regulations

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 cathes 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 illegaly in this area.

Accompanying species

Sepia
Squill
Melice
Aequi
Pecten
Trigla

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: SOL1711G.
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Data source*	CNR ISMAR - ISPRA CHIOGGIA - DCR	OpUnit 2*	ITA 17 C 07 33 - SOL

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 cathes 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

Squill
Melice
Trigla

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Assessment form

Sheet P2b
Fishery by Operational Unit

Code: SOL1711G.
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Data source*	CNR ISMAR - ISPRA CHIOGGIA - DCR	OpUnit 3*	HRV 17 C 07 33 - SOL

Regulations in force and degree of observance of regulations

In Croatian fisheries, the common sole is allowed to be caught by the following gears: trammel nets and bottom trawl net. Beam trawl ("rapido"), according to the Fishing acts (Narodne novine, 148/2010, 25/2011), is a gear used to catch shellfish (not for sole as in Italy), and the rate of other species in the catches cannot exceed 20%. Allowed mesh size for rapido is 40 mm (from knots to knots), and it is allowed to use only two rapido per vessel. Each rapido can be up to 4 meters wide. Only small quantities of sole are caught by bottom trawl, and allowed minimum mesh size for bottom trawl nets is 20 mm (from knot to knot).

The species is mainly caught with trammel nets, and minimum mesh size for trammel nets is 40 mm (inner nets) and 150 mm (outer nets). Maximum length of the nets allowed on the vessel is 6.000 m. If on the vessel is only one fisherman present, maximum allowed length is 4.000 m, and for additional one fishermen 1.000 m more is allowed, but total length of the nets on the vessel is 6.000 m. Maximum height of the nets is 4 m. Trammel nets could be used only in the period from 10th September to 15th January, and in the rest of the year are prohibited

Accompanying species

Sepia
Squill
Melice
Aequi
Pecten
Trigla

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Sex*	Both

Time series

Analysis # *	**XSA**

Data	Size	Age		Model	Cohorts	Pseudocohorts
(mark with X)		X		(mark with X)	X	

Equation used	Pope equation		Tunig method	Rapido trawl survey
# of gears	1		Software	Lowestoft package
$F_{terminal}$	0.2			

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum		0	Recruitment	333	
Average			Average population		
Maximum		5+	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear						
F_1	1.34							
F_2								
Z								

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

Comments

For the first XSA run, catch at age data series of the period 2005-2009, utilised in the in the previous assessments (Demersal WG GFCM - FAO 2010), was extended in 2010 with data provided by 2011 DCF official statistics. Italian GNS and OTB catch at age data were missing in DCF 2011 official statistics and have been reconstructed on the basis of the previous year catch composition observed in DCF 2011 official statistics and 2010 landings provided by the same source.
Slovenian catch at age 2010 data were reconstructed on the basis of the official total landings provided by DCR 2011 official statistics and catch at age composition observed for set netters (mainly using trammel nets) collected in the framework of ADRIAMED-FAO regional project in Istria peninsula in 2010.
Croatian catch at age data were reconstructed in 2010 on the base of the total landing suggested by Ministry of agriculture, fisheries and rural developmentin (185 tons) and catch at age data composition observed for set netters (mainly using trammel nets) collected in the framework of Primo project (Monitoring of commercial coastal fisheries in the RC; IOF- Split).

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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	Pope equation	Tunig method	Rapido trawl survey
# of gears	1	Software	Lowestoft package
$F_{terminal}$	0.2		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum		0	Recruitment	333	
Average			Average population		
Maximum		5+	Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F_1	1.2						
F_2							
Z							

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

Comments

In the second XSA run, catch at age matrix of the period 2006-2010 were provided by 2011 DCF official statistics. In the case of lacking of data from GNS and OTB a reconstruction of catch at age data has been done as explained for the first run. Similarly Slovenian and Croatian data were the same of the previous XSA run. Maturity at age, Weight-Length relationships, growth parameters were provided in the framework of SoleMon project.
Tuning data were provided by SoleMon surveys, carried out in fall for the years 2005-2010.
A vector of natural mortality rate at age was estimated using the PRODBIOM spreadsheet (Abella et al., 1997).

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Sex*	Both

Time series

Analysis # *	**SURBA**

Data	Size	Age
(mark with X)		x

Model	Cohorts	Pseudocohorts
(mark with X)	x	

Equation used	LCA	Tunig method	
# of gears	2010 DCF catches	Software	SURBA
$F_{terminal}$	0.1		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	17		Recruitment		
Average			Average population		
Maximum	39		Virgin population		
Critical			Turnover		

Average mortality

	Total	Gear					
F_1	1.15						
F_2							
Z							

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

Comments

The availability of a time series of data from SoleMon surveys allows the use of the SURBA assessment tool. Using the software, the evolution of fishing mortality rates of sole in the GSA 17 was reconstruct starting from the analysis of the length frequency distribution (LFD).

The main input parameters to run the SURBA-survey based stock analysis are abundances, natural mortality rates and catchability. The parameters used in this analysis were the same used in the XSA analysis.

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Sex*	Both

Analysis # *	**LCA**

Time series

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	LCA	Tunig method	
# of gears	4	Software	VIT Software
$F_{terminal}$	0.2		

Population results (please state units)

	Sizes	Ages		Amount	Biomass
Minimum	17		Recruitment	280992.01	
Average	22.5		Average population		#####
Maximum	39		Virgin population		
Critical	19		Turnover	199.56	

Average mortality

	Total	Gear					
F_1	0.877						
F_2							
Z							

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

Comments

	Total	Rapido	GNS IT	OTB IT	GTR CRO
Catch mean age	1.479	1.422	1.516	2.088	2.843
Catch mean length	22.492	22.024	22.937	26.234	29.898
Mean F	0.877	0.463	0.127	0.227	0.06
Global F	1.261	0.776	0.443	0.039	0.003
Total catch	501018	292296	181487	24693	2541
Catch/D%	79.27	46.25	28.72	3.91	0.4
Catch/B%	158.2	92.3	57.31	7.8	0.8

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Sex*	Both	Gear*	All		Analysis # *	**XSA, SURBA and VIT**

Data source	Catch at age from commercial landing (matrix Ca,y (N. ind.)) and CPUE from survey data at start of the ye

Data
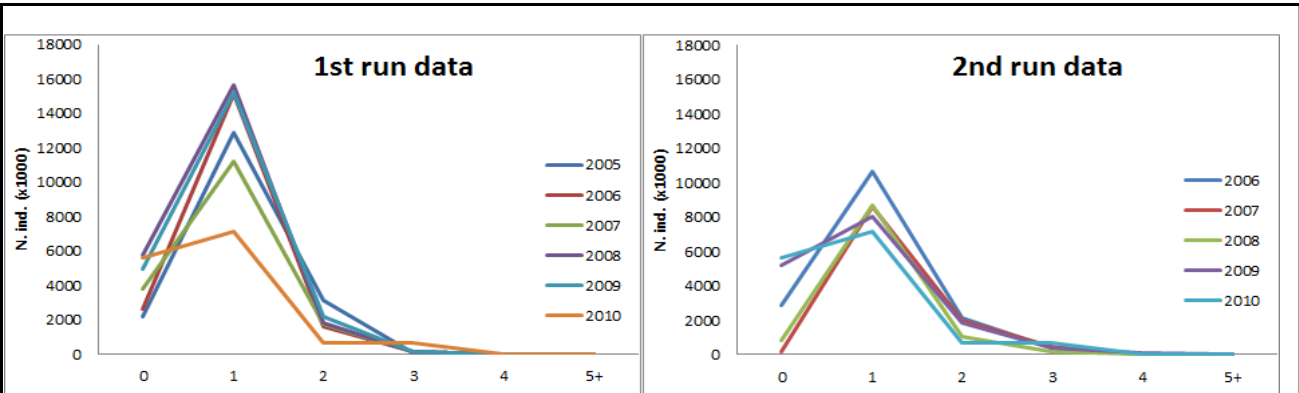
Survey indices

N/km^2

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
162	82	39	12	3	2.2	0.36
91	174	49	9	2	1.2	0.3
192	146	74	18	1	0.6	0.2
128	114	58	11	5	0.6	0.1
177	83	47	6	1	0.2	0.1
55	200	23	5	0.2	1.3	0.1

	0	1	2	3	4	5+
Catch weight	0.024	0.104	0.207	0.304	0.380	0.522
Stock weight	0.024	0.104	0.207	0.304	0.380	0.522
Maturity ogive	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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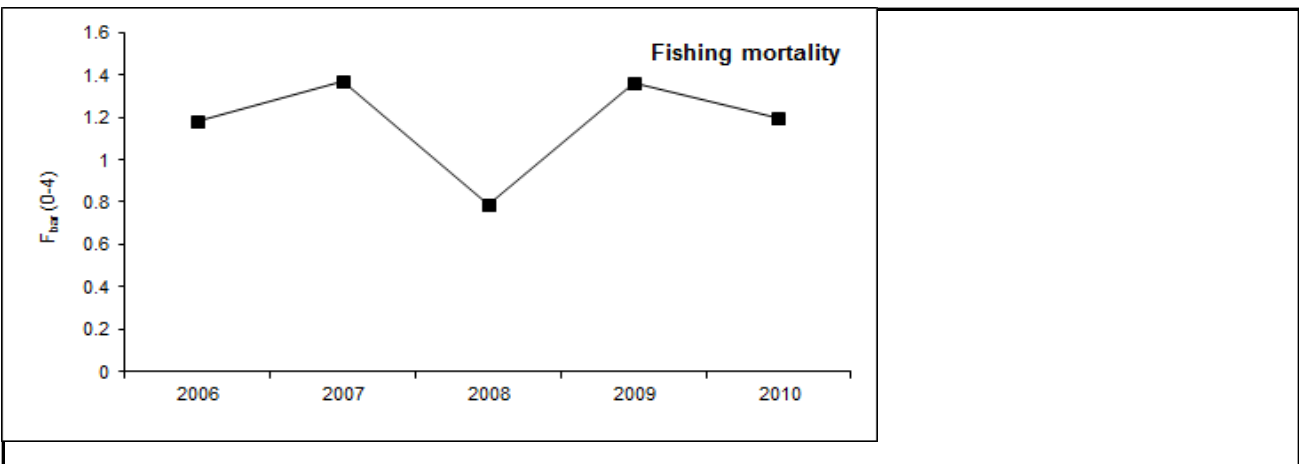| Sex*	Both	Gear*	All		Analysis #*	XSA

Population in figures
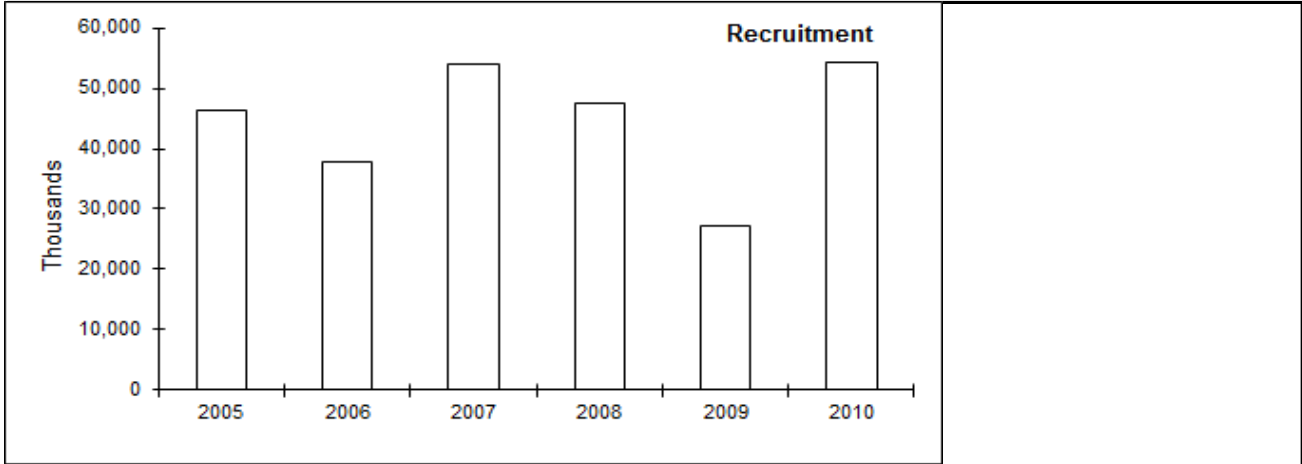
Population in biomass
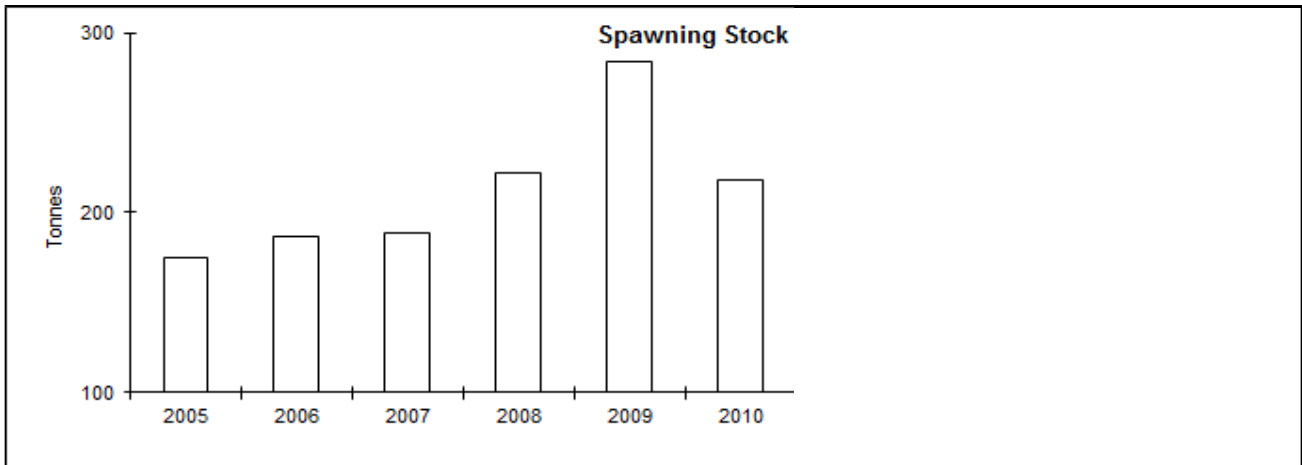
Fishing mortality rates

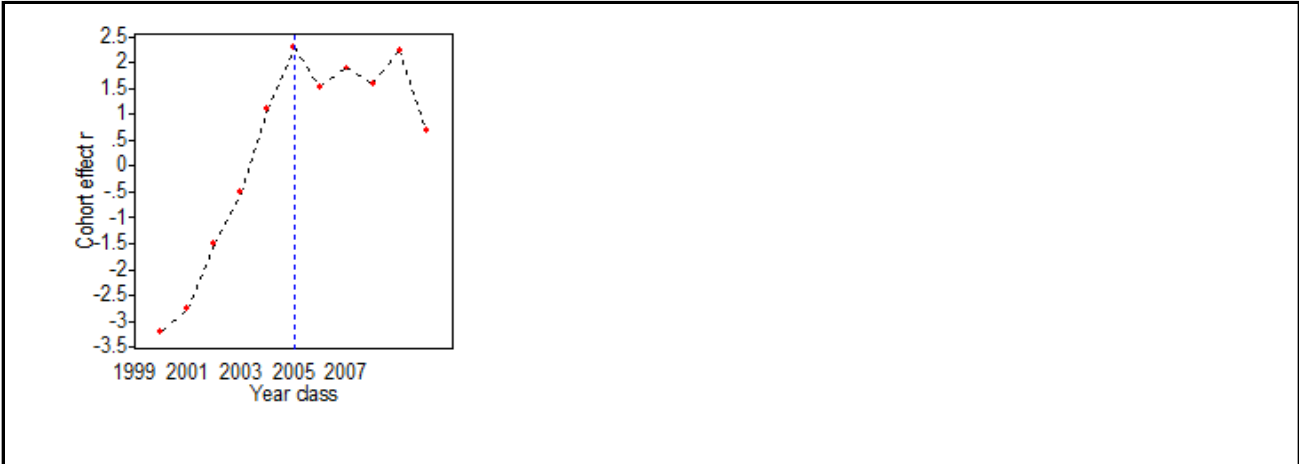## SAC GFCM - Sub-Committee on Stock Assessment (SCSA)

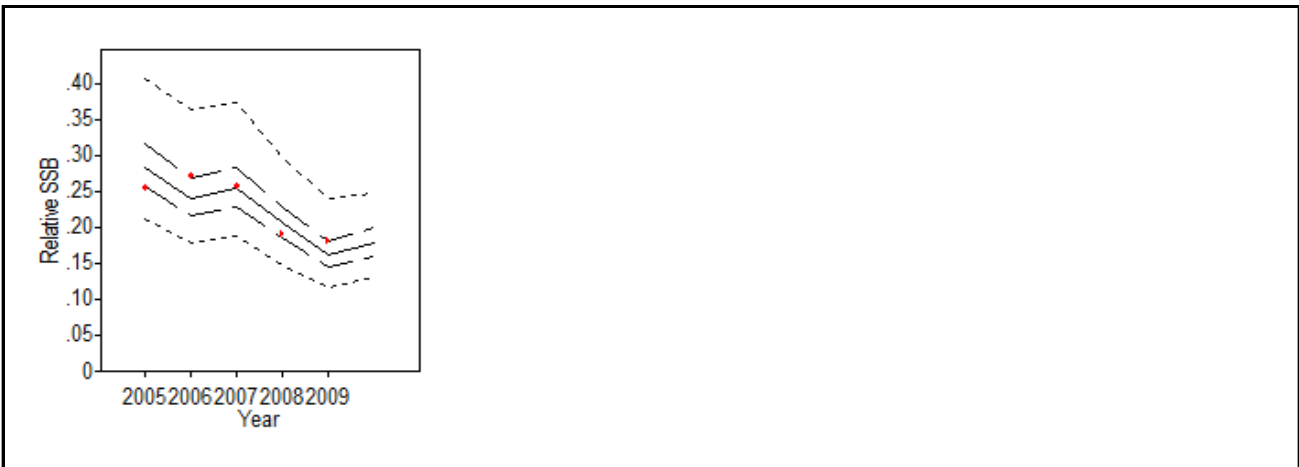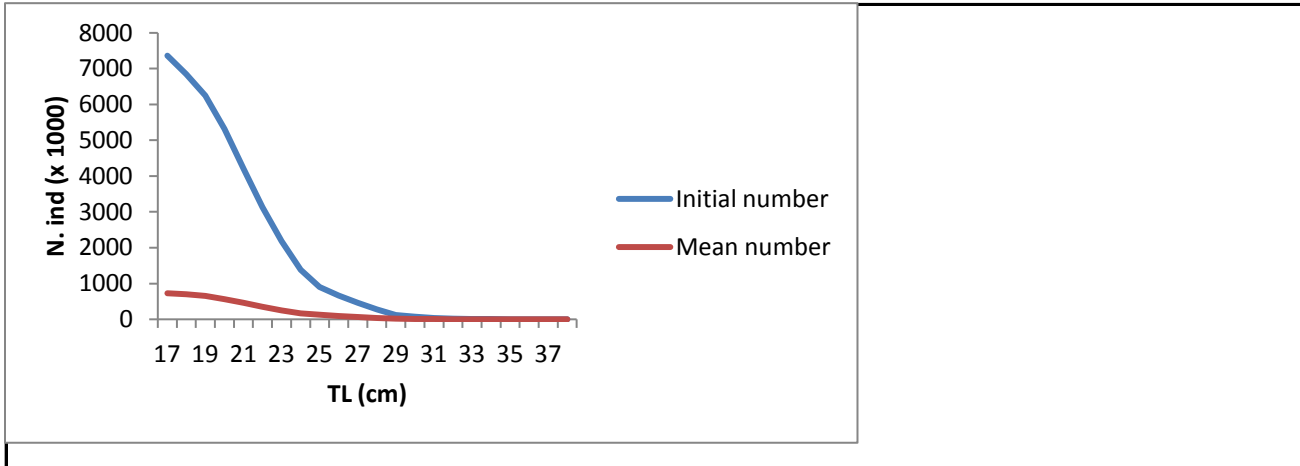**Assessment form**

**Sheet A3**
Indirect methods: VPA results

Code: SOL1711G.

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Sex*	Both	Gear*	All		Analysis #*	**SURBA**

Population in figures

Population in biomass

Fishing mortality rates

Code: SOL1711G.

Sex*	Both	Gear*	all		Analysis #*	SURBA

Population in figures

Population in biomass

Fishing mortality rates

Code: SOL1711G.

Sex*	Both	Gear*	4		Analysis #*	**VIT - LCA**

Population in figures

Population in biomass
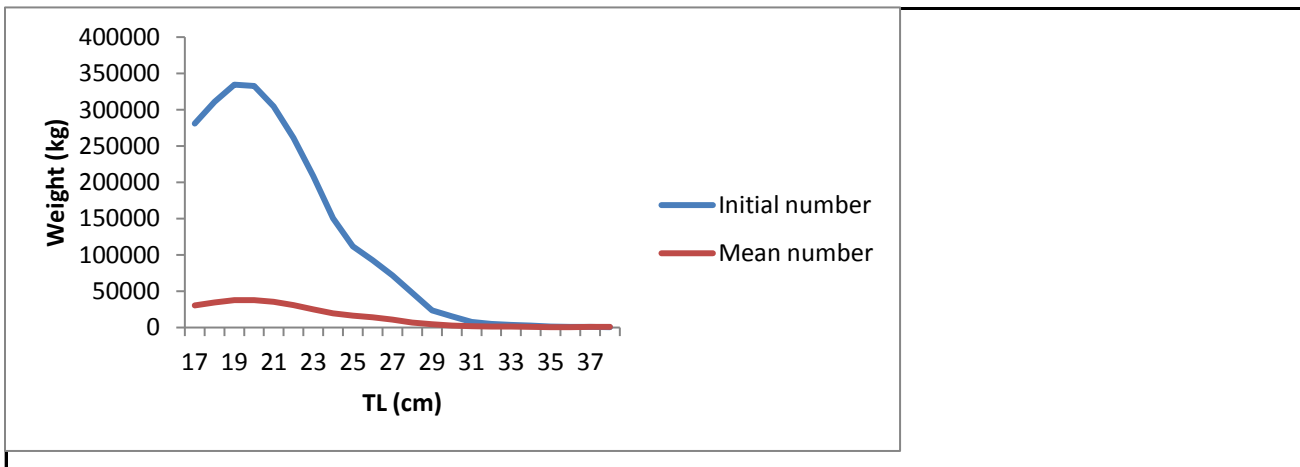
Fishing mortality rates
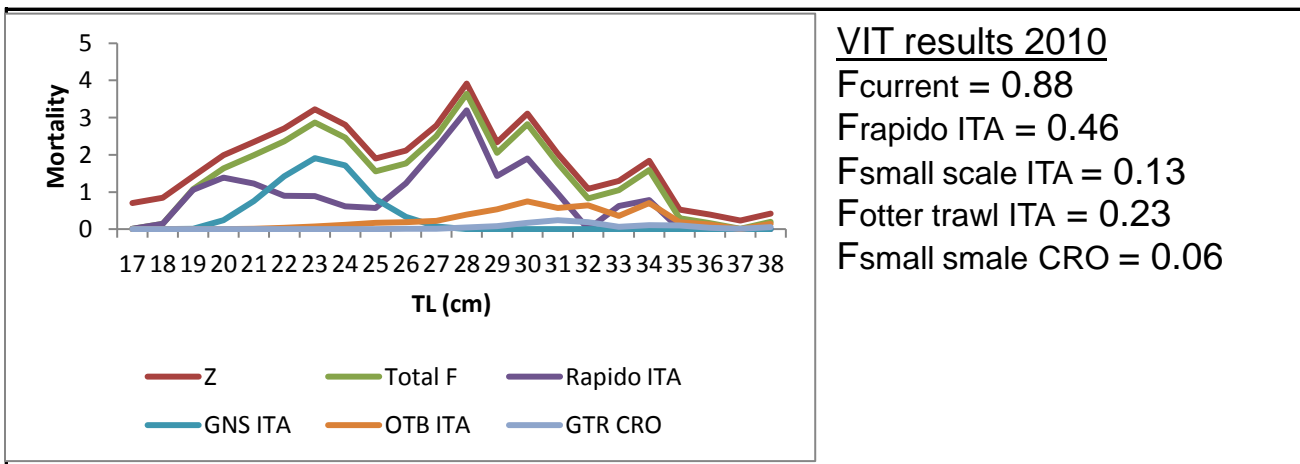
VIT results 2010
Fcurrent = 0.88
Frapido ITA = 0.46
Fsmall scale ITA = 0.13
Fotter trawl ITA = 0.23
Fsmall smale CRO = 0.06

Code: SOL1711G.

Sex	Both

Analysis #	**Y/R**

# of gears	All	Software	Yield 1.0 - VIT

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 *et al.* 2008) Age maturity:

Model characteristics

VIT   RESULTS

Results

	Total	Gear			
		Rapido ITA	GNS ITA	OTB ITA	GTR CRO
Current YR	68.059	39.706	24.653	3.354	0.345
Maximum Y/R	76.518	44.428	19.458	10.497	2.135
Y/R 0.1	67.719	38.44	12.479	13.592	3.208
F_{max}	0.38				
$F_{0.1}$	0.24				
Current B/R	43.02				
Maximum B/R	117.52				
B/R 0.1	255.384				

Comments

	YR VIT	YR YIELD
F0.1	0.24	0.26
Fmax	0.38	0.46

Yield/Rec from VIT

Comments

based	value	RP	value
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

Results with steepnes of **0.9 YIELD SOFT**
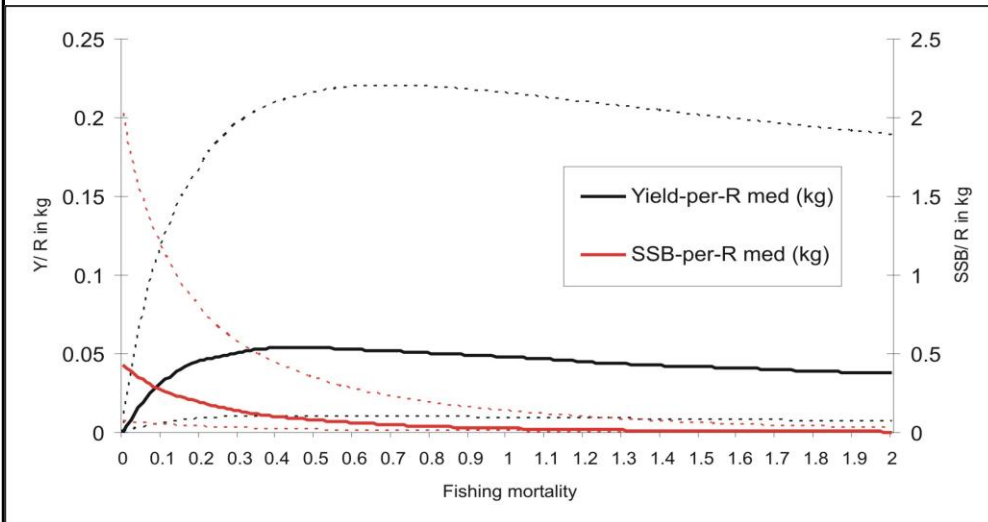
Searching for biological reference points (BRP) through 1000 simulation produced the median values reported in tables considering two different values of steepness. Y/Rmax, Fmax and Y/Rref, Fref, the two latter corresponding to Y/R and F at SSB/initial SSB = 0.30, were assumed as limiting reference points. 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 (1.35 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.

Other assessment methods

Example of abundance indices (ind.· km-2) for sole from SoleMon survey carried out in GSA 17 (fall 2007) interpolated using Kriging (Fabi et al., 2009). It is clear how the rapido trawl catches after the fishing ban (summer) inside the 6 nm of the italian cost are dominated by juveniles.

Figure
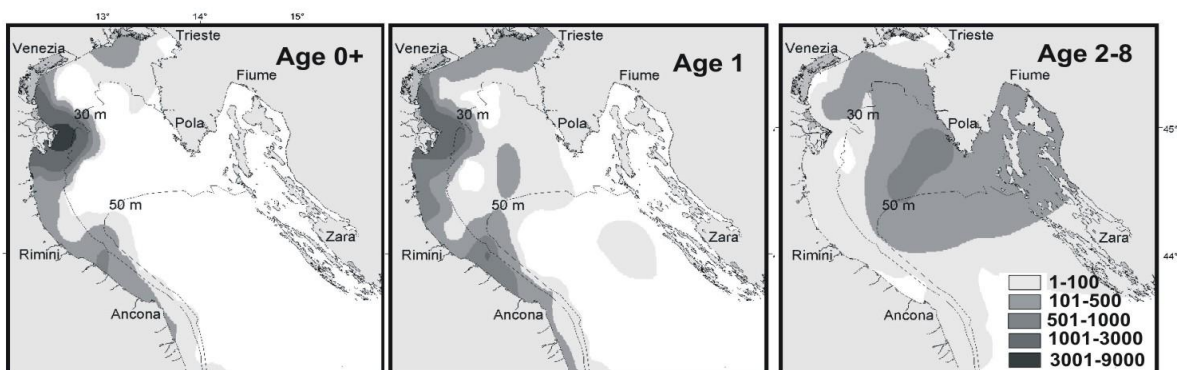
Other assessment methods

Radipo trawl survey (SoleMon survey) in the Northern Adriatic Sea (GSA 17)
SoleMon project started in 2005, financed by the Italian Ministry of Agriculture (MIPAF).
Successively it was supported by FAO AdriaMed Project aiming to a common management of
the Adriatic fishery resources. It is coordinated by the Institute of Marine Research (ISMAR)
of Ancona, Italy, and involves the Istituto Superiore per la Ricerca e Protezione Ambientale
(ISPRA), Chioggia, Italy, the Institute of Oceanography and Fisheries (IOF) of Split, Crotia,
and the Fisheries Research Institute of Slovenia (FRIS), Ljubljana, Slovenia.
SoleMon project is aimed to assess the state of the stock of sole (Solea solea) and other
commercial benthic species in the central and northern Adriatic Sea (FAO GSA 17) by using
rapido trawl survey (Fig. 1). The gear was appositely planned to be fished on different types of
bottom and consists in a modified beam trawl with a rigid mouth. The frame is rigged with iron
teeth along the lower leading edge. Joined to the iron frame there are 4 skids and a reinforced
rubber diamond-mesh net in the lower part to protect the polyamide net bag tied to the iron
frame (Haul duration: 5 - 30 minutes; Towing speed: 5.5 knots). Rapido trawl surveys can
furnish more realistic data on abundance of flatfish and benthic species in respect to the otter
trawl surveys carried out in the area to assess the demersal stocks. From this point of view, the
survey can be considered as an additional tool for the assessment of the Adriatic resources.
Eight beam trawl fishing surveys were carried out: two systematic "pre-surveys" (spring and
fall 2005) and six random surveys (spring and fall 2006, and fall 2007-2010) stratified on the
basis of depth (0-30m, 30-50m e >50m). A total of 67 stations are sampled since 2007 with the
same random stratified strategy excluding the area inside the 12 nm of Croatian waters, due to
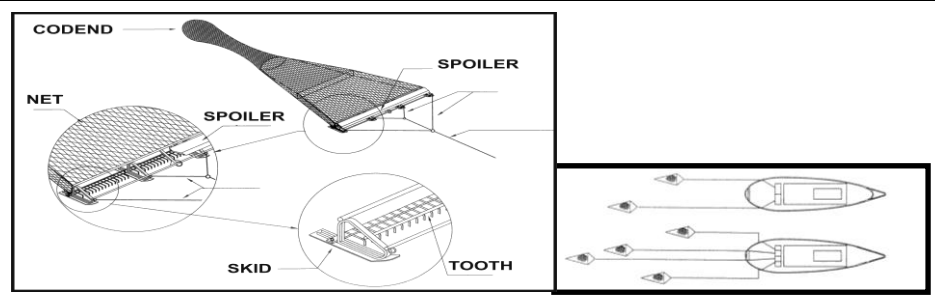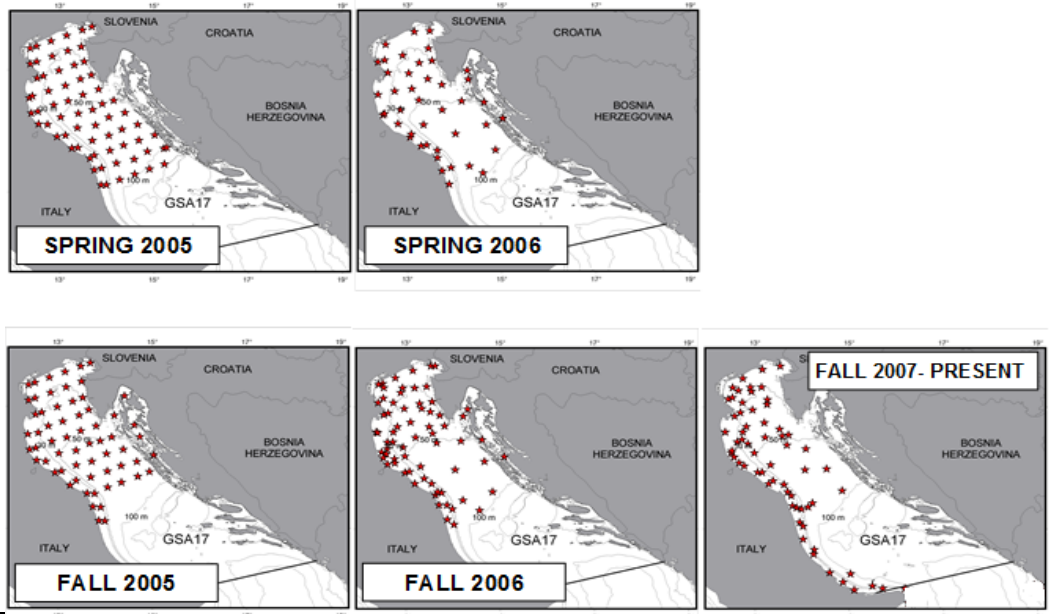

Fig 1

Fig 2

Other assessment methods

The SoleMon trawl surveys provided data either on sole total abundance and biomass as well as on important biological events (recruitment, spawning).

Figure 1 shows the abundance and biomass indices of sole obtained from 2005 to 2008; slightly increasing trends occurred till fall 2007, followed by a decrease in fall 2008-2009.

The recruitment showed a fluctuating trend with the lowest values in 2006, 2008 and 2010 (Fig. 2). The number and biomass of spawners remained practically constant from 2005 to 2008 and decreased in 2009 and 2010 (Fig. 3).
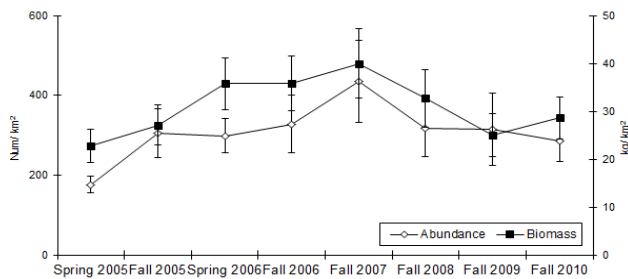
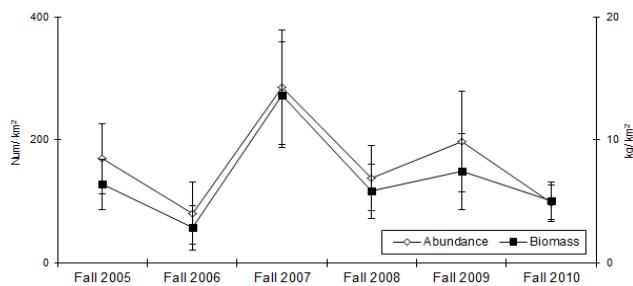

Fig 1   Relative abunda and   biom
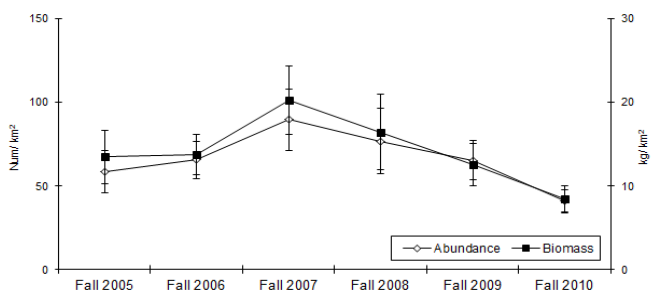
Fig 2   Rel Rec abunda and   biom

Fig 3   Rel   abunda and   biom

Indicators and reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B	3871	Ton		=	
SSB	218	Ton		-	
F	1.34		0.26	+	(F0.1 target reference point: 0.26)
Y	7.6				Yield / SSB
CPUE					

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		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			

Comments

The stock is in growth overfishing. The results of all the approaches (XSA, SURBA, LCA) showed a clear growth overfishing.

XSA based assessments, together with a SURBA and VIT model were carried out during the WG. Two XSA runs were performed: the first using fishery dependent data collected in the framework of the SoleMon project for the period 2005-2009 and DCR data for 2010; the second using fishery dependent data from the 2011 official DCF data call. In both cases the tuning data for the XSA were represented by the CPUE at age matrix provided by the SoleMon survey. The same source of data was used as input in the SURBA and VIT model.

State of the adult abundance and biomass:
A stable trend of SSB with a decrease in 2010 has been observe from each XSA run. A decreasing trend of relative SSB was observed in the SURBA model.

State of the juvenile (recruits):
Recruitment varied without any trend in the years 2005-2010, reaching an higher value in 2010.

State of exploitation:
From the most recent estimate of fishing mortality (varying between 0.9 and 1.34) and with F0.1=0.26 and Fmax =0.46, the stock is considered in overfishing.

The VIT model also evidences that the fishing mortality is mainly due to the rapido trawl fishery. Instead low values of mean F are evidenced for the other operational units.

Code: SOL1711G.

Management advice and recommendations*

Considering the results, it can be concluded that the resource is in overfishing. A reduction of F, especially by rapido trawling, would be recommended, also taking into account that the exploitation is mainly orientated towards juveniles and the success of recruitment sems to be strictly related to environmental conditions. 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 (6 nm) off-shore along the Italian coast, after the biological fishing ban, would be advisable to reduce the portion of juvenile specimens in the catches. In this case is really important to consider the information available from the VMS of the italian rapido trawl fleet. The limit and target BRPs F0.1 and Fmax can be gradually achieved by multiannual management plans focusing especially on the rapido trawl fishing activity.

Moreover, 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.

Fianally, 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 information 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. Scarcella1, O. Giovanardi2, N. Vrgoc3, I. Isajlovic3, B. Marceta4, P. Pengal4, G. Fabi1, F. Grati1, S. Raicevich2, P. Polidori1, F. Domenichetti1,

Year   **2011**

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 1996-2010 (data source: DCF, 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 2005-2010 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 2010 lenght catch data.

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. The eastern part of the basin contributes for about the 10% of the total landings, with on average 8 tons from Slovenia (2011 official data call) and 200 tons from Croatia (MAFRD - Croatia).

Rapido trawl landings were traditionally dominated by small sized specimens: they are basically composed by 1 and 2 year old individuals. Set net fishery lands mostly the same portion of the population, while the otter trawl fishery, exploiting wider fishing grounds, shows a different size distribution of the landings. In the eastern part of the basin common sole is exploited mainly by set netters (using trammel net), the catch composition, as suggested by preliminary data collection started in 2010 by Croatian colleagues is dominated by adults (Primo Project - 2010. Monitoring of Catches Fishery - R.C. - IOF Split)

Stock Status*

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;

Exploitation rate

High fishing mortality

Stock abundance

Intermediate abundance

Comments

The stock is in any case overexploited. The results of all the approaches (XSA, SURBA, VIT) showed a stock growth overexploitation.

Source of management advice (brief description of data and methods used for the assessment) The assessment of sole stock was performed for the period 2005-2010 by means of XSA of the weekly abundance indices for the period 2005-2010 from SoleMon to EXP surveys for 2010. SURBA model was carried out with the same data set. Considering the short data series, the tuning VIT model were also implemented with the different strategic metrics provided by the SoleMon surveys. The same source of data was used as input to the SURBA and VIT model.

State of the adult abundance and biomass part of the basin contributes for about the 10% to for the total landings, with on average 8 tons from Slovenia SAB was observed in the SURBA model.

State of the juvenile abundance population juvenile indexes obtained from the SoleMon 2010 trawling and depleted from the 2010 Rapido trawl fisheries

State of exploitation pattern set net, the catch composition, as suggested common sole and collected by trawl in the eastern Croatian colleagues is exploited.

The VIT model also computes that the fishing mortality is much more to the rapido trawl fishery, which was above all target value estimated for the sustainable exploitation.

Management advice and recommendations*

Advice for scientific research*

A two–months closure for rapido trawling inside 11 km (6 nm) off-shore along the Italian coast, after the biological fishing ban, would be advisable to reduce the portion of juvenile specimens in the catches. In this case is really important to consider the information available from the VMS of the italian rapido trawl fleet. The limit and target BRPs F0.1 and Fmax can be gradually achieved by multiannual management plans focusing especially on the rapido trawl fishing activity.

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