Stock Assessment Form

Spicara smaris

Reference year: 2015

Reporting year: 2016

The last assessment of this species in GSA25 has been performed in 2014, during the GFCM stock assessment demersal species working group with a reference year of 2012 using tuned VPA (Extended Survivor Analysis - XSA) on the cohorts present during 2005-2012. According to this analysis, the stock was in full exploitation. For updating the status of *Spicara smaris* an integrated approach was used under SS3 environment were all available historical data since 1965 have been analysed. Given the results from this analysis, the stock is sustainably exploited (F0.1=0.36; Fcurrent=0.05). The abundance indices are in agreement with the stock assessment results, indicating an increase both in recruitment and in SSB and the subsequent increase in recent catch.

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Ioannis Thasitis version 3.0 (July 2017)*

Stock assessment form

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Spicara smaris	Picarel	[ISCAAP Group]
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
GSA_25	[GSA_2]	[GSA_3]
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
[GSA_4]		
1st Country	**2nd Country**	**3rd Country**
Cyprus	[Country_2]	[Country_3]
4thCountry	**5thCountry**	**6thCountry**
Stock assessment method: (direct, indirect, combined, none)		
Indirect		
Authors:		
Ioannis Thasitis, Charis Charilaou		
Affiliation:		
Department of Fisheries and Marine Research		

The ISSCAAP code is assigned according to the FAO 'International Standard Statistical Classification for Aquatic Animals and Plants' (ISSCAAP) which divides commercial species into 50 groups on the basis of their taxonomic, ecological and economic characteristics. This can be provided by the GFCM secretariat if needed. A list of groups can be found here:

http://www.fao.org/fishery/collection/asfis/en

Indirect method (you can choose more than one):

- ICA
- VPA
- LCA
- AMCI
- XSA
- Biomassmodels
- Lengthbasedmodels
- Other (pleasespecify)

2 Stock identification and biological information

The assessment is considered to cover a complete stock unit though this has not been evidenced by studies on population structure; it is assumed that the stock limits of the assessed *Spicara smaris* are in agreement with the limits of GSA 25.

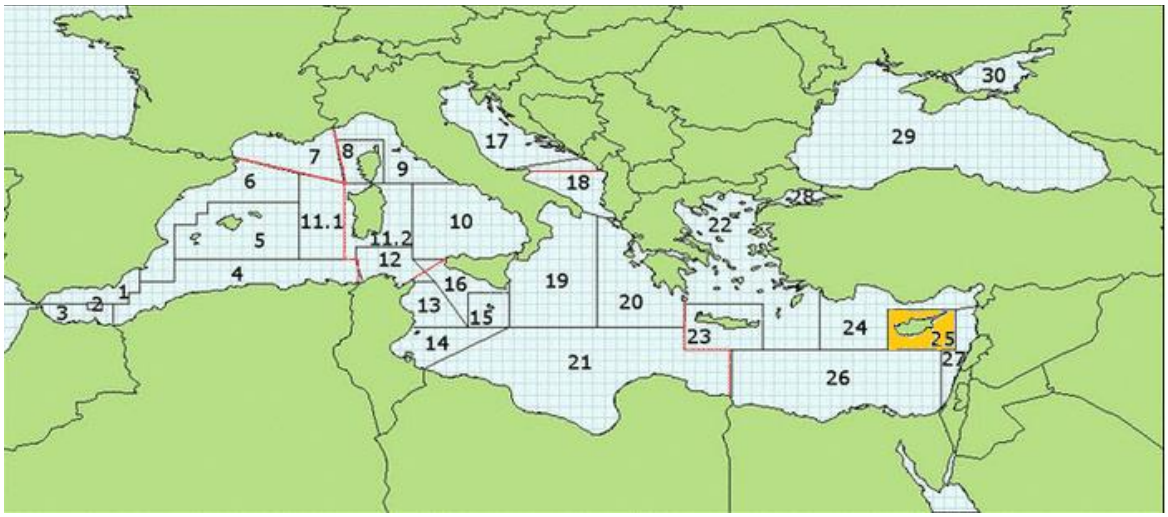


Figure 2.1-1: Geographical location of GSA25.

2.1 Stock unit

2.2 Growth and maturity

The following tables provide growth and maturity information on the stock, based on combined data from commercial catches. All information is based on data collected under the Cyprus National Data Collection Program.

Table 2.2-1: Maximum size, size at first maturity and size at recruitment.

Somatic magnitude measured (LT, LC, etc)			**LT**	**Units**	**cm**
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	February-May
Maximum size observed			20	**Recruitment season**	Autumn
Size at first maturity			9.1	**Spawning area**	Shelf
Recruitment size to the fishery				**Nursery area**	Shelf

Table 2-2.2: M vector and proportion of matures by size or age (sex combined)

Size/Age	Natural mortality (Prodbiom)	Proportion of matures
0	0.55	*0.80*
1	0.44	*0.86*
2	0.38	*0.90*
3	0.36	0.96
4	0.34	0.99
5	0.36	*1.00*
6	0.39	*1.00*

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	**L_∞**	cm			19.62	
	K	years-1			0.27	
	t_0	years			-2.01	
	Data source					
Length weight relationship	**a**				0.007	
	b				3.1	
	M (scalar)					
	sex ratio (% females/total)					

3 Fisheries information

Picarel (*Spicara smaris*) is the most important demersal fish targeted by bottom trawl fisheries in GSA 25, covering ~ 60% of the total catch. Artisanal fishery target the species at particular times of the year when fish aggregate in shallower waters bellow 50m. It is exploited in depths ranging from 5-150 meters and mostly distributed in depths less than 100 m. It inhabits sandy and muddy bottoms. Fishing season has duration of about 7 months starting on 7th of November and ending on 31st of May. Since 2012 the trawlers operating in territorial waters are limited to two. Further information on the restrictions applied on this fleet is provided in Section 3.3.

3.1 Description of the fleet

Table 3-1: Description of operational units exploiting the stock

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	CYP	GSA25	E - Trawl (12-24 metres)	03 - Trawls	33 - Demersal shelf species	*Spicara smaris* (SPC)
Operational Unit 2	CYP	GSA25	C-Polyvalent small-scale vessels with engine (6-12 metres)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	*Spicara smaris* (SPC)
Operational Unit 3	CYP	GSA25	B – Polyvalent small-scale vessels with engine (<6 metres)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	*Spicara smaris* (SPC)
Operational Unit 4	CYP	GSA25	M – Polyvalent vessels (>12 metres)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	*Spicara smaris* (SPC)

Table 3.1-2: Catch, bycatch, discards and effort by operational unit in the reference year

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
Trawlers	2	49 T	*Boops boops* (12t), *Spicara smaris* (49t), *Pagellus erythrinus* (5t), P. acarne (9 t) *Mullus surmuletus* (3t), Serranus cabrilla (4T), *Merluccius merluccius* (0.7t), *Octopus vulgaris* (1T)	0.015 t, (included in Catch)	*Boops boops, Pagellus erythrinus, P. acarne, Spicara smaris, Serranus cabrilla, Merluccius merluccius*	375 (days)
Polyvalent small-scale vessels (6-12 metres)	360	49 T	*Boobs boops* (88T), *Mullus surmuletus* (27 T), *Pagellus erythrinus (5.8T), Sparisoma cretense (22 T), Pagellus acarne* (15.4T), *Siganus rivulatus (13.2T), Spicara maena (49 T), Serranus cabrilla* (67.6 T), *Diplodus sargus* (10.8T), *Spicara smaris (40.3 T), Octopus vulgaris (20 T), Sepia officinalis (13.4T), Loligo vulgaris (3.5T)*	No discards	*Lagocephalus* spp.	20341 (days)
Polyvalent small-scale vessels (0-6m)	33	2.6 T	*Boobs boops* (5.5T), *Mullus surmuletus* (1 T), *Pagellus erythrinus (0.06 T), Siganus rivulatus (1.2T), Sparisoma cretense (2.5 T), Diplodus sargus* (0.8 T), *Spicara smaris (2.6 T), Spicara maena (3 T), Pagellus acarne*	No discards	*Lagocephalus* spp.	1240 (days)

			(0.01T), *Serranus cabrilla* (3.1 T), *Octopus vulgaris (2T), Sepia officinalis (3.4T), Loligo vulgaris (0.2T)*			
Polyvalent vessels (>12 metres)	26	0.6 T	*Boobs boops* (8.1T), *Mullus surmuletus* (0.66 T), *Spicara smaris (0.6 T)*	No discards	*Lagocephalus* spp.	515
Total						

3.2 Historical trends

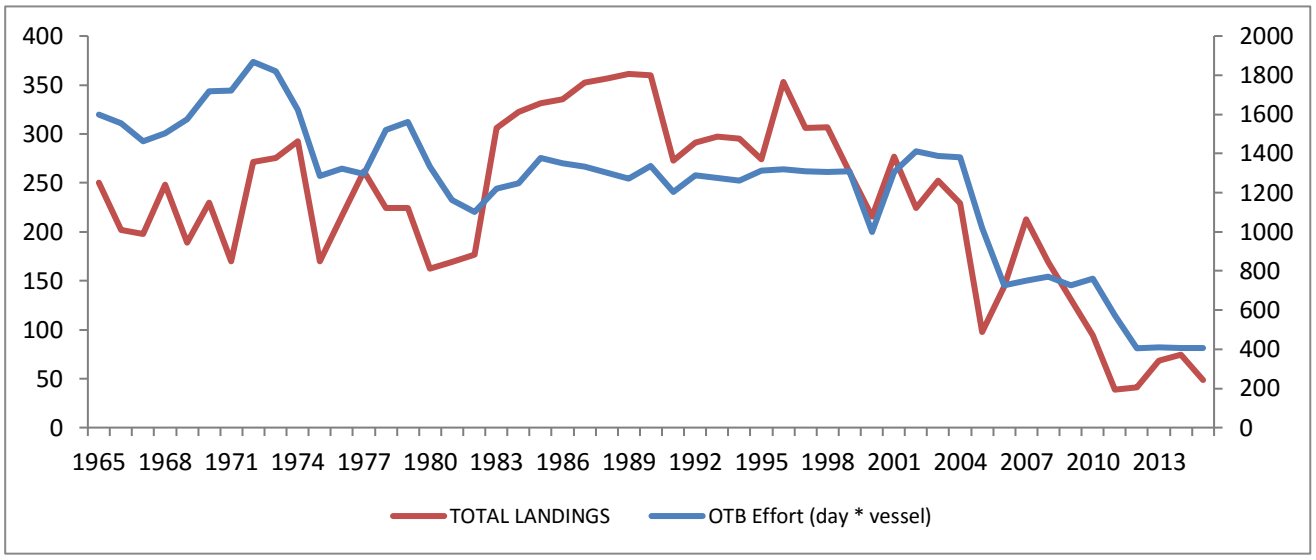


Fig. 1. Landings and effort time series for *S. smaris* in GSA 25 from bottom trawl for the period 1970-2012.

3.3 Management regulations

Current and past management regulations:

1. Polyvalent small-scale vessels (0-6m, 6-12m)

- Restriction of the maximum number of licenses.

  Small scale inshore vessel licenses (Category A&B) are restricted to 500 by legislation; however, the maximum number is further reduced in accordance with the number of vessels that are permanently removed from the fleet through adjustment schemes.

  During 2013, 107 vessels were scrapped with public aid, in accordance with an effort adjustment plan based on Article 21 (a) of Regulation (EC) 1198/2006 on the *European Fisheries Fund* –EFF. In 2014 the maximum number of licenses was reduced accordingly to 393 licenses. During 2015 additional 66 vessels were scrapped with public aid, under the Operational Programme 2014-

2020 of the European Marine and Fisheries Fund. From 2016 the maximum number of licenses has been reduced accordingly to 327 licenses.

- Restrictions on the use of fishing gears depending on the fishing license category.

  Until March 2011 minimum mesh size of nets was set at 32mm (open mesh size). From March 2011 minimum mesh size of nets is set at 38mm (open mesh size).

  Maximum length of nets: For boats with license A is 5000m, for boats with license B is 3000m.

  Maximum height of nets: 4m.

  Restrictions on the time and duration of fishing, depending on mesh sizes.

  Additional restrictions on the use of monofilament nets (mesh sizes, length of nets).

2. Bottom Trawlers in territorial waters

- Restriction of the maximum number of licenses. Before 2006 the maximum number of licenses was restricted to 8, while from 2006 until 2011 the maximum number was reduced to 4. From November 2011 maximum number of licenses is restricted to 2.
- Minimum mesh size: From June 2010 the 40mm diamond shape trawl net has been replaced by a diamond meshed net of 50mm at the cod-end. From November 2011 minimum mesh size of 50mm diamond in any part of the net.
- Depth and distance from the cost restrictions: Prohibition of bottom trawling at depths less than 50m and at distances less than 0.7 nautical miles off the coast.
- Seasonal and Area restrictions:
  - Closed trawling period in territorial waters from 1st of June until the 7th of November (in force since the mid '80s).
  - Prohibition of bottom trawling in the Zygi coastal area, at a distance of 3 nautical miles from the coast.

Restriction of 2 areas from fishing with trawl nets, on a rotational basis (northwest part of Cyprus from 8 November – 15 February, southeastern part from 16 February – 31 May every year). Applied from November 2011. Maximum number of licenses restricted to 4 in 2006 and to 2 since 2011: fully observed.

Closed trawling period from 1st of June until the 7th of November (in force since 1982 implementing a management plan for the protection of the recruits): fully observed.

Minimum mesh size of trawl net at 50mm (diamond shape): fully observed. Since 2004 the 32mm diamond shape trawl net was replaced by the diamond meshed net of 40mm at the cod-end, while in 2010 it was replaced by the diamond meshed net of 50mm.

Prohibition of bottom trawling at depths less than 50m for the protection of nursery grounds.

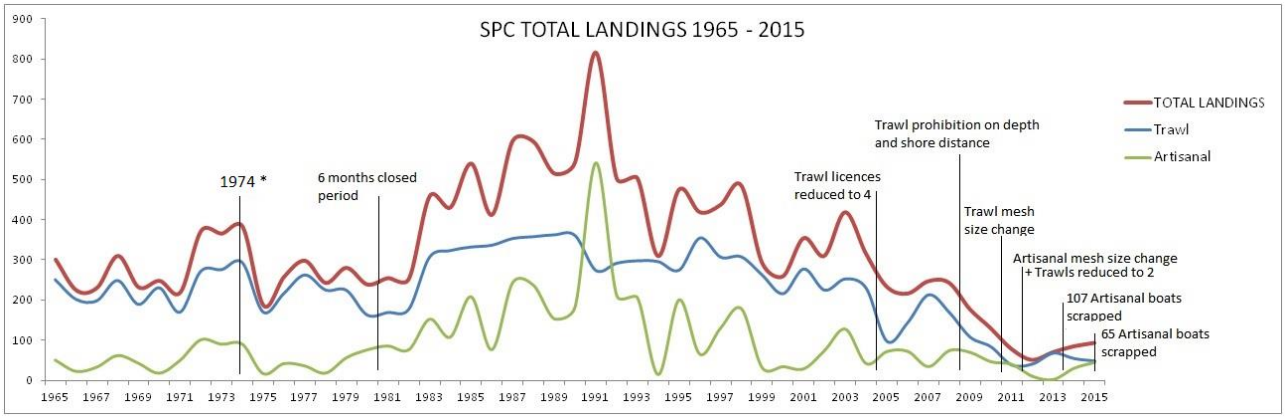


Fig. 2. Landings and effort time series for S. smaris in GSA 25 from bottom trawl for the period 1970-2012. 1974*: Important fishing grounds became inaccessible to Cyprus Republic.

3.4 Reference points

Table 3.4-1: List of reference points and empirical reference values previously agreed (if any)

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F					
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 MEDITS Trawl Survey

The Medits survey is the only fisheries independent analysis performed in GSA25 but as it is carried out during the day, catchability is low due to the daily vertical migration phenomenon of *Spicara smaris* that moves off the bottom.

Due to this commercial Trawl CPUE was used as a relative abundance index to tune the model.

5 Ecological information

5.1 Protected species potentially affected by the fisheries

The protected species that are potentially affected by the fisheries are the two turtle species (*Chelonia mydas*, *Caretta caretta)* encountered in Cyprus waters, and cetaceans (*Tursiops truncatus).* The interaction of the net fisheries with cetaceans involves mostly the damage of fishing gear and depredation by the dolphins.

In general, the catch of protected species (shark species, turtles, monk seal, cetaceans) is prohibited in accordance with international obligations (including relevant GFCM recommendations), and data on incidental catches are collected.

5.2 Environmental indexes

An auxiliary set of external exercises performed using rainfall data for the validation of the model resulted recruitment as well as Landings report.

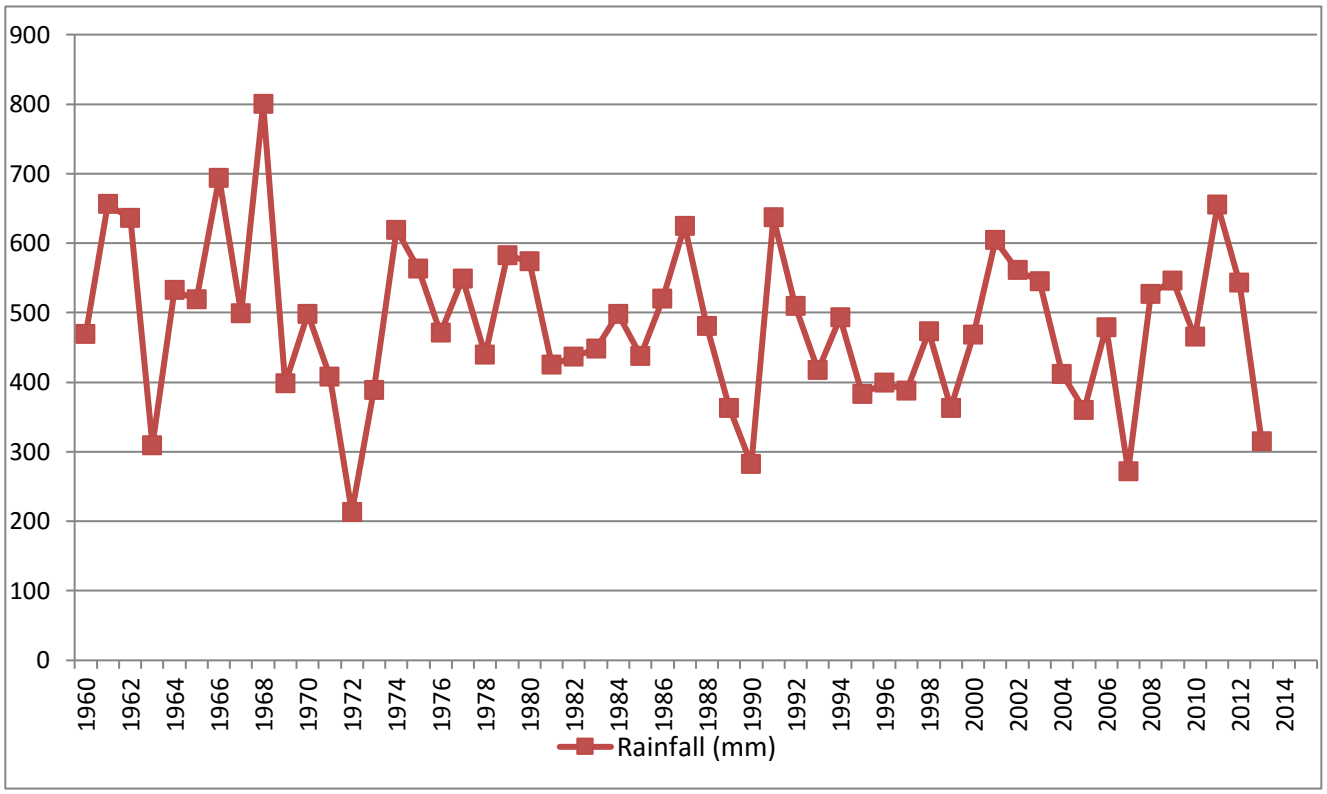


Fig. 3 Rainfall data plot

6 Stock Assessment

6.1 Stock Synthesis v. 3.0 (SS3}

A statistical catch at age SS3 model was constructed in order to incorporate all available information's, as this method can allow data gaps in the time series and evaluate the incorporated uncertainty. An aspect of paramount importance is the potential of the method to move things forward for the assessment of this stock by the impeded hermaphroditism biological function and the fleet specific analysis which are crucial aspects for the sound assessment of Spicara smaris.

The two fleets target different population segments with picks at different seasons and areas. Assigning the effect that each fleet has on the stock in quantitative means as well as risk evaluation of sperm depletion and sex ratio shifts were very important to be measured.

6.1.1 Model assumptions

The settings used in SS3 model:

- 1 area;
- Year time step;
- 4 fleets (Trawlers , Gill and trammel netters, Purse-seine for 2000 to 2005 only, Discard fleet)
- 1 Survey fleet (Trawl CPUE)
- No time-varying parameters (although this would be the next phase development needed in this model)
- Males contribute to SSB due to nest guarding feature.
- 98% of the individuals born as Females (unpublished data evidence the existence of a satelite population of Male born individuals).
- Size based logistic selectivity for Trawl, cubic spline for Discard fleet (to simulate accidental discard of small individuals from trawl and intentional discard of Males with no market value, caught after reproduction) and double normal with defined initial and final selectivity level.
- Age based selectivity with min and max ages.
- No stock-recruitment relationship (annual scalar recruitment).

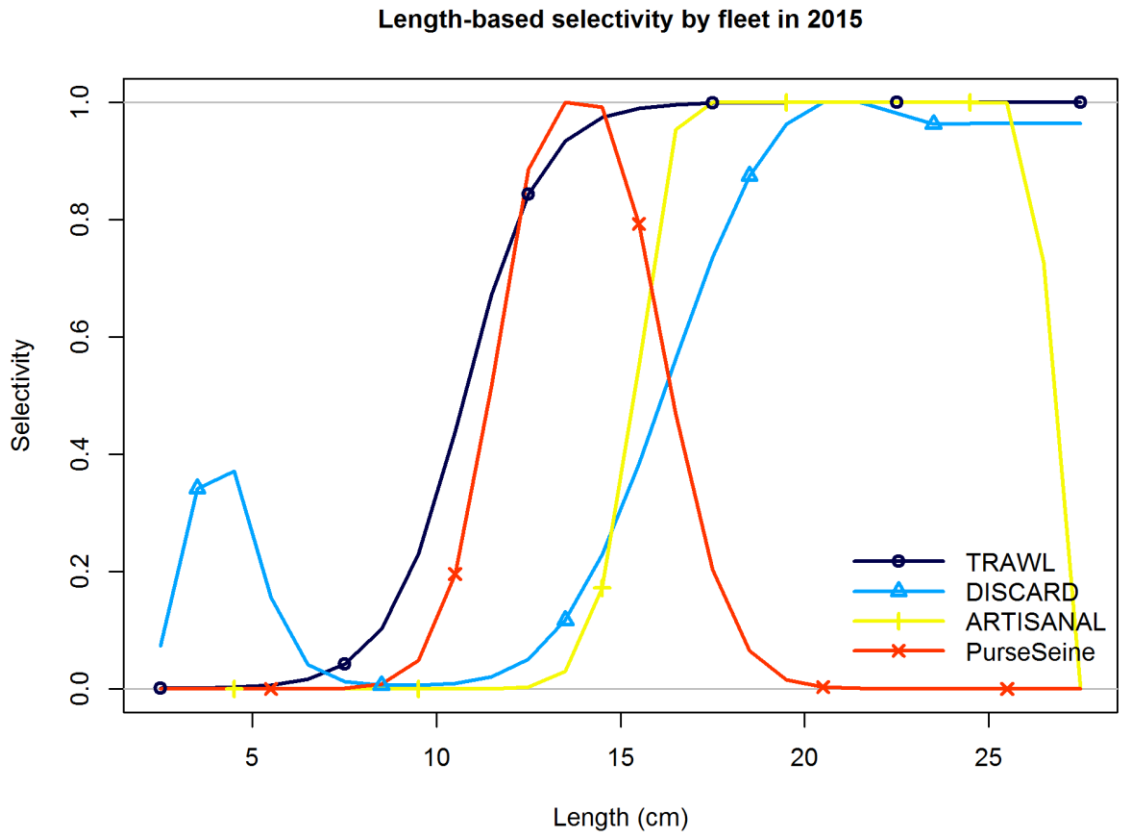


Fig. 4 Length based selectivity estimated by SS3 in 2015.

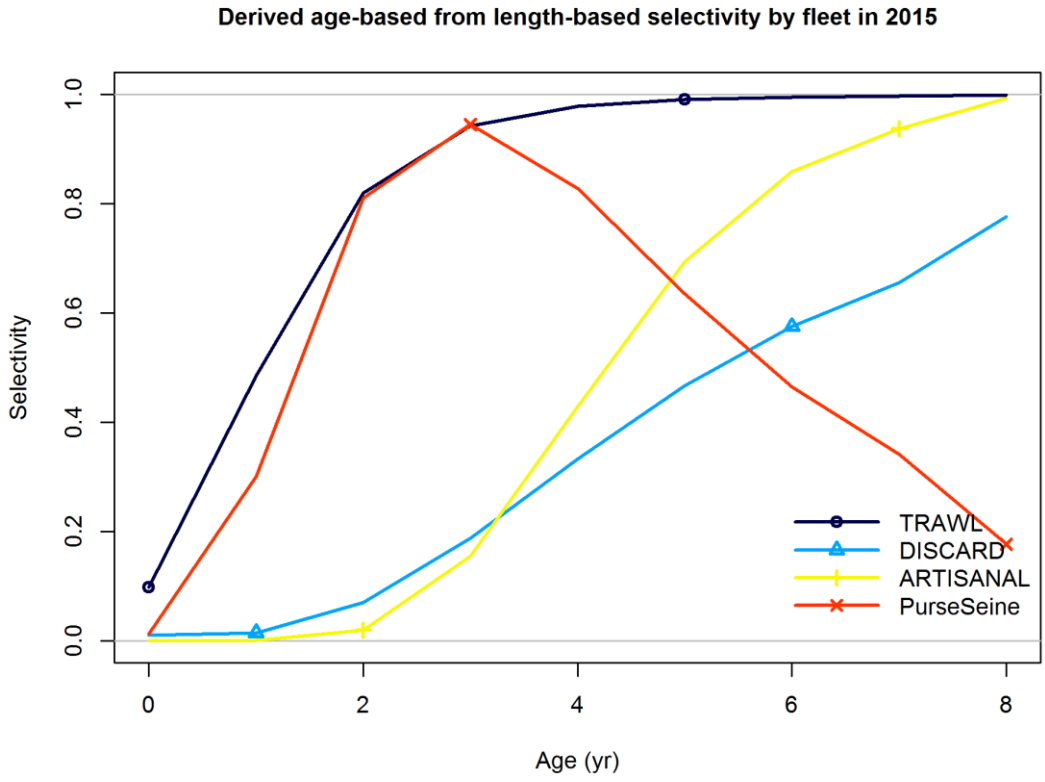


Fig. 5 Age based selectivity estimated by SS3 in 2015.

6.1.2 Scripts

The version 3 of Stock Synthesis has been used to carry out the assessment (SS3fast_Win64.exe). The inputand files of the final run have been uploaded on the GFCM Extranet.

6.1.3 Input data and Parameters

As catch composition for length and age are per sex and time series used is long, presentation is not convenient in the current Stock Assessment Form. All relevant files used for the assessment are available on the data file of SS3 on GFCM sharepoint. Length distribution of the catches was converted to age distribution with the use of ALKs. A summarized presentation of the data series is given in Figure 6.

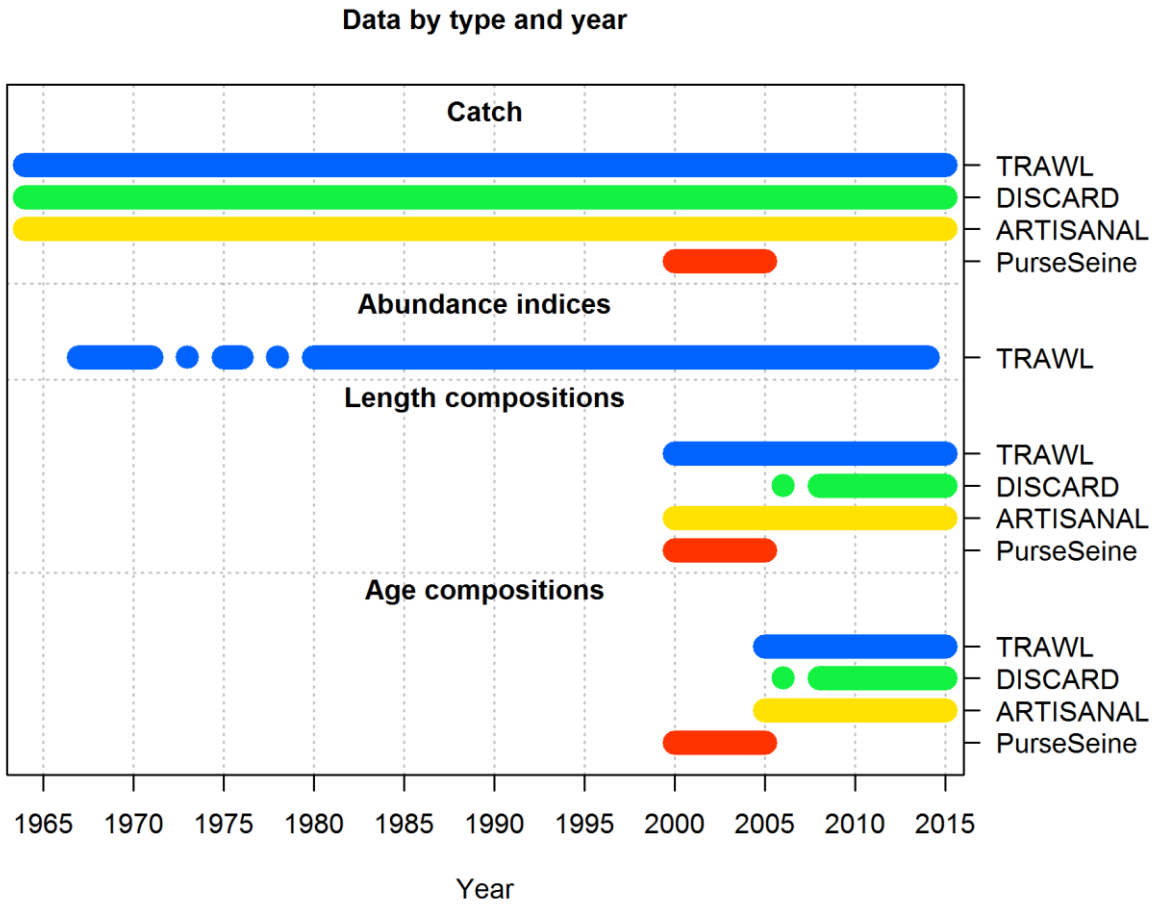


Fig. 6 Analytic presentation of the data used in the assessment.

A previous study on LPUE standardization from the trawl fishery indicated no significant difference between the nominal and standardized values (Fig. 7, Table 6.3.1-1) (Josephides 2013).

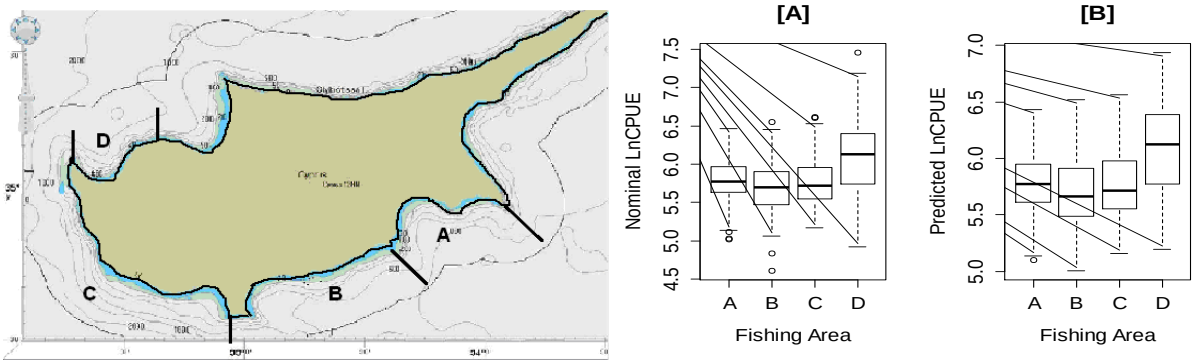


Fig. 7. Results of LPUE standardization from bottom trawl fisheries in four minor strata of GSA 25.

Table 6.1.3-1. Results of Two sample Kolmogorov-Smirnov test between the nominal and standardized LPUE indicating no significant difference.

Two sample K-S	**All data**	**Area (A)**	**Area (B)**	**Area (C)**	**Area (D)**
D-criterion	0.078	0.1	0.1143	0.1429	0.1075
p-value	0.0884	0.4858	0.3200	0.1148	0.6554

6.1.4 Tuning data

The tuning data used in the assessment derived from commercial Trawl CPUE and refer to the period 1965-2014. Assignment of length and distribution is performed internally in the Model.

Table 6.1.4-1: *Spicara smaris* in GSA25 - CPUE (kg/day) used as tuning data in SS3 model.

Year	Kg/day	σ
1967	129.1	0.64
1968	161.6	0.69
1969	113.3	0.62
1970	127.3	0.71
1971	96.7	0.64

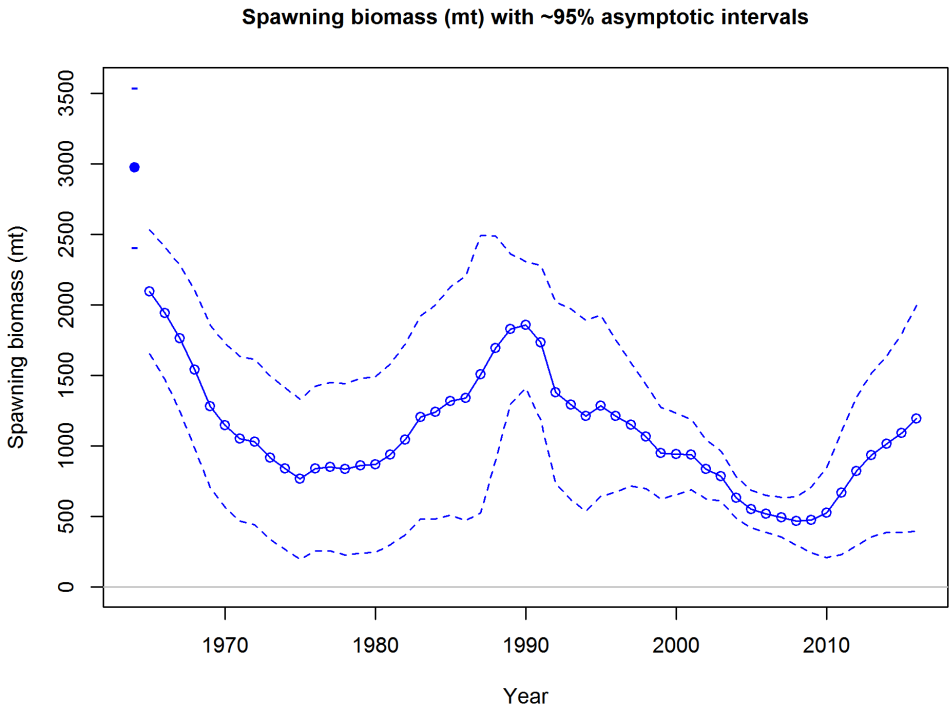
1973	148.3	0.72
1975	132.3	0.62
1976	163.7	0.68
1978	146.5	0.68
1980	123.1	0.63
1981	131.8	0.6
1982	154	0.67
1983	250.8	0.64
1984	253.5	0.66
1985	237.5	0.73
1986	242.3	0.74
1987	264	0.63
1988	274.3	0.71
1989	285	0.65
1990	271.7	0.65
1991	227.2	0.64
1992	242.6	0.73
1993	236	0.68
1994	233.5	0.67
1995	201.8	0.67
1996	241.5	0.66
1997	243	0.66
1998	242.1	0.66
1999	200.5	0.69
2000	224	0.67

2001	204.7	0.67
2002	157.4	0.63
2003	178.6	0.67
2004	163.2	0.66
2005	93.9	0.71
2006	193.1	0.64
2007	278.4	0.62
2008	215.1	0.61
2009	180.7	0.71
2010	267	0.73
2011	100.9	0.73
2012	96.8	0.7
2013	115.4	0.61
2014	184.24	0.65

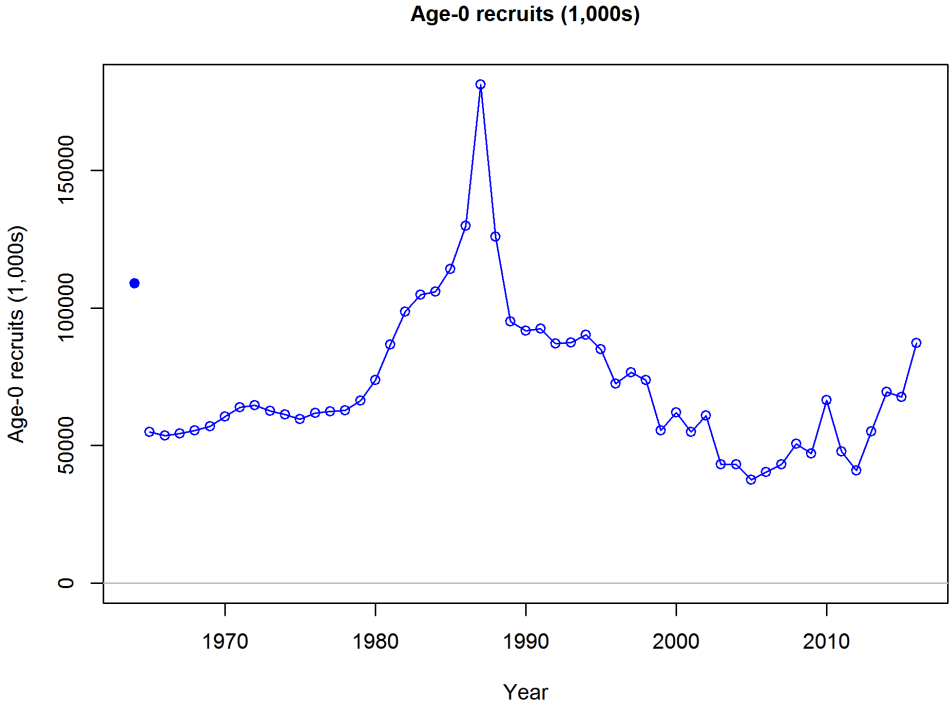
6.1.5 Results

Fishing mortality (F) shows the minimum value of 0.05 (F or $F_{bar\ 1\text{-}5}$) in 2015, and a maximum of 0.66 in 20048.

The $F_{0.1}$ value estimated by Yield Per Recruit analysis was 0.36



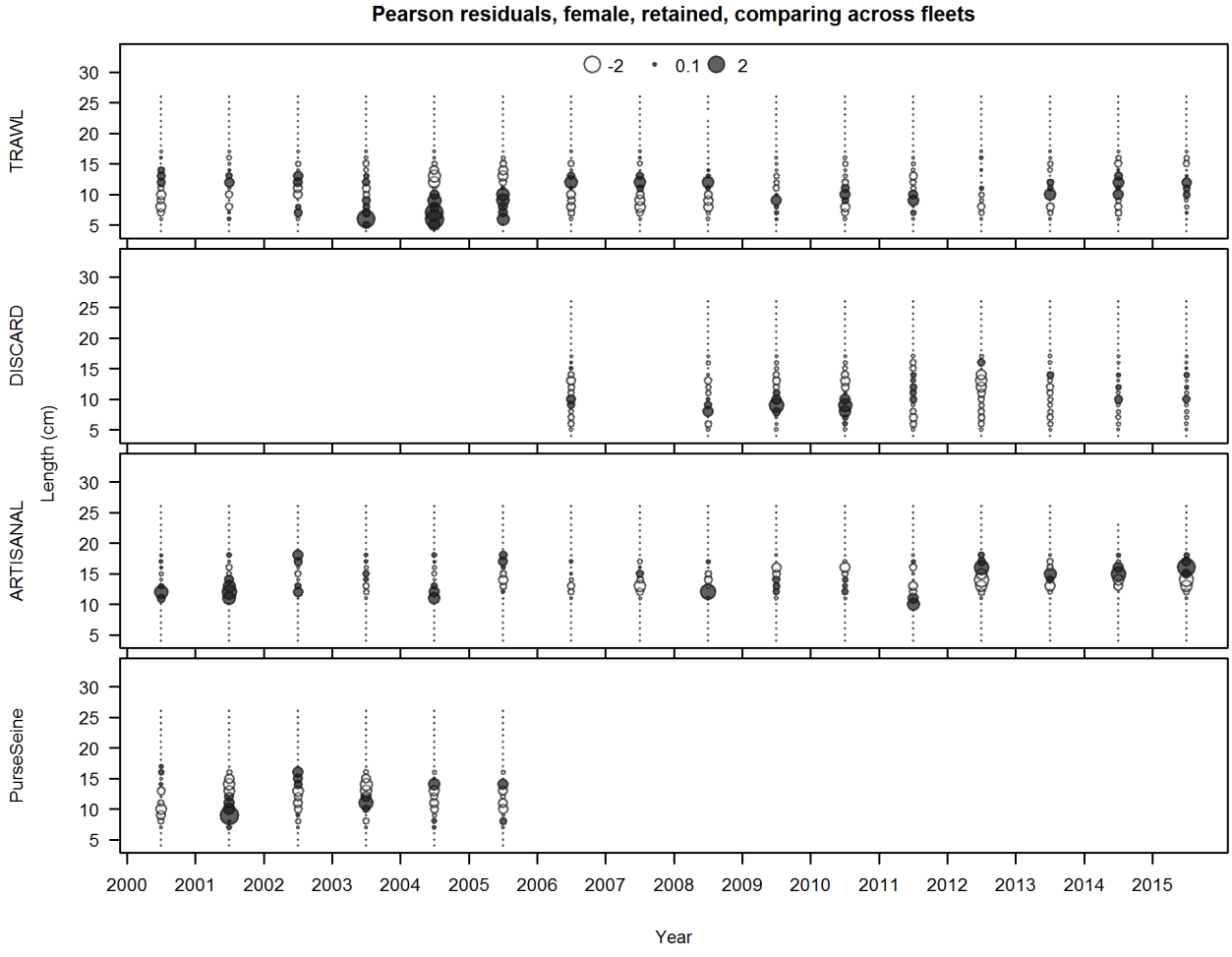
The SSB was decreasing from the beginning of the fishery and reached a steady plateau of five years from 1975 to 1980. Then the implementation of several measures gave a dome shape trend with the highest pick in year 1989 and the finishing of this curve in 2008 with the historical lowest value. From 2009 onwards SSB is increasing constantly.

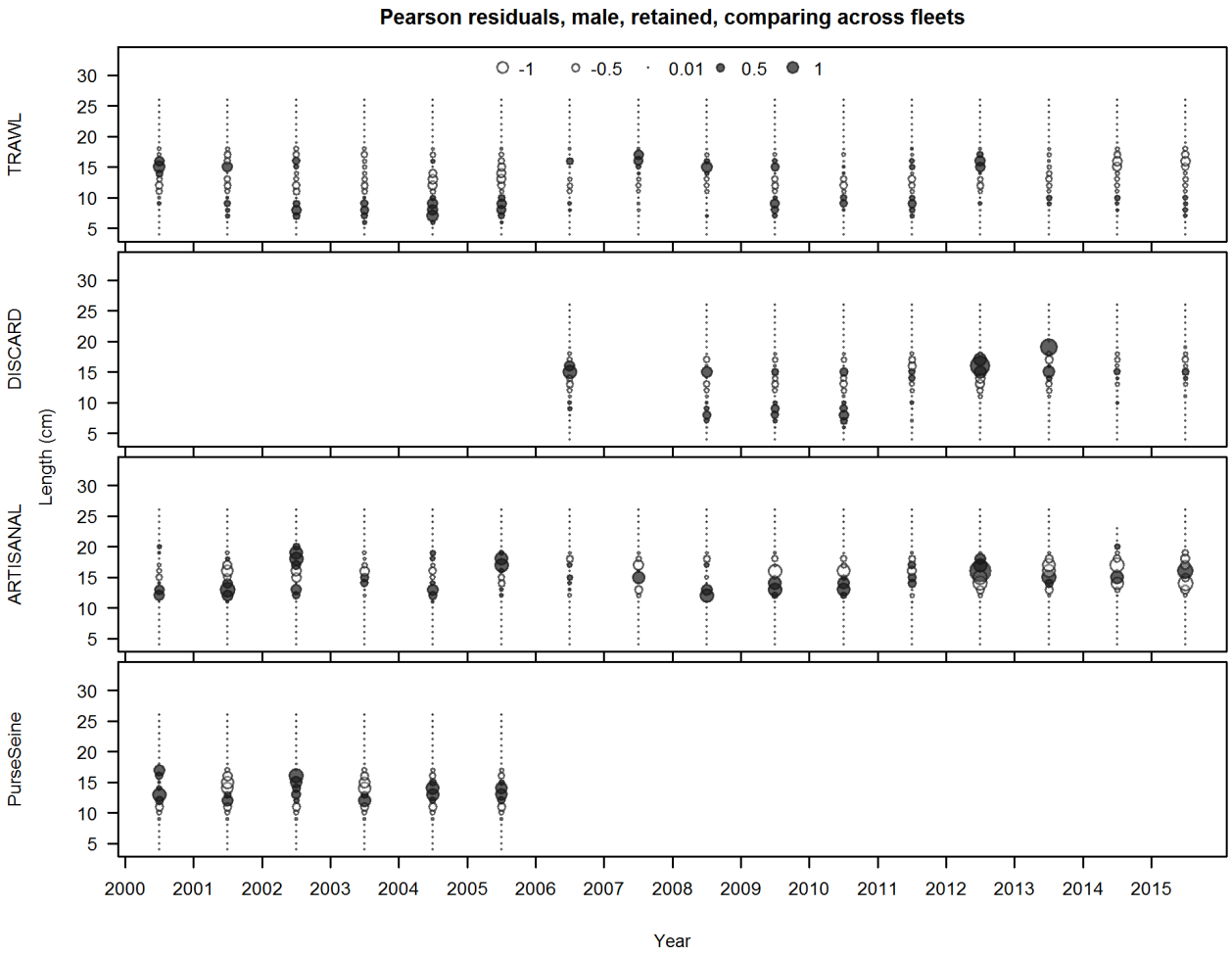


Recruitment varied with an increasing trend from the beginning of the time series up until 1989 were a constant drop occurred until 2005 a year that starts to increase steadily up until the end year of the analysis.

6.1.6 Robustness analysis

6.1.7 Retrospective analysis, comparison between model runs, sensitivity analysis, etc.





6.1.8 Assessment quality

The residuals do not show any particular trend and the comparison between observed and estimated commercial LFDs and mean length along the years as well as between observed and estimated mean length, log index and LFDs seems quite satisfactory.

7 Stock predictions

7.1 Short term predictions

7.2 Medium term predictions

7.3 Long term predictions

8 Draft scientific advice

Based on	Indicator	Analytic al reference point(name and value)	Current value from the analysis(name and value)	Empirical reference value(name and value)	Trend(time period)	Stock Status
Fishing mortality	Fishing mortality	$F_{0.1}$ = 0.36	$F_{1\text{-}5}$ = 0.05		D (2009-2015)	S
	Fishing effort				D	
	Catch					
Stock abundance	Biomass		Bcur = 2065 T	Percentiles SSB (tons): 33rd : 1242 66th : 1670 Current: 2065		**O_H**
	SSB					
Recruitment					I	
Final Diagnosis	$F_{curr}/F_{0.1}$= 0.138 In sustainable exploitation with relatively high biomass					

The diagnosis of the stock status was based on the analytical reference point regarding the fishing mortality ($F_{0.1}$), as well as on empirical reference values of biomass (33rd and 66th percentile).

8.1 Explanation of codes

Trend categories

1) N - No trend
2) I - Increasing
3) D – Decreasing
4) C - Cyclic

Stock Status

Based on Fishing mortality related indicators

1) **N - Not known or uncertain** – Not much information is available to make a judgment;
2) **U - undeveloped or new fishery** - Believed to have a significant potential for expansion in total production;
3) **S - Sustainable exploitation**- fishing mortality or effort below an agreed fishing mortality or effort based Reference Point;
4) **IO –In Overfishing status**– fishing mortality or effort above the value of the agreed fishing mortality or effort based Reference Point. An agreed range of overfishing levels is provided;

Range of Overfishing levels based on fishery reference points

In order to assess the level of overfishing status when $F_{0.1}$ from a Y/R model is used as LRP, the following operational approach is proposed:

- If $Fc^*/F_{0.1}$ is below or equal to 1.33 the stock is in **(O_L): Low overfishing**
- If the $Fc/F_{0.1}$ is between 1.33 and 1.66 the stock is in **(O_I): Intermediate overfishing**
- If the $Fc/F_{0.1}$ is equal or above to 1.66 the stock is in **(O_H): High overfishing**

*Fc is current level of F

5) **C- Collapsed**- no or very few catches;

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

- **Relative low biomass:** Values lower than or equal to 33rd percentile of biomass index in the time series **(O_L)**
- **Relative intermediate biomass:**Values falling within this limit and 66th percentile **(O_I)**
- **Relative high biomass:**Values higher than the 66th percentile **(O_H)**

4) **D–Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

Overfished (or overexploited) *- A stock is considered to be overfished when its abundance is below an agreed biomass based reference target point, like B0.1 or BMSY. To apply this denomination, it should be assumed that the current state of the stock (in biomass) arises from the application of excessive fishing pressure in previous years. This classification is independent of the current level of fishing mortality.*

Stock subjected to overfishing (or overexploitation) *- A stock is subjected to overfishing if the fishing mortality applied to it exceeds the one it can sustainably stand, for a longer period. In other words, the current fishing mortality exceeds the fishing mortality that, if applied during a long period, under stable conditions, would lead the stock abundance to the reference point of the target abundance (either in terms of biomass or numbers)*