Stock Assessment Form

Small Pelagics

Reference Year: 2015

Reporting Year: 2015

Stock Assessment Form version 1.0 (January 2014)

Uploader: *Claire Saraux*

Stock assessment form

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Engraulis encrasicolus	Anchovy	[35]
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA 07 Gulf of Lions]	[GSA_2]	[GSA_3]
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
[GSA_4]		
1st Country	**2nd Country**	**3rd Country**
[France]	[Country_2]	[Country_3]
4th Country	**5th Country**	**6th Country**
Stock assessment method: (direct, indirect, combined, none)		
Direct acoustic method		
Authors:		
Claire Saraux & Jean-Hervé Bourdeix		
Affiliation:		
IFREMER CS 30171, Av Jean Monnet, 34203 Sète Cedex (France)		

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

Direct methods (you can choose more than one):

- Acoustics survey
- Egg production survey
- Trawl survey
- SURBA
- Other (please specify)

Indirect method (you can choose more than one):

- ICA
- VPA
- LCA
- AMCI
- XSA
- Biomass models
- Length based models
- Other (please specify)

Combined method: you can choose both a direct and an indirect method and the name of the combined method (please specify)

2 Stock identification and biological information

2.1 Stock unit

The assessment covers the whole GSA07 area corresponding to the Gulf of Lions. However, the Gulf of Lions may not correspond to a complete stock unit. Indeed, hydrological exchanges between the Gulf of Lions and the Catalan Sea for instance are well known, which should at least affect larval transport (see Ospina-Alvarez et al. 2013) and then recruitment of juvenile anchovies in both areas. Similarly, part of the young recruited in the Gulf of Lions anchovy population may come from larval transport from spawners of the Ligurian Sea. Further, preliminary genetic analyses have shown no differences between Spanish and French stocks of anchovies in the North-Western Mediterranean Sea. Because of these questions about the stock unit, further investigations have been conducted combining French and Spanish landing data in order to see whether the disappearance of large individuals from the Gulf of Lions might result from a migration towards Spanish waters. This does not seem to be the case (see below) and we believe the two GSA may be assessed independently.

2.2 Growth and maturity

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

Somatic magnitude measured (LT, LC, etc)				**Units**	
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	**Spring-Summer**
Maximum size observed	18.5	17	18.5	**Recruitment season**	
Size at first maturity			8.5	**Spawning area**	Shelf and upper
Recruitment size to the fishery	5	5	5	**Nursery area**	Shelf and upper

*Maximum size observed corresponds to the maximum size ever observed in PELMED (1993-2015)

**Size at first maturity was calculated based on samplings in Novembre, Decembre and January (peak of reproduction) from 2009 onwards (as a change in size at first maturity was observed around 2008).

Table 2-2.2: Proportion of matures by size

Size/Age	Proportion of matures (Males)	Proportion of matures (Females)
6cm	*0.0136*	*0.0048*
7cm	*0.0654*	*0.0281*
8cm	*0.2617*	*0.1490*
9cm	*0.6422*	*0.5143*
10cm	*0.9009*	*0.8649*
11cm	*0.9787*	*0.9748*
12cm	*0.9957*	*0.9957*
13 cm	*0.9991*	*0.9993*
14 cm	*0.9998*	*0.9999*
15 cm	*1.000*	*1.0000*
16 cm	*1.000*	*1.0000*

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**				16.02	2008-2014
	K				0.58	2008-2014
	t_0				-1.38	2008-2014
	Data source	Growth parameters evaluated from PELMED data (i.e. July) on the 2008-2013 period.				
Length weight relationship	**a**				0.0037	2015
	b				3.20	2015
	M (scalar)					
	sex ratio (% females/total)					

Length-weight relationship parameters are derived from data collected during the 2015 PELMED survey only

3 Fisheries information

3.1 Description of the fleet

Identification of Operational Units exploiting this stock. Use as many rows as needed

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

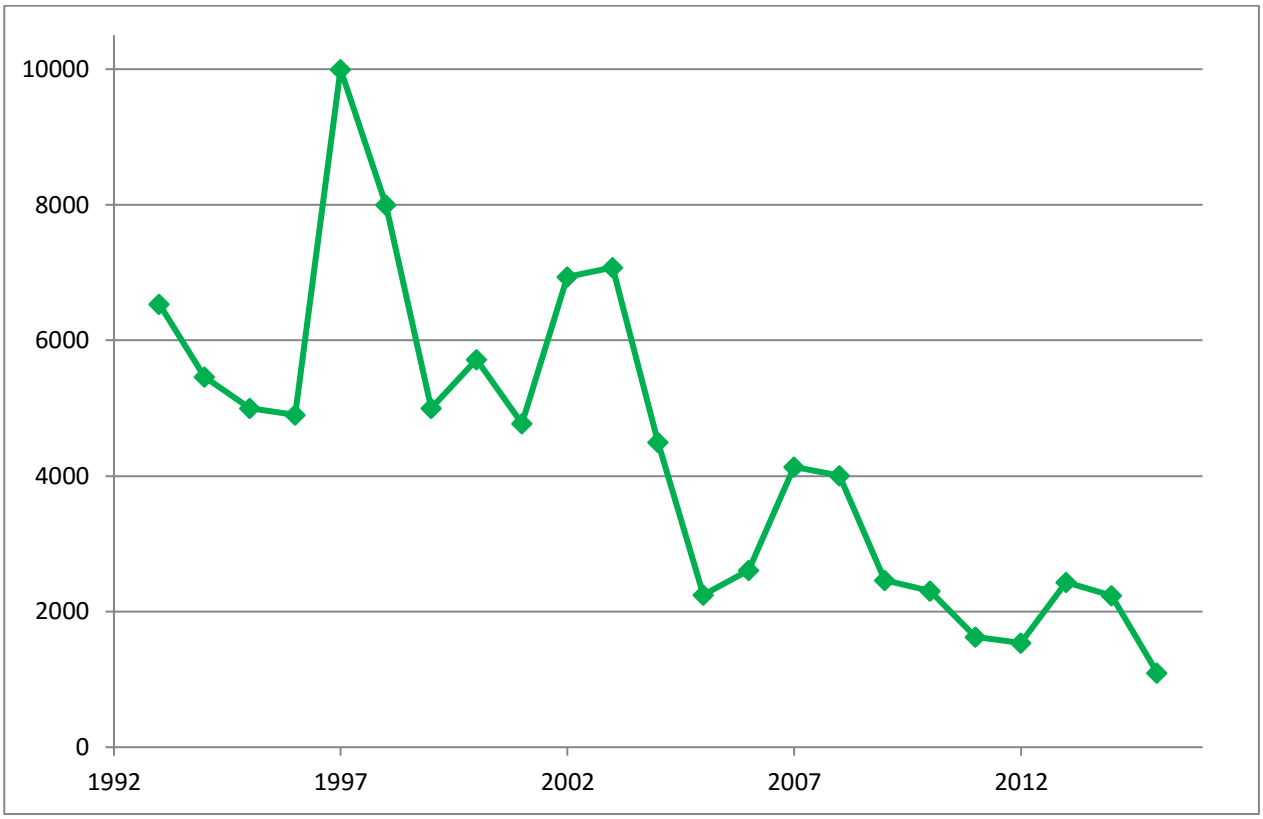
	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	FRA	[07]	E – Trawl (12-24 m)	03 - Trawls	35 – Small gregarious pelagic	ANE

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

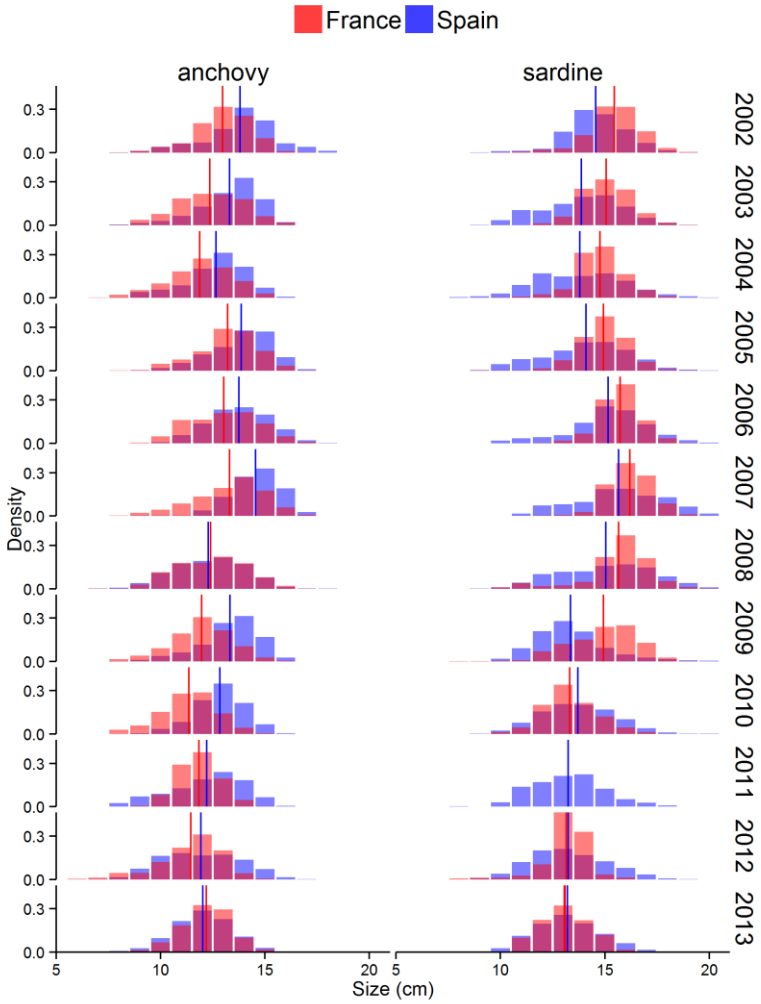
Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
[Operational Unit1]	11	1099				
Total						

We estimated the number of boats as the number of boats landing more than 1T during the year. Only 6 of them caught more than 100 T and a single boat targets small pelagics all year long.

3.2 Historical trends



Questions about the disappearance of large and old small pelagic fish have been raised during the last years. As small pelagic fish population dynamics governed by adult mortality is very unusual, one question concerns the possibility of a displacement of these fish rather than mortality. In such a case, they would have likely moved towards the Spanish South coast, especially as there is a general strong south-westward circulation in the GOL (Millot 1990; Nicolle, Garreau & Liorzou 2009) and the continental shelf is broader than the one of the Ligurian coast (Italy). As French and Spanish acoustic surveys have taken place at the same season only for a few years, it is difficult to compare abundance, size distribution… between regions based on these data. Nevertheless, the annual size distribution of the landings can still be paralleled. For France, the landing sizes follow roughly the same trend as the size distribution observed during July surveys. Thus, landed size distributions are a reasonably proxy for the size distributions of the wild populations. Only the frequencies of the smallest fish are perhaps biased because of the used mesh sizes, but given that we are primarily interested in the larger fish, this does not pose a problem. From a comparative analysis, it becomes clear that Spanish landed pelagic fish were also smaller during recent years. The converging of the size distributions of both areas for both species might stress similarities between the French and Spanish populations, or a close connection between both. As we found evidence that sardine and anchovy in Spain are also smaller, there might have been a driver that acted on a larger scale, that is, the NW Mediterranean basin rather than just the Gulf of Lions. Hence, without excluding migration between areas itself, it can still be concluded that large individuals did not move to Spain.



3.3 Management regulations

- Exclusive licence for trawling, with a given number each year (both for small pelagics and demersals) - fully respected
- Limited engine power for trawlers to 318 kW or 430 hp - not respected
- Length of fishing trawlers inferior to 25 meters - fully respected
- Fishing effort limitation :
    - No fishing on Saturdays and Sundays, authorised hours trip: 3.00am to 8.00pm - fully respected
    - Trawling forbidden from coast to 3NM - not fully respected
    - Professional organisation regulations: Additional holidays: on average 40 days/year - fully respected

National management plans have also been established for trawlers (2014) in the Gulf of Lions. Objectives in terms of harvest rate and age selectivity have been fixed. The current situation compared to these objectives is assessed each year, affecting the number of licences delivered the following year or the number of allowed fishing days.

3.4 Reference points

Table 3.3-1: 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	Blim	22 889 T	Bpa	45 778 T	
SSB					
F					
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 Direct acoustic method

4.1.1 Brief description of the chosen method and assumptions used

Sampling was performed along 9 parallel and regularly spaced transects (inter-transect distance = 12 nautical miles, see map below). Acoustic data were obtained by means of echosounders (Simrad ER60) and recorded at constant speed of 8 $nm.h^{-1}$. A 3D-echosounder (Simrad ME70) is also now installed and used onboard to help discriminating schools. The size of the elementary distance sampling unit (EDSU) is 1 nautical mile. Discrimination between species was done both by echo trace classification and trawls output (Simmons & MacLennan 2005). Indeed, each time a fish trace was observed for at least 2 nm on the echogram, the boat turned around to conduct a ≥30 min-trawl at 4 $nm.h^{-1}$ in order to evaluate the proportion of each species (by random sampling of the catch and sorting before counting and weighing per species). While all frequencies were visualized during sampling and helped deciding when to conduct a trawl, only the energies from the 38kHz channel were used to estimate fish biomass. Acoustic data were preliminary treated with Movies 3D software in order to perform bottom corrections and to attribute to each echotrace one of the 5 different echotypes previously defined. Acoustic data analyses (stock estimation, length-weight relationships, etc.) were later performed using R scripts.

Table 4.1-1: Acoustic cruise information.

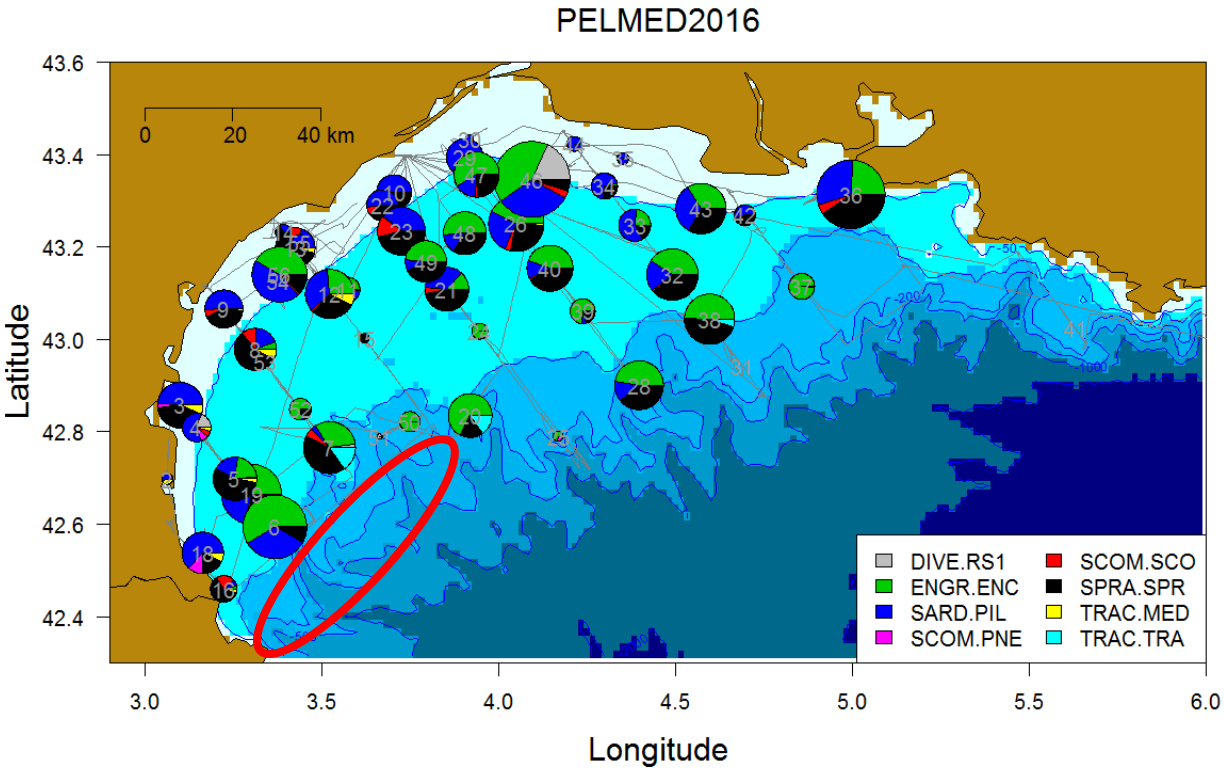
Date	28/06/2015 – 01/08/2015		
Cruise	PELMED 15	**R/V**	L'Europe
Target species	Anchovy - Sardine		
Sampling strategy	9 // transects spaced 12Nm		
Sampling season	Summer		
Investigated depth range (m)	20-200m		
Echo-sounder	ER60 38 KHz for assessment 70, 120, 200 and 333 used as complementary frequency ME70 (3D echosounder) as support for echotype definitions		
Fish sampler	Pelagic trawls: 4FF176 with 7 m of vertical opening 4PM159 with 16 m of vertical opening		
Cod –end mesh size as opening (mm)	9 mm of mesh side; 18 mm of mesh size		
ESDU (i.e. 1 nautical mile)	1 Nm		
TS (Target Strength)/species	- 71.2 for anchovy and sardine		
Software used in the post-processing	Movies3D and R scripts		
Samples (gear used)	Pelagic trawl		
Biological data obtained	Length-Weight relationship, Age, Sex, Maturity, Fat content		
Age slicing method	Otolith		
Maturity ogive used	L50		

Table 4.1-2: Acoustic results, if available by age or length class

	Biomass in metric tons	fish numbers	Nautical Area Scattering Coefficient	Indicator …	Indicator …
Anchovies	22 740	2 239 862 934			
Sardines	70 387	8 121 674 787			
Sprats	29 373	6 260 854 166			

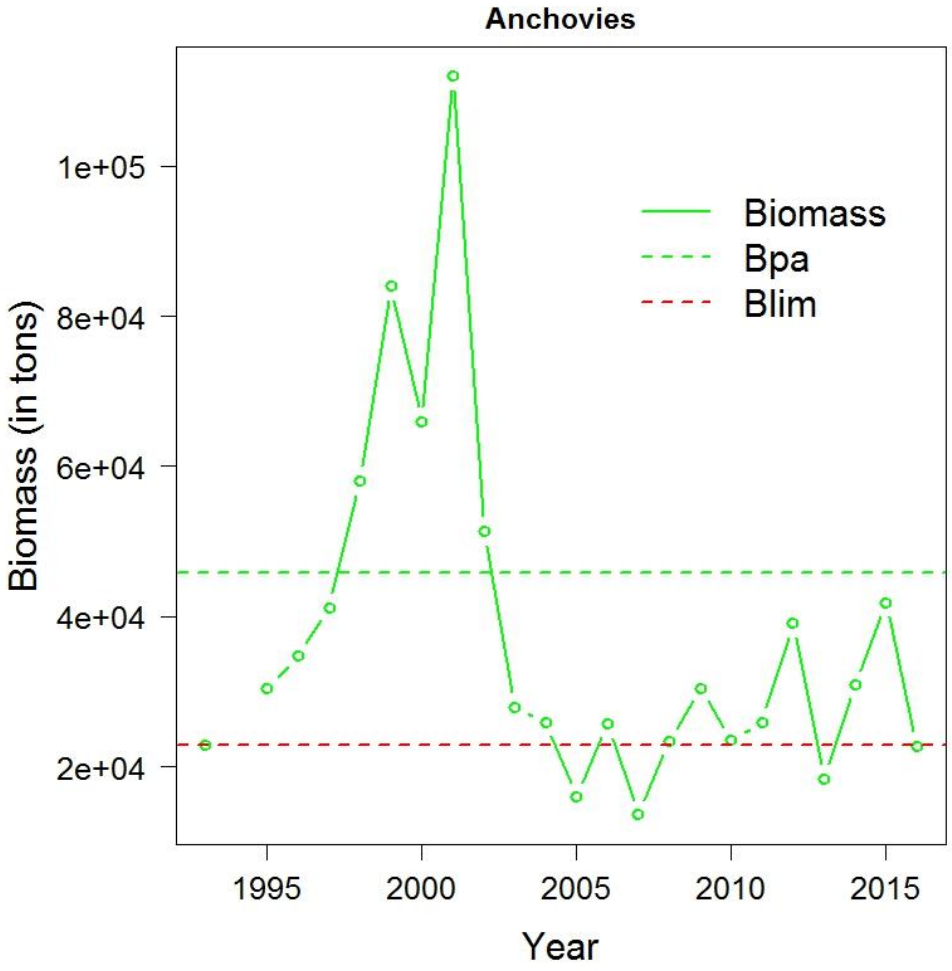
This corresponds to the abundance and biomass of the whole sampled area.

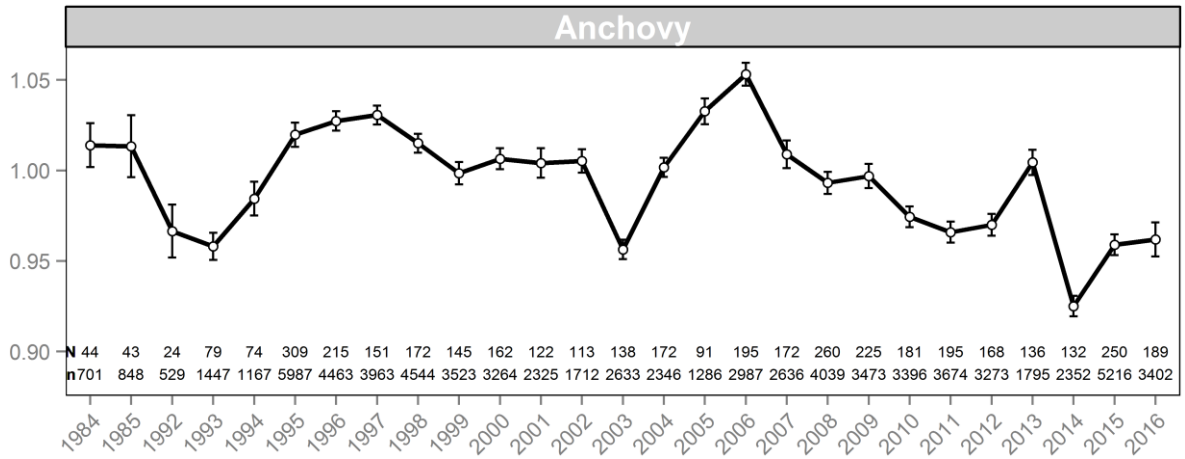
4.1.2 Spatial distribution of the resources

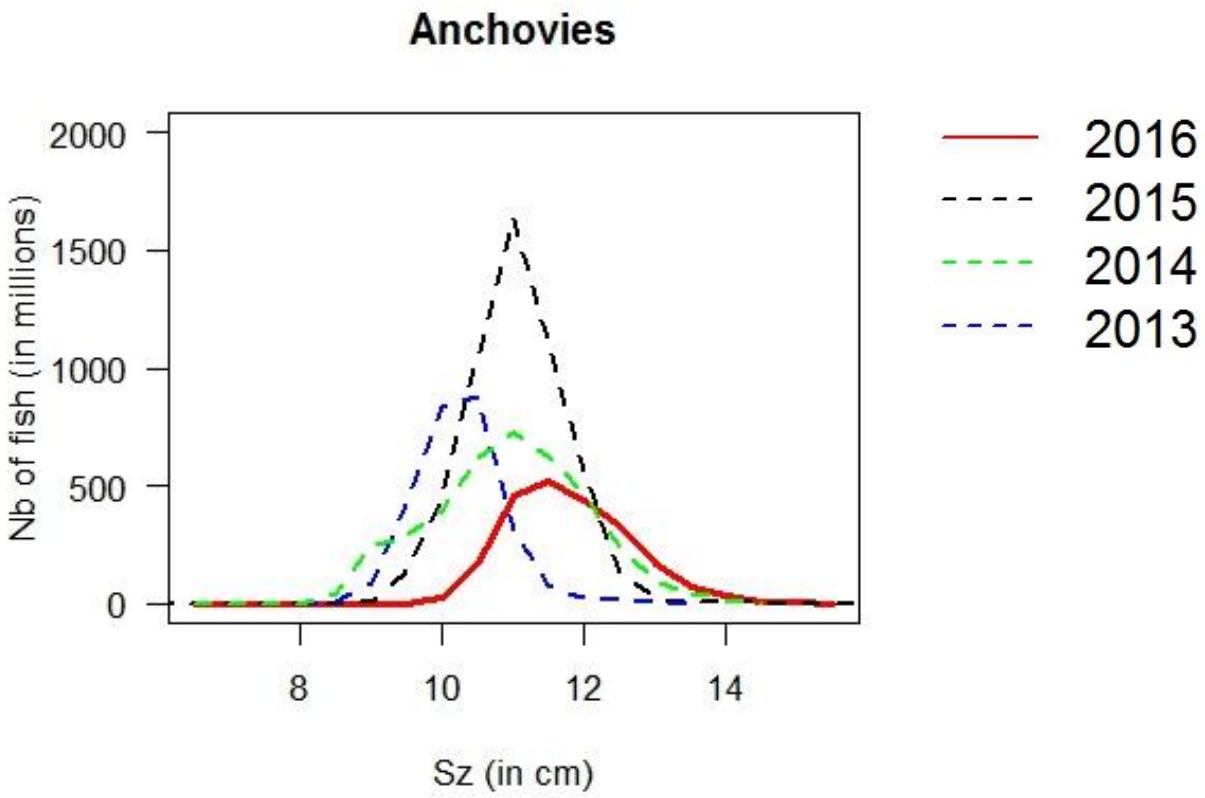


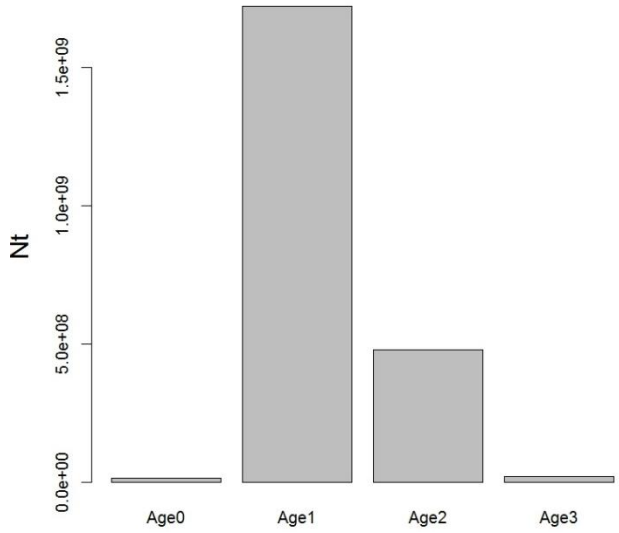
Importantly, a small part of the first 4 transects was not sampled due to administrative and political problems. An interdiction to enter the area had been applied. In total, this represented only a few nm, so that the evaluation should not be strongly affected, although this zone often shelters large anchovies.

4.1.3 Historical trends









Anchovies are slightly larger this year and the proportion of age 2 increased from 5% in 2015 to 21% in 2016. Body condition is still below 1.

5 Ecological information

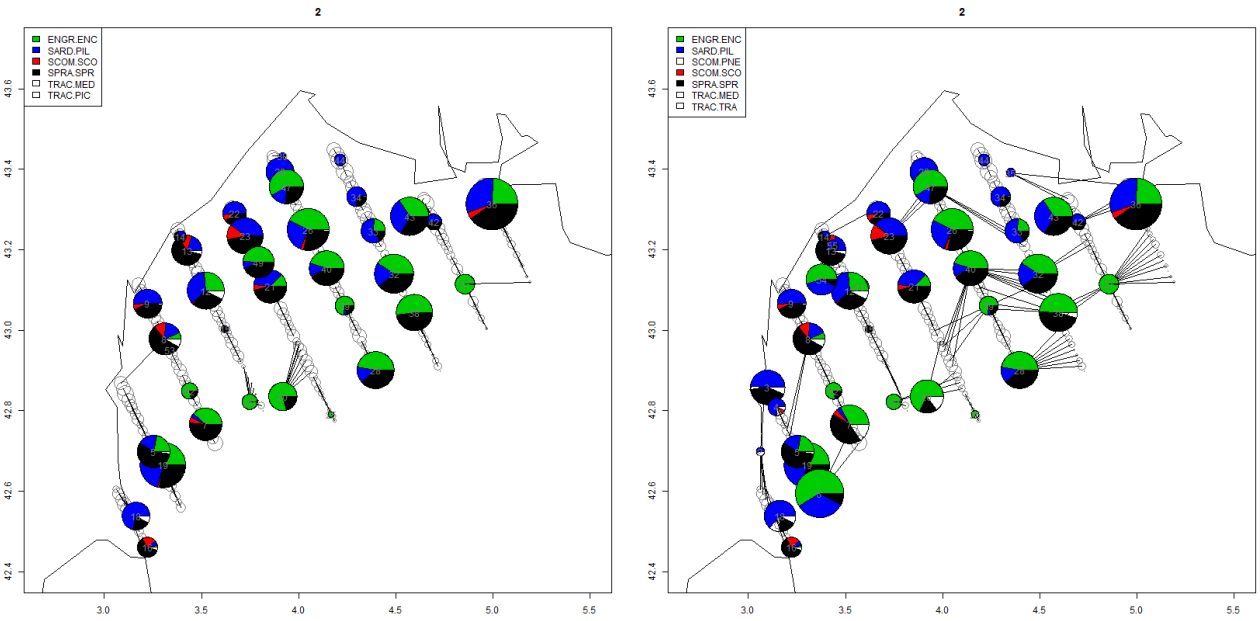
5.1 Protected species potentially affected by the fisheries

No protected species should be affected by small pelagic fisheries

6 Stock Assessment

The stock assessment relies on the direct method with no analytical model being used. Indeed, the very small number of age classes in the age composition prevents from using age-based model. Recruitment indices are unavailable as PELMED survey occurs in summer during the peak of reproduction. No analytical methodology is thus available to assess this stock.

To estimate acoustic biomass, different trawl allocations to echotraces have been tested. Trawl allocation has been done in two different ways: 1) closest trawl allocation, where each echotrace is attributed the closest trawl under the condition that the trawl is in the correct stratum (surface vs. pelagic), 2) expert allocations. In allocation 2, each echotrace was allocated a trawl according to the form and intensity of the echotrace. This also enables to put more importance on depth strata than the closest trawl allocation. Indeed, depth has been shown to be an important factor of the spatial distribution of these species and of the size structuration (sardines are more coastal than anchovies and small individuals are also more coastal regardless of the species). The 2 allocations for bottom energy are shown below (near trawl on the left and expert allocation on the right).



The weather being globally good during the survey, we have been able to perform a lot of trawls (56) this year, so that the uncertainty associated with trawl allocation was small. For anchovies, CV on biomass due to different allocations (up to 4 allocations tested) was of 1%, while it equaled 7 % for sardines.

7 Stock predictions

As no analytical assessment exists, no stock predictions are done.

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)	Status
Fishing mortality	Fishing mortality					
	Fishing effort				D	
	Catch				D	
Stock abundance	Biomass	Blim and Bpa	22 740	Blim = 22 889 T Bpa = 45 778 T	N	Depleted
	SSB					
Recruitment						
Final Diagnosis		Depletes + still poor biological state (small size, low body condition) despite some small improvement = implement a recovery plan				

Biomass decreased below B_{lim}. Landings in 2015 decreased as well. The fishing effort is much more opportunistic than before. The total number of boats landing anchovies is not negligible. However, all but 1 of them target small pelagic fish only at given restricted periods. Further, biological parameters showed slight improvement: anchovies maintained their slightly larger size as last year, and their condition was very similar to that of last year (still below 1). If the stock shows slight encouraging improvement in terms of age composition, it still hasn't recovered from poor exogenous environmental factors. As a consequence, the stock is judged depleted (situated below B_{lim}), and the advice is to implement a recovery plan.

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)*