

**GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
SCIENTIFIC ADVISORY COMMITTEE
Sub-Committee for Stock Assessment
Working Group on small pelagic species
Málaga, Spain, 6-7 May 2004**

OPENING OF THE MEETING

1. The fifth meeting of the SAC Working Group on Small Pelagic Species of GFCM was held in Málaga, Spain from 6 to 7 May, 2004.
2. Seventeen scientists from 5 countries assisted the WG (Appendix A).
3. The agenda of the Working Group was adopted (Appendix B) and the list of documents updated. The final list of documents presented during the meeting is attached as Appendix C.
4. Mrs. I. Palomera (ICM-CSIC) chaired the Session. Mr. A. García (IEO) acted as Rapporteur.

PRESENTATIONS AND DISCUSSIONS BY THE WORKING GROUP

5. Twenty-one technical papers were presented and discussed by the Working Group.
6. These documents covered totally or partially 6 Geographic Sub-Areas (GSA) and two species.
7. Two types of documents were presented: (i) assessment documents, (ii) assessment related documents. The conclusions and recommendations adopted by the Working Group and referring to assessment presented in each document are as follows:

ASSESSMENT FORMS AND DOCUMENTS

8. Document n° 01. ANC-01 *Engraulis encrasicolus*. 2003

9. Document n° 02. ANC-06 North *Engraulis encrasicolus*. 2001-2003

These documents presented the assessment of anchovy of the Alborán Sea and Northern Spain. The method applied was Length Cohort Analysis (LCA) and Yield per Recruit Analysis (Y/R) using the VIT program. The Alborán Sea stock is exploited by small-sized fishing vessels in comparison to the N Spain. The trend in the N Spain is decreasing. Although the estimated fishing mortality in Alborán Sea was lower than the N Spain, the stock according to the analysis is considered fully exploited. The state of the resource is considered growth overexploited. With respect to N Spain, the analysis showed a moderately exploited situation, although a great decrease was observed during 2003. Some discussion questioned the analysis method (LCA) because it assumes a steady state situation in highly fluctuating species. In addition, the method is highly sensitive to the input parameters, producing a strong bias in the assessment.

During the period from 2000-2003, the anchovy stock of the Alborán showed great fluctuations in the catch. A successful recruitment as estimated by echo-acoustic tracking was observed during 2001 in the Alborán Sea (13210 tons). Nevertheless, the catch in 2003 dropped to 177 tons. This decline is consistent with the echo-acoustic evaluation (550 tons).

Catch data from the N Spain, showed a similar fluctuating trend for the period analysed (2001-2003). The biomass estimated by acoustics resulted in values for 2001, 32447 tons and for 2003, 27137 tons. Unfortunately, no acoustic data during 2002 was able to be provided.

Recommendations:

Fishing effort should not be increased.

Minimum size at catch should be adjusted to length at first maturity

Control improvement on the commercialization of undersized specimens

To guarantee the catch and effort data availability in time to provide yearly assessments.

Continuation of the data acquisition for proceeding towards other indirect methods of assessment, eg. tuned VPA.

10. Document n° 3. SAR- 01. *Sardina pilchardus*. 2003

11. Document n°4 . SAR-06 North. *Sardina pilchardus*. 2001-2003

12. Document n°5 . SAR-06 South. *Sardina pilchardus*. 2003

The state of exploitation of *Sardina pilchardus* has been assessed using the VIT software and applying Length Cohort Analysis (LCA) and Yield per Recruit Analysis (Y/R) to the GSA 01 (2003), GSA 06 South (2003) and GSA 06 North (2001, 2002 and 2003). GSA 06 assessments have been accomplished separately for two different regions (North and South) because of their different exploitation patterns.

The analyses were based on size composition of purse seine landings and official landings. The input parameters sets of each analysis (Growth Model, Length-Weight relationship and Natural Mortality) were based on own data or selected from those available in the bibliography after several trials. Terminal Mortality values were chosen to continue the general tendency observed in the previous size classes. Two

different approaches corresponding to different growth models are presented for GSA 01 and GSA 06 South.

The length of first maturity (L_{50}) was estimated in 2003 for the GSA 01 at 13.25 cm. The present work is the first attempt to assess by indirect methods the state of exploitation of sardine caught by purse seine in the whole Spanish Mediterranean coast. In general, sardine stocks analysed are under-exploited with reference to Y/R_{max} and over-exploited with reference to $Y/R_{0.1}$. Nevertheless, the LCA steady state assumption, the great sardine recruitment fluctuations, the uncertain natural mortality value and the LCA sensitivity to slight variations in input parameters (specially growth parameters L_{inf} and k) can lead to important biases. This makes results to be an approximation of the population dynamics and, therefore, they should be considered with caution.

With regards to acoustic biomass estimations, 2003 estimated 7142 tons for the GSA 01 (partially covered). For the GSA 06, 122127 tons were estimated in 2001, which declined to 52026 tons in 2003. Although a small recovery was observed in 2003, landings, CPUE's and acoustic evaluations show a general decreasing tendency during the last 14 years.

Recommendations:

Fishing effort should not be increased.

Minimum size at catch should be adjusted to length at first maturity

Control improvement on the commercialization of undersized specimens

To guarantee the catch and effort data availability in time to provide yearly assessments.

Continuation of the data acquisition for proceeding towards other indirect methods of assessment, eg. tuned VPA.

13. Document n°6(a,b). SAR-03. *Sardina pilchardus*.

Mediterranean Moroccan waters register a mean landing of 14000 tons/year, which represents 70% of the total small pelagic catch, fished by around 150 fishing vessels.

The exploitation status of the Mediterranean sardine is based on the analysis of catch, efforts and CPUE. During the last years, a strong effort on the fishery has been applied, which has caused a lower fishing yield.

The evaluation based on the analysis of pseudo-cohorts (LCA) has been updated for 2003. The results show that the fishing mortality is relatively high in mature individuals. The yield per recruit analysis indicates an overexploitation of the resource.

Based on the analysis, the preliminary results recommend to:

- decrease progressively the fishing effort on sardine for a 3 year period
- implementation of a seasonal closure of one month during the sardine spawning period
- ameliorate the assessment, it is considered necessary to acquire more information on the growth and reproductive parameters of sardine.

From observations on the exploitation, it is also recommended to:

- establish a seasonal closure for the area east of Nador, from Kariat Arkmen to Ras Kebdana, where juveniles concentrate during the recruitment period (May-June)

- the prohibition of artisanal fishing in sardine nursery grounds (small bays and lagoons).

14. Document n° 7. ANC-07 *Engraulis encrasicolus*. 1993-2003

The annual landings of anchovy is between 5000 and 6000 tons in the Gulf of Lions. The landings are regulated by the market prices. When market price is low, the pelagic trawl fleet directs its activities towards demersal resources, which are overexploited.

The evaluation of the resource is through yearly echo-acoustic surveys since 1993. The anchovy resource off the Gulf of Lions is rather stable, averaging 72000 tons in the period from 2001-2003.

During the working group on small pelagic species celebrated in Rome (2002), we presented with our Spanish colleagues a document titled « Preliminary results on anchovy shared stock in the Gulf of Lions ». The results of that document were :

- fleets from both France and Spain are sharing this stock with a predominance of Spanish purse seiners fishing at night with lights in the Gulf of Lions. At the moment, there is no conflict with French trawlers that operate only during daytime.
- regarding to the present biomass estimated by direct methods, at the moment, it is necessary to maintain the effort on this fishery.

Management recommendations for the market : It is considered necessary to monitor the fishing strategy followed by the fishing fleet. It is necessary to this purpose to monitor the evolution of landings and prices of the other pelagic and demersal species being targeted.

Discards : a monitoring of anchovy discards is recommended.

15. Document n° 8. SAR- 07 *Sardina pilchardus*. 1993-2003

The sardine landing in Gulf of Lions is averages 9000 t., for the period from 2001-2003. The landings and fishing effort are being monitored since 1985.

The production is less regulated by fishing market than anchovy, but when the market price is low, pelagic trawl directs its effort to demersal resources, which are overexploited.

The acoustic evaluation is being carried out since 1993 off the Gulf of Lions during the summertime. The survey series provides data on resource variability of sardine, anchovy and other small pelagic species.

The estimated average biomass of sardine is 82000 tons for the period from 2001-2003. The resource is moderate exploited and regulations are established by professional organisations and national administrations.

Management recommendations for the market : It is considered necessary to monitor the fishing strategy followed by the fishing fleet. It is necessary to this purpose to monitor the evolution of landings and prices of the other pelagic and demersal species being targeted.

Discards : a monitoring of sardine discards is recommended.

16. Document n° 9. ANC+SAR. 16, *Sardina pilchardus*

Biomass evaluations from seven echo-surveys carried out from June 1998 to June 2003 in the Strait of Sicily were presented. Both sardine and anchovy populations experienced quite large inter-annual fluctuations, from about 36000 t in July 2000 to 6000 t in 2002 for sardine and 7000 t in 1998 to 23000 t in 2001 for anchovy. Specifically for anchovy this evidence would suggest, taking also into account the age structure of the catches (low proportion of juveniles), the importance of environmental factors variability on yearly recruitment success. Acoustic evaluations are largely consistent with landings (from purse seiners and midwater pair trawlers) recorded in Sciacca (the most important base port in the G.S.A. 16 for the small pelagic fish landings) during the year following the evaluation campaigns. The recent decreasing trend in sardine biomass suggests to consider the risks connected to possible negative effects on this population, resulting from wintertime (from January to March) pressure of other fishing gears on larval stages. However, sardine biomass estimate for 2003 showed an increase respect to the previous year.

Recommendations:

Fishing effort should not be increased.

17. Document n° 10(a,b). SAR 17-04 *Sardina pilchardus*

The sardine stock living in northern and central Adriatic Sea, is shared between Italy, Slovenia and Croatia. The present assessment is relative to the sardine stock of northern and central Adriatic Sea (GFCM GSA 17), pooling together data coming from Italy, Slovenia and Croatia. It has been carried out in the ambit of the AdriaMed-SP research programme.

The annual catch of sardine for the three mentioned countries was obtained for the time interval 1975-2003. These quantities were distributed into fish age classes, so that catch-at-age data were available, that represented the basic input data of Virtual Population Analysis (VPA), employed for the present stock assessment.

Annual values of mid-year stock biomass at sea, annual values of the unweighted mean fishing mortality rate over the age class range 0-5, were obtained. In addition, annual exploitation rates were calculated and compared with a threshold derived from literature and suggested for small pelagics.

Recommendation:

A continuous decline of stock biomass is observed after the peak in the first half of 1980s, and lowest values of this series correspond to recent years. Furthermore, difficulties in obtaining economically satisfactory catches by fishermen were perceived both in Italy and Croatia. Given this situation it is recommended not to allow the fishing effort to rise.

18. Document n° 11(a,b). ANC 17-04 *Engraulis encrasicolus*

The stock of anchovy living in northern and central Adriatic Sea, is shared between Italy, Slovenia and Croatia. The present assessment is relative to the anchovy stock of northern and central Adriatic Sea (GFCM GSA 17), pooling together data coming from Italy, Slovenia and Croatia. It has been carried out in the ambit of the AdriaMed-SP research programme. The annual catch of anchovy for the three mentioned countries was obtained for the time interval 1975-2003. These quantities were distributed into fish age classes, so that catch-at-age data were available. That

represented the basic input data of Virtual Population Analysis (VPA), employed for the present stock assessment.

Annual values of mid-year stock biomass at sea, annual values of the unweighted mean fishing mortality rate over the age class range 0-3, were obtained. In addition, on the basis of the mentioned fishing mortality rates and natural mortality rate, annual exploitation rates were calculated and compared with a threshold derived from literature and suggested for small pelagics. The minimum value of both catch and biomass at sea were estimated in 1987, when a strong drop in the catch and crisis of the anchovy fishery took place. Even if high values of both fishing effort and fishing mortality rate were obtained for some years before 1987, very low levels of recruitment in 1986 and 1987 seems to be mainly responsible for the collapse of the stock.

Recommendation:

The current biomass, that has shown a continuous slight increase in about ten years (1988-1996) after the collapse of 1987, has not risen to the values observed before this year. Further, it should be noted that in the most recent years, biomass shows important fluctuations which may represent higher risks for the stock. Given this situation, it is recommended not to allow the fishing effort to rise.

RELATED DOCUMENTS

LENGTH AT FIRST MATURITY (LFM) OF MEDITERRANEAN ANCHOVY

19. Document n° 12. ANC 17. *Engraulis encrasicolus*

Size at first maturity of anchovy (*Engraulis encrasicolus*) in Adriatic Sea has been analysed by the histological method. Anchovy samples were collected from May to September, 2003. Total length of specimens analysed ranging from 7 to 11 cm. Preliminary results shows that all the males of sample from 7.5 cm of total length show testes in phase of advanced spermatogenesis, while all the females of sample with the total length equal or greater than 9 cm were ripe or in post reproductive phase. These preliminary results are complementary with the prior Adriatic estimates of L₅₀ using the maturity key method shown in Appendix D.

20. Document n° 13. ANC 12, 13, 14, 16, 17. *Engraulis encrasicolus*

During the Working Group recently organized by the MedSudMed Project on length at sexual maturity of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*), experts reviewed and compared the methodologies they currently use to estimate the L₅₀. Data provided by 5 GSA's (12, 13, 14, 16, 17) show that the estimates of the L₅₀ for anchovy vary between 7.3 and 11.3 cm. The lowest values came from GSAs 12 and 14. Differences in the approaches were highlighted, in particular regarding the maturity scales used, the sampling period and the calculation of the gonadosomatic index. Participants discussed the possibility of standardizing the methodologies at regional level, taking into consideration the agreed protocol prepared on the request of the SCSA Working Group in 2002. A joint estimation made on the same sampling period reduces the difference between the estimates (between 7.5 and 11 cm), but values still show important differences. Further knowledge of the reproductive ecology of anchovy and more details on the sampling procedures as well

as histological analysis would be requested to enhance the accuracy of the estimates of L_{50} of this species. However, the L_{50} value shows an important geographical variability which is may be due not only to methodological discrepancies, but also to environmental effects.

GENERAL DISCUSSION ON LENGTH AT FIRST MATURITY

During the 2001 SCSA meeting in Rome, it was proposed to revise the existing information on the size at first maturity of the Mediterranean anchovy. A revision of the existing information showed that the majority of studies were based on visual classification of the maturity stages of the gonads. The results showed important differences between some of the Mediterranean populations. For that reason, during the last meeting of the 2002 Working Group of Small Pelagics of the SCSA (Rome, 2002), it was decided to perform a simultaneous analysis of this parameter following an agreed protocol that included histological analysis, to improve the precision.

Since 2002 only scientists of two subareas Northern Spain and North Adriatic (GSAs 6 and GSA 17) had performed analysis using histological methodology as following the protocol methodology. Also, new data of LFM of anchovy from South Sicily (GSA 16) using the maturity key analysis were presented (see **Appendix D**).

Taking into account all the information available at the time being we can conclude that:

- There is enough scientific evidence to state that the anchovy of western Mediterranean has a length at first maturity (L_{50}) of 11 cm total length.
- For the Adriatic anchovy, the previously reported LFM of 9 cm has been now validated using histological methods.
- New information coming from the MedSudMed Working Group provided new values for the L_{50} of anchovy and highlighted the variability of this parameter probably due, both to methodological differences and to environmental characteristics of the represented areas.

IDENTIFICATION OF NURSERY AREAS AND SENSITIVE HABITATS

21. Document n° 14 SAR+ANC 07-04. *Sardina pilchardus*, *Engraulis encrasicolus*

For security reasons, research vessels are not able to explore less than 15-20 m depth strata. However, a non-negligible part of the available fish biomass, mainly juveniles may be distributed in these inshore areas. The annual PELMED (PELAGiques MEDiterranée), surveys carried out on board the R/V L'Europe de l'Ifremer (catamaran, 30 m) estimate by the acoustic method the small pelagics biomass off the Gulf of Lions, from Marseille to the Spanish border. These surveys have been coupled to inshore acoustic explorations, within the depth range from 4-30 m. During 2001-2003, a synchronous sampling with the R/V Europe and a small inshore vessel Chlamys, equipped with the SIMRAD EY500.

The ten acoustic surveys have shown that there is an increasing density gradient towards inshore waters. The experience on acoustic evaluation in shallow waters (<20m) show that the acoustic densities were highly variable, and yet important juvenile concentrations.

The conclusion from this research recommends to assess the importance small pelagic juvenile concentrations of inshore waters (<20m) in similar ecosystems as the Gulf of Lions.

22. Document n° 15 SAR 01-06. *Sardina pilchardus*

Results of the first use of CUFES (Continuous Underwater Fish Egg Sampler) combined with standard Bongo 40 oblique hauls to map sardine spawning grounds off the Spanish Mediterranean coasts, jointly with the echo-acoustic evaluation (ECOMED) were presented. Low spawning activity is observed in the area off the Gulf of Valencia and the Catalanian coasts, in comparison to the Alborán Sea coasts. However, the significant larval abundances in the northern part seem to suggest an important decrease of sardine spawning, probably caused by undetermined environmental conditions.

The CUFES equipment proved to be a useful tool for mapping spawning grounds, showing a good agreement with the Bongo hauls; although due to its fixed depth at sampling (5m) is not representative true egg abundance.

23. Document n° 16. ANC 16-04 *Engraulis encrasicolus* 1997-2002.

Using information from six annual ichthyoplanktonic surveys carried out from 1997 to 2002 during the peak of anchovy spawning season, a correlation between anchovy egg horizontal distributions and hydrographic surface circulation, specifically the trajectory of the Modified Atlantic Water motion (locally called Atlantic Ionian Stream, AIS), was identified. The AIS path, which is quite variable from a year to another, may produce changes in temperature regime in coastal areas. This in turn may reflect upon the distribution pattern of anchovy spawning grounds, as low temperature regimes can inhibit the spawning process. The preference of the Sicilian Channel anchovy for spawning in warmer waters would be confirmed by the results of the present study, showing that surface thermal structures produced by AIS path and its distance from the shoreline can be successfully used as an indicator of anchovy spawning activity. In addition, data on anchovy larval distributions in the same period (1997-2002) emphasize the importance of the southern limit of the region, where a retention area has been detected, for the recruitment of anchovy population, indicating it as an area where possible actions able to reduce fishing effort could be undertaken.

24. Document n° 17. ANC 6,7,9-04 *Engraulis encrasicolus* 1983-1994

The spawning distribution of the anchovy in the Northwestern Mediterranean is reviewed from the published literature and project reports. This review clearly defines the prominent locations where the spawning of anchovy takes place. The main spawning grounds are located along the central part of the Gulf of Lions whose edges coincide with the shelf break in continuation with the northern Catalanian coast. This area is under the influence of the Rhône river outflow. At the southernmost area the important spawning ground is clearly located over the continental shelf in front of the Ebro river delta. The Liguro Provençal basin has anchovy spawning grounds located mainly along the Tuscan shelf, but in comparison to the previously described areas, the scale of abundance decrease six fold, approximately. Spawning is clearly associated with areas under the influence of the inflows of the Rhône river at the Gulf of Lions and the Ebro river in the Catalan Sea. It is also important the influence of the shelf slope front that runs along the entire shelf. The higher abundance found at the Tuscan shelf are also related with river outflows. Recently, it has been demonstrated the

importance of the contribution of freshwater discharges in enhancing recruitment of anchovy in both spawning areas, Gulf of Lions and continental shelf of the delta Ebro. Water enrichment during spawning season in those areas is enhanced by river run-off, thus increasing plankton production and favouring the survival rate of anchovy's early stages. From this review and the persistence of the results shown over the different years provides strong evidence that the two areas influenced by the rivers Rhône and Ebro are essential habitats for the anchovy population.

PRESENTATION OF AVAILABLE INFORMATION AND EVALUATION OF THE IMPACT OF DISCARDED QUANTITIES IN THE STOCK ASSESSMENT OF SMALL PELAGICS SPECIES

25. Document n° 18. SAR 17-04. *Sardina pilchardus*

In the past (1987-1999) there was evidence of sardine discards at sea as documented in the EU 97/65 EU Study "Discards from the Adriatic Small Pelagic Fishery". In the recent years sardine discards at sea by fishing fleet likely diminished, both for difficulties in obtaining enough catches and the rises of fish market price. Nevertheless, sardine discards at sea may occur. It is recommended to implement a discard monitoring programme.

OTHER RELATED DOCUMENTS

26. Document n° 19. ANC+SAR 07-04. *Engraulis encrasicolus*, *Sardina pilchardus*

Exploitation of small pelagic fishes from the Gulf of Lions requires a monitoring of their resources. The most important species fished are anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*). It is on these species that echointegration method is the most powerful. The results from ten years of evaluation by this method show that the level of biomass for the two species is high in regards to landings, and that different parameters used in each species biomass calculation should be respected, as those that include energy distribution detected along transects, importance of zone coverage by transects and trawling operations (percentage of caught species).

27. Document n° 20. SAR 16-04. *Sardina pilchardus*

A study on reproductive biology of sardine was performed based on data collected off the southern coast of Sicily (G.S.A.16). This work represents the first attempt to investigate the reproductive features of the sardine population in this area. During the period January 2000 to December 2002 gonadosomatic index (GSI) evolution was studied and size at first maturity (SFM) was estimated for separate and combined sexes. Monthly gonadosomatic index values and corresponding maturity stages evolution indicated that the spawning season approximately extends from late November to March-April of the following year, though the greatest part of spawning effort is done during November- January. L50 estimates (total length) assessed over two consecutive spawning events (2000-2001 and 2001-2002) were of 11.55 cm for all the sampled specimens, of 11.60 cm for males and 11.54 cm for females. However, these results have to be considered as preliminary, as sources of variability able to affect L50 estimates needs to be investigated more in depth.

28. Document n° 21. SAR 17-04. *Sardina pilchardus*

First sexual maturity of sardine, *S. pilchardus* (Walb.) from the Krka River estuary in the eastern Adriatic Sea was studied. A total of 470 sardine specimens were caught by beach seine (mesh size 7 mm) in the Krka River estuary during the spawning period in December 2002. Total length of sardine specimens used for obtaining the lowest size of its sexual maturation ranged from 7.0 to 12.0 cm. The minimal length at first maturity, as well as L50 and L100 of sardine, *Sardina pilchardus* (Walb.) were estimated. The L50 obtained was 8.0 cm and L100 11.5 cm.

The results of this research together with those of the previous document corroborate the difference found with this parameter between the Adriatic and other areas of the Mediterranean Sea.

REMARKS

The WG recommends that participation of more scientists from more countries to be financially supported.

The facilitator of the WG, if not supported by his national government should be supported by the GFCM.

ADOPTION OF THE REPORT

The report of the 5th WG of Small Pelagic Species of the Subcommittee on Stock Assessment was adopted on May 7, 2004.

APPENDIX A

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APPENDIX B

AGENDA

Thursday 6th May 2004

- 9:00: Opening of the meeting, election of the chairman and of rapporteurs
- 9:30-9:45: Adoption of the agenda and planning of the session;
- 9:45-11: Presentation and discussion of new assessments
- 11-11:30: coffee break
- 11:30-13:30 Presentation and discussion of new assessments
- 13:30- 15:30 Lunch
- 15:30-17:00: Length at first maturity of Mediterranean anchovy
Discussion and conclusions taking into account the new and existing information on this matter.
- 17:00-17:30 coffee break
- 17:30-18:30 Presentation and discussion of other related documents

Friday 7th of May 2004

- 9.00-10:00: identification of nursery areas and sensitive habitats
- 10-10:30: Presentation of available information and evaluation of the impact of discarded quantities in the stock assessment of small-pelagic species.
- 11:00: coffee break
- 11:30-13:30: Preparation of final report
- 13:30-15-30: Lunch
- 15:30-16:30: Preparation of final report
- 16:30-18:30 Adoption of the report

APPENDIX C
G.F.C.M. SAC Working Group on the Assessment of Small Pelagics Màlaga 6-7 May 2004
List of Working Documents

Nb	GSA	Authors	Title	AssForm	Doc
1)	1	P. Torres, A. Giráldez, M. González, L. Quintanilla and J. Baro	Anchovy (<i>Engraulis encrasicolus</i>) Stock Assessment in the GFCM Geographical Sub-Area 01 (2003)	X	
2)	6	P. Torres, A. Giráldez, M. González, L. Quintanilla and J. Baro	Anchovy (<i>Engraulis encrasicolus</i>) Stock Assessment in the GFCM Geographical Sub-Area 06 North (2001, 2002 and 2003)		
3)	1	L. Quintanilla, M. González, P. Torres, A. Giráldez and J. Baro	Sardine (<i>Sardina pilchardus</i>) Stock Assessment in the GFCM Geographical Sub-Area 01 (2003)	X	
4)	6	L. Quintanilla, M. González, P. Torres, A. Giráldez and J. Baro	Sardine (<i>Sardina pilchardus</i>) Stock Assessment in the GFCM Geographical Sub-Area 06 North (2001, 2002 and 2003)	X	
5)	6	L. Quintanilla, M. González, P. Torres, A. Giráldez and J. Baro	Sardine (<i>Sardina pilchardus</i>) Stock Assessment in the GFCM Geographical Sub-Area 06 South (2003)	X	
6)	3	O. Kada, N. Abid	Sardine (<i>Sardina pilchardus</i> , Walb.) in the Management Unit 3 Mediterranean coast of Morocco	X	
7)	7	Y. Guennegan, B. Liorzou, J.L. Bigot	Sardine (<i>Sardina pilchardus</i>) Stock Assessment in the Gulf of Lions 1985-2003	X	
8)	7	Y. Guennegan, B. Liorzou, J.L. Bigot	Anchovy (<i>Engraulis encrasicolus</i> , L.) stock assessment in the Gulf of Lions 1985-2003	X	
9)	16	A. Bonnano, S. Mazzola, B. Patti, G. Basilone, S. Goncharov, M. Cancemi, G. Buscaino, A. Cuttitta, V. Palumbo, G. Cosimi	Biomass estimates of small pelagic fish species in the Strait of Sicily in the period 1998-2003		X
10)	17	N. Cingolani, A. Santojiani, E. Arneri, A. Belardinelli, S. Colella, F. Donato, G. Giannetti, G. Sinovcic, B. Zorita	Anchovy (<i>Engraulis encrasicolus</i> , L.) stock assessment in the Adriatic Sea: 1975-2003		X

11)	17	N. Cingolani, A. Santojiani, E. Arneri, A. Belardinelli, S. Colella, F. Donato, G. Giannetti, G. Sinovicic, B. Zorica	Sardine (<i>Sardina pilchardus</i> , Walb.) stock assessment in the Adriatic Sea: 1975-2003		X
12)	17	ISMAR-CNR & Univ. Ancona	Observations about first maturity size of Anchovy (<i>Engraulis encrasicolus</i> , Linnaeus 1758) in Adriatic Sea.		X
13)		T. Bahri	Working Group on basic parameters related to small pelagic fish: length at sexual maturity of anchovy and sardine in the MedSudMed Project area (14-16 April 2004, Mazara del Vallo, Italy) - Preliminary report of the meeting		X
14)	7	Y. Guennegan, J. Guillard, J.L. Bigot, P. Brehmer, M. Colon, Y. Cheret, B. Liorzou	Importance de la zone côtière dans les évaluations de stock de petits poissons pélagiques		X
15)	1, 6	A. García, J.M. Rodriguez, F. Alemany, J.M. Quintanilla	Mapping of sardine (<i>Sardina pilchardus</i>) spawning grounds off the Spanish Mediterranean coasts by means of the CUFES and plankton hauls		
16)	16	B. Patti, A. Cuttitta, A. Bonanno, G. Basilone, G. Buscaino, L. Rollandi, J. García Lafuente, A. Garcia, S. Mazzola	Spawning grounds of the European anchovy <i>Engraulis encrasicolus</i> in the Strait of Sicily (G.S.A. 16) and relations with hydrographic surface circulation		
17)	6,7	I. Palomera, A. Garcia	Anchovy spawning grounds in the Northwestern Mediterranean: A review		X
18)	17	N. Cingolani, G. Kirkwood, E. Arneri, A. Santojanni, A. Belardinelli, G. Giannetti, S. Colella, F. Donato, and C. Barry	Discards from the Adriatic Small Pelagic Fishery		X
19)	7	B. Liorzou; J.L. Bigot, Y. Guennegan	Evolution des stocks de sardine et d'anchois dans le golfe du Lion		X
20)	16	G. Basilone, B. Patti, S. Mazzola, A. Cuttitta, A. Bonanna, P. Sposito, C. Patti, L. Rollandi	Length at first maturity estimation for Sardine (<i>Sardina pilchardus</i>) in the Strait of Sicily.)		X
21)	17	G. Sinovicic, B. Zorica	Minimal length at maturity of sardine <i>S. pilchardus</i> (Walb.) in the Adriatic Sea		X

APPENDIX D

Data on Length at First Maturity (LFM) of Mediterranean anchovy from the literature and from the new analysis after the recommendation by SCSA 2002 (in bold)

GEOGRAPHICAL AREA	LFM (cm)	DEFINITION	APPROACH	REFERENCE	MANAGEMENT UNITS	SAMPLING PERIOD
Northern Alborán Sea	10.9	L50	Maturity key	Giráldez & Abad, 1995	Northern Alborán Sea - GSA 1	1990-1991
Algeria coast	11.4	L50	Maturity key	Djabali et al., 1988	Algeria – GSA 4	
Algeria coast	11.4	L50	Maturity key	Hemida, 1987	Algeria – GSA 4	
Castellón coast	11.0		Unexplained	Suau, 1979	Northern Spain -GSA 6	
Catalonia coast	12.6	L50	Maturity key	Pertierra, 1992	Northern Spain -GSA 6	1984-1985
Catalonia coast	12.5	L50	Histological method	Ochoa-Baez, 1998	Northern Spain -GSA 6	1994-1995
Gulf of Lions	11-13		Unexplained	Bertrand, 1991	Gulf of Lions – GSA 7	
Central Adriatic Sea	9.1	L50	Maturity key	Sinovic, 1992 and 2000	Northern and Central Adriatic – GSA 17	
Gulf of Kavala	11.0	L50	Maturity key	Torre, 1995 and Project 97-0048, Final report, 2000	Aegean Sea – GSA 22	1998-1999 1983-1984 1992-1993
Catalonia coast	11.08	L50	Maturity key Histological method	Palomera et al. 2003	Northern Spain - GSA 6	2001
South Sicily	11.24	L50	Maturity key	Basilone et al. 2003	South of Sicily – GSA 16	1997-2002
Central Adriatic Sea (river estuary)	8.2	L50	Maturity key	Sinovic & Zorica, 2004	Northern and Central Adriatic – GSA 17	2003
Adriatic sea	9.0	Minimum size	Histological method	CNR_ISMAR & Univ. Ancona, 2004	Northern and Central Adriatic – GSA 17	2003
* Tunisian coast	7.3 8.5 7.5		Maturity key Histological method	MedSudMed Report of WG 2004	Northern Tunisia – GSA 12 Gulf of Hammamet-GSA 13 Gulf of Gabes – GSA14	2000-2002

* Data from the report of the Working Group on basic parameters related to small pelagic fish: length at sexual maturity of anchovy and sardine in the MedSudMed Project area (14-16 April 2004, Mazara del Vallo, Italy).