GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN (GFCM)

REPORT OF THE SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA) Málaga (Spain), 10-12 May 2004

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1. OPENING OF THE MEETING

The sixth meeting of the SAC Sub-Committee (SC) on Stock Assessment (SCSA) of the GFCM was held at Palacio de la Aduana in Málaga (Spain) from 10-12 May 2004. It was opened and chaired by the Co-ordinator of the SCSA Mr P. Oliver. Mrs Constantina Karlou-Riga was nominated as rapporteur.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS OF THE SESSION

The agenda of the meeting was adopted (Annex 1).

The meeting was attended by 15 scientists from 8 countries as well as by an expert from FAO, 1 by EU, 1 from the FAO Regional Project ADRIAMED and 2 from COPEMED (Annex 2).

3. REVIEW AND ANALYSIS OF THE ASSESSMENTS PRESENTED TO THE DEMERSAL WORKING GROUP

The SC analyzed the assessments submitted by the Working Group (WG) on demersal species (Annex 3) held on May 6-7 of this year in Malaga (Spain).

The facilitator of the WG, Enrico Arneri was not present and the report was presented by Constantina Karlou-Riga (rapporteur of the WG). In this Working Group, 21 scientists from 7 countries attended the meeting.

Eighteen technical papers were presented and discussed by the Working Group. These documents were classified as: (i) assessment documents and (ii) assessment-related documents. Fourteen assessments were carried out covering 6 GSA and 7 species.

No assessments on shared stocks were presented (Annex 4). The following 14 stocks were evaluated for which the SC gives opinions:

HAKE (*Merluccius merluccius*)

- Stock in Geographical Sub Area 01 (Northern Alboran)
- Stock in Geographical Sub Area 05 (Balearic Islands)
- Stock in Geographical Sub Area 06 (Northern Spain)

RED MULLET (*Mullus barbatus*)

- Stock in Geographical Sub Area 01 (Northern Alboran)
- Stock in Geographical Sub Area 06 (Northern Spain)
- Stock in Geographical Sub Area 03 (Southern Alboran)
- Stock in Geographical Sub Area 11 (Sardinia)

STRIPED MULLET (*Mullus surmuletus*)

- Stock in Geographical Sub Area 05 (Balearic islands)

DEEP WATER ROSE SHRIMP (*Parapenaeus longirostris*)

- Stock in Geographical Sub Area 03 (Southern Alboran)

BLUE AND RED SHRIMP (*Aristeus antennatus*)

- Stock in Geographical Sub Area 01 (Northern Alboran)
- Stock in Geographical Sub Area 05 (Balearic Islands)
- Stock in Geographical Sub Area 06 (Northern Spain)

GIANT RED SHRIMP (*Aristaeomorpha foliacea*)

- Stock in Geographical Sub Area 11 (Sardinia)

BLUEFISH (*Pomatomus saltatrix*)

- Stock in Geographical Sub Area 14 (Gulf of Gabes)

HAKE (*Merluccius merluccius*)

Stock assessment of hake (*Merluccius merluccius***)** in **Geographical Sub Areas 01** (Northern Alboran), **05** (Balearic Islands) and **06** (Northern Spain).

FISHERIES: Hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries developed by around 800 vessels along the GFCM geographical sub-areas Northern Alboran Sea (GSA01), Balearic Islands (GSA05) and Northern Spain (GSA06). In last years, the annual landings of this species, which are mainly composed by juveniles living on the continental shelf, were ~4000 tons in the whole area. 95% of the landings come from trawlers.

SOURCE OF MANAGEMENT ADVICE: The state of exploitation was assessed applying a length cohort analysis (LCA) and yield per recruit (Y/R) analysis on a mean pseudo-cohort (2001-2003 for GSA05 and GSA06 and 2002 for GSA5), based on size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings. The input parameters set and the program (VIT) used were the same as previous assessments of the species in the area. Transition analysis were also performed, on a 20 year basis with constant recruitment, in order to simulate different management strategies directed to improve the exploitation pattern of this species in the area

STOCK STATUS: Growth overexploitation. Current level of B is very low compared to B_0.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: The WG noted that there are differences in the exploitation pattern in the three GSAs although the stock can be considered as unique. The need for sensitivity analysis and for an update of the growth and mortality parameters was raised, as well as the need to monitor discards mainly in GSA 01 and in the future to move to non equilibrium assessments. Transition analysis was made reducing the fishing effort by 20% and using 40mm square mesh size. The results showed that the increase in Y/R was higher after improving the selectivity than reducing fishing effort. There were gains in the second year after the application of this management measures. Assessments including also trawl survey data were encouraged. The WG recommends:

- To improve the selectivity: in comparison with the 40 mm diamond mesh size the use of 40 mm square mesh size is more effective.
- To control the effort on nursery areas.

SC OPINIONS: The SC, taking into account that the stock is heavily overexploited and that biomass is very low in comparison with the virgin one, highlights the necessity of both improving the selectivity and reducing the fishing effort.

RED MULLET (*Mullus barbatus)* AND STRIPED MULLET (*Mullus surmuletus*)

Stock assessment of red mullet (*Mullus barbatus*) in **Geographical Sub Areas 01** (Northern Alboran), and **06** (Northern Spain) and **of striped mullet (***Mullus surmuletus*) in **Geographical Sub Area 05** (Balearic Islands).

FISHERIES: Red mullets (*Mullus barbatus* and *Mullus surmuletus*) are one of the most important target species for the trawl fisheries developed by around 800 vessels along the GFCM geographical sub-areas Northern Alboran Sea (GSA01), Balearic Islands (GSA05) and Northern Spain (GSA06). In the last years, the annual landings of these species, which are mainly exploited in coastal areas on the continental shelf, were ~2200 tons in the whole area. Although both species are mixed in the official landings data, *M. surmuletus* predominates in the GSA05 catches (~80%), while in GSA01 and GSA06 the most important species is *M. barbatus* (~80%).

SOURCE OF MANAGEMENT ADVICE: The state of exploitation of these demersal resources was assessed by applying length cohort analysis (LCA) and yield per recruit (Y/R) analysis on a mean pseudo-cohort, based on size composition of trawl catches (obtained from on board and on port monthly samplings) and official landings. The software used to perform the analysis was the VIT programme and the input parameters sets were obtained from available previous assessments. Transition analysis was also performed in order to simulate different management strategies. The present work is the first attempt to assess the state of exploitation of red and striped mullets caught by trawlers in the whole Spanish Mediterranean coast.

STOCK STATUS: *Mullus surmuletus* in GSA 05 is fully exploited. *Mullus barbatus* in GSA 01 and 06 is overexploited. Growth overfishing was detected for *Mullus barbatus*.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: The exploitation pattern for *Mullus barbatus* is different in the two GSAs and this is due probably to different seasonal targeting by the fishermen. In the Alboran Sea (GSA 01) fishery is more concentrated on the recruitment. The WG noted that this was the first assessment of mullets (*Mullus* sp.) stocks in these GSAs. The best available data were used while longer time series including catch from other gears will have to be used in the future. Transition analysis was made reducing the fishing effort by 20% and using 40mm square mesh size. The results showed that the increase in Y/R was higher after improving the selectivity than reducing fishing effort. There were gains in the second year after the application of this management measures. The need for sensitivity analysis and for an update of the growth and mortality parameters was raised, as well as the need to monitor discards. The need of a vector of natural mortality was stressed. Assessments including also trawl survey data were encouraged . The WG recommends:

- For *Mullus surmuletus*: do not increase the fishing effort.
- For *Mullus barbatus*: a more effective control in closed coastal areas in order to protect recruitment. Seasonal closures are encouraged.
- To improve the selectivity for both species with a more strict control of the legal mesh size, moreover, in comparison with the 40 mm diamond mesh size, the use of 40 mm square mesh size would improve the exploitation pattern.

SC OPINIONS: The SC recognizes the need of updating the biological parameters and also the importance of sensitivity analysis for natural mortality. Moreover, it stresses the importance of including trawl survey data for a more reliable assessment (see item7: assessment methods). The SC considers that a better exploitation for red mullet stock would be achieved by improving the selectivity, as well as applying seasonal closures and the enforcement of regulations would improve the exploitation of the stock.

RED MULLET (*Mullus barbatus*) AND DEEP WATER ROSE SHRIMP (*Parapenaeus longirostris*)

Stock assessment of red mullet (*Mullus barbatus*) and **deep water rose shrimp** (*Parapenaeus longirostris*) in **Geographical Sub Area 03** (Southern Alboran).

FISHERIES: The main demersal resources are *Mullus barbatus* and *Parapenaeus longirostris*. They are target species for trawlers. The fleet consists of 120 trawlers. Trawler catches are landed mainly in three harbours: Nador (62.6%), Al Hoceima (23.2%) and M'diq (14.2%). Landings of these two species constitute 12% of the total demersal landings. *Mullus barbatus* is the target species in coastal areas while *Parapenaeus longirostris* is fished offshore in deeper waters. The two fishing activities partially overlap.

SOURCE OF MANAGEMENT ADVICE: An analysis of length frequency distribution obtained from sampling of landings has been performed by means of analytical models (VPA based on pseudocohort) for the main resources exploited by the Mediterranean fleet of Morocco. The Y/R analysis was utilised to test the behaviour of the populations to different exploitation levels. A vector of natural mortality was used to account for changes by age.

STOCK STATUS: *Mullus barbatus* is overexploited and *Parapenaeus longirostris* is fully exploited.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: The possibility of reducing the fishing mortality in coastal areas by moving the fleet activity further offshore was discussed with its implications on the level of exploitation of *Parapenaeus longirostris*: this was considered feasible only under a strict control of the fishing capacity. The WG recommends:

- A reduction of the fishing effort in coastal areas which could be achieved by transferring part of the fishing effort to more offshore fishing grounds.
- Enforcement of legal mesh size regulations and of coastal areas closures.

SC OPINIONS: The SC taking into account that the two fishing activities (inshore for red mullet and offshore for *Parapenaeus longirostris*) partially overlap, acknowledges that a

better condition for red mullet stock could be achieved by transferring part of the fishing effort to more offshore fishing grounds, but under a strict control of fishing capacity and enforcement of the regulations.

BLUE AND RED SHRIMP (*Aristeus antennatus*)

Stock assessment of blue and red shrimp (*Aristeus antennatus*) in **Geographical Sub Areas 01** (Northern Alboran), **05** (Balearic Islands) and **06** (Northern Spain).

FISHERIES: There are no relevant changes to the description of the fisheries given in the 2003 WG report. However the overall landings of *A. antennatus* decline in recent years and have been followed by a decrease in the number of trawlers fishing red shrimp. Long-term series of the landing and effort shows various phases, but the overall trend is clearly downward. Data series of mean sizes in the landings from 1996 to 2003 shows fluctuations about 26 and 24 mm CL for males. and 29 and 34 mm CL for females. *Aristeus* discards are negligible in this fishery. There is biological information on growth, maturity, length-weight coefficients and natural mortality rates applicable to the management units. The monthly sampling programme of the landings produces reliable length frequency distributions (LFDs.) and fishing effort figures. The data were considered to be adequate for an age-based assessment (after length/age conversion) that has been done.

SOURCE OF MANAGEMENT ADVICE: Size composition of landings from 1996 to 2003 was used to run a standard VPA. Extended Survivor Analysis was followed as a tuning method applying the Lowestoft VPA program on age groups generated by slicing the length distribution with L2AGE program. MFDP program was used for short time prediction and MFYPR was used for a yield per recruit estimation.

STOCK STATUS: VPA detected some sign of slight overexploitation.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: The WG welcomed the application of VPA as a non equilibrium assessment method. The assessment analysis by sex was considered as essential but for management purposes the assessment should be then merged, keeping in mind that the fishery is targeting females which are segregated by depth. Short term predictions suggest that at current level of fishing mortality the stock biomass will continue to decrease. Long term Y/R predictions show that females are overexploited with current F level well above Fmax. The Y/R curve is very flat topped in males. The WG noted that fishing mortality is not increasing but SSB is decreasing in short term predictions. Therefore indications are sometimes contradictory. The need to compare independent estimates of biomass from direct methods (trawl surveys) was strongly recommended. Taking into account also previous assessments the WG recommends:

- Do not increase the fishing effort.

SC OPINIONS: The SC welcomed the application of VPA as a non equilibrium assessment method and encourages the scientists using this method in other GSAs and stocks. However based on some contradictory results, it stresses the necessity to include in the assessment also trawl survey data.

GIANT RED SHRIMP (*Aristaeomorpha foliacea*) AND RED MULLET (*Mullus barbatus*)

Stock assessment of giant red shrimp (*Aristaeomorpha foliacea*) and **red mullet** (*Mullus barbatus*) **in Geographical Sub Area 11 (**Sardinia coasts)

FISHERIES: The red shrimp and the red mullet are commercially two of the most important species in the Sardinian seas where the biology, population dynamics, and feeding ecology have been studied intensively in the past fifteen years. During these last 10 years, in GSA 11, the trawling-fleet is remarkably changed. The change has mostly consisted in a general increase of the number of vessels (from 62 in 1991 to 71 in 2000) and by the replacement of the old, low-tonnage wooden boats by larger steel boats. For the entire GSA an increase of 120 % and 50 % for boats over 70-100 Tons class and >100 Tons class respectively occurred. We also observe a decrease for the smaller boats (<30 GRT).

SOURCE OF MANAGEMENT ADVICE: The data refer to 10 summer trawl surveys carried out between 1994 and 2003. Density and biomass indexes were used. Length frequency distributions were break down in age groups. Total mortality Z was estimated with length converted catch curve analysis. For natural mortality Pauly's regression was used. The trend of the mortality rate has been correlated with the variation of the fishing effort recorded between 1994 and 2003.Y/R analysis was performed as a function of F and t_c. Assessment was performed considering both the whole GSA 11 and three zones with different exploitation levels.

STOCK STATUS: For giant red shrimp (*Aristaeomorpha foliacea*) the biomass shows a gradual increase while for red mullet (*Mullus barbatus*) shows an oscillating trend. The analysis of the yield per recruit for both species evidences the good ecological conditions of the resource. The estimated F levels suggest that the resource is close to full exploitation.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: The WG noted the different level of exploitation in the different zone inside the GSA11 and highlighted the good condition of the stocks but the possible local overexploitation of some zones. Moreover the strong increase in fishing effort since 1996 generated some concern. A system of temporarily closed areas can reduce local situations of overexploitation. The WG recommends:

- Do not increase the fishing effort

SC OPINIONS: The SC despite the good condition of both species expresses some concern due to the increase of fishing effort. However, it welcomes the work for its contribution to the knowledge of the spatial behaviour of fishing effort.

BLUEFISH (*Pomatomus saltatrix*)

Stock assessment of bluefish (*Pomatomus saltatrix*) **in the Geographical Sub Area 14 (**Gulf of Gabes)

FISHERIES: *Pomatomus saltatrix* is caught by purse seine (55%), gill nets (40%) as well as bottom trawls (5%). Landings for 2003 were around 1000 tonnes.

SOURCE OF MANAGEMENT ADVICE: State of stock was assessed by applying a LCA using the VIT software.

STOCK STATUS: Fully exploited. Annual mean biomass was estimated at 1570 tonnes.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS:

- Do not increase the fishing effort.

SC OPINIONS: The SC endorses the assessment and advice

ASSESSMENT RELATED DOCUMENTS

Use of bottom trawl surveys data (program MEDITS) for stocks assessment. Particular case of France (GSA 7 – Gulf of Lions and 8 - Corsica)

This work will be discussed under the issue of assessment methods.

Assessment of the stock status of hake *Merluccius merluccius,* red mullet *Mullus barbatus* and Norway lobster *Nephrops norvegicus* in Geographical Subarea 09 Ligurian, Northern and Central Tyrrhenian Sea

This work is a contribution to the Reference Point Workshop.

Estimation of Reference Parameters through Survival Analysis

This work will be discussed under the issue of assessment methods. Moreover it is a contribution to the Reference Point Workshop.

Identifying nursery areas: a synopsis of case studies in the Strait of Sicily

A series of elaboration of trawl surveys data were presented aiming at the definition of nursery areas in the strait of Sicily (GSAs 15 and 16). Species covered are *Mullus barbatus, Merluccius merluccius, Parapenaeus longirostris, Pagellus erythrinus, Illex coindetii* and *Phycis blennoides.*

WG comments: WG welcomes the contribution and endorses the suggestion of establishing a common framework for the definition of nursery areas.

SC OPINIONS: The SC welcomed the suggested approach and the clear identification of nursery areas. The SC noted that the identification of nursery areas is under the mandate of SAC and encourages the scientists to address this issue in other GSAs.

Estimation bottom trawl discards in the northwestern Mediterranean

This work will be discussed under the issue of assessment methods

Genetic stock structure analysis revealed single population units in the Adriatic shared stocks of demersal species

Two genetic research projects (financed in parallel by FAO-AdriaMed and the Italian Ministry of Agriculture and Forestry Policies) have been carried out to identify population status and structure within the Adriatic shared stocks of the demersal resources, which are bio-economically relevant for SCSA in the Mediterranean. The sampling and genetic methodologies adopted in the project were standardised as possible for all species by means of MEDITS samplings and microsatellite marker analysis. Genetic estimators for population status (i.e. genetic polymorphism in terms of allele diversity, heterozygosity, fitting of Hardy-Weinberg equilibrium) and structure (i.e. genetic differentiation in terms of fixation indexes, gene flow rates) were applied using dedicated statistical software. The species studied were *Sepia officinalis, Loligo vulgaris, Nephrops norvegicus, Lophius budegassa, Mullus barbatus, Merluccius merluccius* and *Solea vulgaris*.

WG comments: The WG welcomed the document and considered it as an important contribution to stock identification for assessment purposes.

SC OPINIONS: The SC acknowledges the contribution of genetic studies to the definition of a stock for the purposes of stock assessment and encourages such investigations in all the Mediterranean.

4. REVIEW AND ANALYSIS OF THE ASSESSMENTS PRESENTED TO THE SMALL PELAGIS WORKING GROUP

The SC analyzed the assessments submitted by the Working Group (WG) on small pelagics (Annex 5) held on May 6-7 of this year in Málaga (Spain).

The facilitator of the WG, held in May of this year, Isabel Palomera was not present and the report was presented by Luis Francisco Quintanilla. Fifteen scientists from 5 countries attended the meeting.

Twenty two technical papers were presented and discussed by the Working Group. These documents were classified as: (i) assessment documents and (ii) assessment-related documents. Eight assessments were carried out covering 6 GSA and 2 species. Two assessments referred to shared stocks (see also annex 4), for which SC gives recommendations to SAC, while for the rest gives opinions:

ANCHOVY (*Engraulis encrasicolus*)

- Stock in Geographical Sub Area 01 (Northern Alboran)
- Stock in Geographical Sub Area 06 (Northern Spain)
- Stock in Geographical Sub Area 17 (Northern and Central Adrtiatic)

SARDINE (*Sardina pilchardus*)

- Stock in Geographical Sub Area 01 (Northern Alboran)
- Stock in Geographical Sub Area 06 (North of Northern Spain)
- Stock in Geographical Sub Area 06 (South of Northern Spain)

- Stock in Geographical Sub Area 03 (Sourhern Alboran)
- Stock in Geographical Sub Area 17 (Northern and Central Adrtiatic)

ANCHOVY (*Engraulis encrasicolus*)

Stock assessment of anchovy (*Engraulis encrasicolus*) in **Geographical Sub Areas 01** (Northern Alboran) and **06** (Northern Spain).

FISHERIES: Anchovy is caught by purse seiners. The Alborán Sea stock is exploited by small-sized fishing vessels in comparison to the N Spain, where the catch in 2003 was 177 tn.

SOURCE OF MANAGEMENT ADVICE: The method applied was Length Cohort Analysis (LCA) and Yield per Recruit Analysis (Y/R) using the VIT program. 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. 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.

STOCK STATUS: 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.

WG MANAGEMENT ADVICE AND 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.

SC OPINIONS: The SC endorses the assessments. However it stresses the necessity of some clarifications on the terms used in recommendations by WG

SARDINE (*Sardina pilchardus*)

Stock assessment of sardine (*Sardina pilchardus*) in **Geographical Sub Areas 01** (Northern Alboran), **06 North and 06 South** (Northern Spain).

FISHERIES: Sardine is caught by purse seiners. 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.

SOURCE OF MANAGEMENT ADVICE: 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 (L50) was estimated in 2003 for the GSA 01 at 13.25 cm.

STOCK STATUS: 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/Rmax and over-exploited with reference to Y/R0.1. 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 (especially 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.

WG MANAGEMENT ADVICE AND 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.

SC OPINIONS: SC endorses the assessments. However it stresses the necessity of some clarifications on the terms used in recommendations by WG

Stock assessment of sardine (*Sardina pilchardus*) in **Geographical Sub Area 03** (Southern Alboran)

FISHERIES: 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.

SOURCE OF MANAGEMENT ADVICE: 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.

STOCK STATUS: The results show that the fishing mortality is relatively high in mature individuals. The yield per recruit analysis indicates an overexploitation of the resource.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS:
Based on the analysis, the preliminary results recommend:

- 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).

SC OPINIONS: The SC endorses the assessments. Mr. Rafael Robles, Director of COPEMED, presented a draft proposal for a co-management pilot plan in the GSAs 01 (Northern Alboran) and 03 (Southern Alboran). The SC wondered wether sardine and anchovy stocks can be considered as shared in the area; no scientific evidences have been presented. The SC invites the concerned scientists to address this issue.

Stock assessment of sardine (*Sardina pilchardus*) in **Geographical Sub Area 17** (Northern and Central Adriatic)

FISHERIES: The sardine stock living in northern and central Adriatic Sea is shared between Italy, Slovenia and Croatia.

SOURCE OF MANAGEMENT ADVICE: 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. Acoustic data for biomass have already been taken into account. 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.

STOCK STATUS:

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: 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

SC OPINIONS AND RECCOMMENDATIONS: No agreement was reached regarding the interpretation of this assessment. The following two paragraphs summarize the different positions:

1) The biomass decreasing trend, consistent all over a period of 15 yrs, together with the increase of fishing mortality are clear signals of a process of a continuous overexploitation and more drastic measures should be implemented.

2) The recommendation of the WG is in agreement with more recent data of the first echo-syrveys in Croatia waters, in September 2003, presented at SAC meeting on Reference Points in April 2004. The results show a biomass of 200000 tn for sardine only in this part of the Adtiatic (Croatia), never investigated by Italian echo-survey. The total catch of sardine in the whole area is estimated equal to 15000 tn by year. The fishery on the small pelagics in GSA 17 is directed on anchovy and only a little part of effort on sardine.

ANCHOVY *(Engraulis encrasicolus)*

Stock assessment of anchovy (*Engraulis encrasicolus*) in **Geographical Sub Area 17** (Northern and Central Adriatic)

FISHERIES: The stock of anchovy living in northern and central Adriatic Sea, is shared between Italy, Slovenia and Croatia

SOURCE OF MANAGEMENT ADVICE: 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.

STOCK STATUS: 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.

WG MANAGEMENT ADVICE AND RECOMMENDATIONS: Given the situation of the stock, it is recommended:

- Not to allow the fishing effort to rise.

SC OPINIONS AND RECOMMENDATIONS: SC endorses the assessments and the recommendations

ASSESSMENT RELATED DOCUMENTS

Three documents evaluated as assessments in the Working Group were not discussed, since they were not considered as assessments by the SC.

DOCUMENTS RELATED TO THE 1ST MATURITY (LFM) ON MEDITERRANEAN ANCHOVY (*Engraulis encrasicolus*)

The first document concerns the GSA 17 (Northern and Central Adriatic). 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 ranged from 7 to 11 cm. Preliminary results show that all the males from 7.5 cm of total length show testes in phase of advanced spermatogenesis, while all the females with 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 of this WG report.

The second document concerns GSAs 12 (North Tunisia Coast), 13 (Gulf of Hamamed), 14 (gulf of Gabes), 16 (Sicily waters), and 17 (Northern and Central Adriatic). 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 L_{50}. Data provided by 5 GSAs (12, 13, 14, 16, 17) show that the estimates of the L_{50} 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.

WORKING GROUP GENERAL DISCUSSION 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 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 of WG on small pelagic report).
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 (L50) 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 L50 of anchovy and highlighted the variability of this parameter probably due, both to methodological differences and to environmental characteristics of the represented areas.

SC COMMENTS: The SC agrees with the WG conclusions. However, taking into account that the 1st maturity length may vary by year, it suggests a monitoring interannual estimation of L_{50} on anchovy. It also suggests continuing improving the methodology used despite the approved protocol by GFCM and highlights the need of including in the estimations given to the WG the values regarding L_{25} and L_{75}.

Regarding in general the size at first maturity (defined as the size at which 50% of the individuals reach their first maturity) is a routine procedure. However, its usefulness as a reference measure aimed at the allowance for most of the individuals of the population to spawn at least one during their life can not be generalised, in particular in the case of fast growing-short living species. In fact, analyses of the probability of maturity by size (maturity ogive), even done exactly during the peak of the spawning period result in an underestimation of the true size at which most of the individuals will really spawn. This is due to the fact that in the computations, also the smaller mature individuals will also be considered. Taking into account that also for the smaller individuals, the mature fraction will be high, the L_{50} estimated will be necessarily lower than the mean size at which individuals massively spawn; (the size of massive spawning can be defined as the mean size of the individuals at which will spawn for the first time estimated at the moment of the reproductive peak for this age class. Setting a Lc at the Lm value may produce a non

precautionary minimum size of capture for a stock because it does not guaranty the possibility of spawning for an adequate fraction of the stock.

DOCUMENTS RELATED WITH THE IDENTIFICATION OF NURSERY AREAS AND SENSITIVE HABITATS

The first document is related with ***Sardina pilchardus*** and ***Engraulis encrasicolus*** on GSA 07 (Gulf of Lions). In this document it is referred that 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 WG according to the results recommends to assess the important small pelagic juvenile concentrations of inshore waters (<20m) in similar ecosystems as the Gulf of Lions.

The second document is related with ***Sardina pilchardus*** on GSA 01-06 **(**Northern Alboran to Northern Spain). 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 Catalonian 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.

The third document is related with ***Engraulis encrasicolus*** on GSA 16 (Sicily waters). 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.

The fourth document is related with ***Engraulis encrasicolus*** on GSAs 06 (Northern Spain), 07 (Gulf of Lions) and 09 (Ligurian, Northern and Central Tyrrhenian Sea). 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 Catalonian 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.

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

One document was presented related with ***Sardina pilchardus*** on GSA 17 (Northern and Central Adriatic). 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

Under this title three documents were presented in the WG.

The first one is related with ***Engraulis encrasicolus*** and ***Sardina pilchardus*** on GSA 07 (Gulf of Lions). In this document it is shown that 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).

The second document is related with ***Sardina pilchardus*** on GSA 16 (Sicily waters). 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.

The third document is related with ***Sardina pilchardus*** on GSA 17 (Northern and Central Adriatic). 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.

Additionally the three following documents evaluated by the WG as assessments, were considered by the SC as related documents:

Anchovy (*Engraulis encrasicolus*) stock assessment in the Gulf of Lions 1985-2003

The annual landings of anchovy are 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.

Sardine (*Sardina pilchardus*) stock assessment in the Gulf of Lions 1985-2003

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.

Biomass estimates of small pelagic fish species in the Strait of Sicily in the period 1998-2003
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.

5. PRELIMINARY ANALYSIS OF THE REPORT ON THE REFERENCE POINTS WORKING GROUP MEETING

The results of the workshop on Reference Points, held in Rome on April 20-21 2004, were presented by G. Lembo (Annex 6).

The workshop was attended by 60 participants; 14 communications were presented by researchers and 1 communication was presented by the fishermen associations. The presentation of the scientific contributes was followed by a discussion session, which main outcomes are hereinafter summarised.

It was agreed that the indicators should be characterised by the following desirable features:

a) easy compilation and processing procedures;
b) minimization of basic assumptions;
c) reliable performance with respect to interactions between fishery, environment and resources;
d) applicability to different scenarios;
e) comprehensibility for the stakeholders;
f) easy integration and comparison among indicators coming from different sources.

It was stated that the uncertainty of reference points could be reduced through collaboration and sharing of data and experiences, as well as calibration of data.

It was suggested that in addition to indicators and reference points for single different stocks, specific indicators for each fishery or Operational Unit should be identified (poly-indicator system), which would be understood by all stakeholders. Moreover, it was proposed that each reference point should undergo a robustness and / or sensitivity test before being applied.

Furthermore, the use of a "traffic light approach" for assembling different indicators into a baseline of information for management decision was suggested before going deeply into modelling on a narrow range of assumptions.

It was pointed out that indicators and reference points could be obtained through catch assessment surveys and direct methods to get information mainly on the catch size spectrum (individual species and all species), mortality rates (e.g. Z_{med}, Z_{MBP}, $F_{0.1}$), recruit and spawner indices (e.g. R/S, SSB/SSB_0, SSB/B, B/R), life expectancy-survival, abundance indices, condition factors and estimates of the area extend of the stocks surveyed. Further indicators could be derived by examining historical data sources for past changes in overall ecosystem indicators (e.g. pelagic/demersal ratios, piscivore/planktivore ratios, PPR-TL_{catch}), diversity indices as overall indicators of ecosystem change (e.g. BOI index), change in basic ecosystem productivity and other environmental variables such as meteorological data.

SC COMMENTS: The SC welcomed the work had been done. However discussing the results presenting in the workshop, some different approaches on estimating Indicators and Refernce Points were discussed by SC to be addressed for fisheries management.

The use of multi-species indicators (for instance BOI index) and ecological indicators presented in the workshop, as those appeared on Caddy's paper and on Coll et al., are recommended to the scientists in the Mediterranean.

Another possibility is to identify indicators coming from composite models and surveys. This kind of indicators can be used as a monitoring system for Mediterraenan countries.

6. REVIEW AND ANALYSIS OF THE REPORT OF THE WORKING GROUP ON *Coryphaena hippurus*

The recently established working group on *Coryphaena hippurus* presented the last advances on the work (Annex 7) achieved in 2003 with the same data of the previous years (2000-2001), since no new sampling has been possible during the last year. The group has also presented the SCSA sheets B, P1, P2a, P2b, G, A1, A2, A3, D and Z.

More refined selection of starting parameters (i.e. Reference age, terminal fishing mortality and selection-at-age) after consultations withal the authors has allowed a second exploratory Separable VPA which lead to the results presented in the corresponding SCSA sheet A3 and which are not significantly different from those reached on the previous trials. Nevertheless we present them as is the only "assessment" done so far, but it has to be looked at with all the caution possible, taking into account that the data series is very short and incomplete and that very little is known on the growth dynamics of this species that is fished at the early stage of life: immature specimens, practically recruits. Therefore the state of the resource can be considered unknown at the moment. However, based on some other findings of this study, some recommendations in terms of management strategies can be stated:

- Genetic homogeneity of samples taken from the 4 areas, according to a study carried out at the beginning of the COPEMED-CORY program suggests that it comprises a single stock that should be managed in a coordinated way.

- The seasonal character of this fishery causes strong price fluctuations in the market that should be somehow regulated.
- The fishery should not be opened before middle August in the whole area to avoid fish <15 cm to be caught.
- The number of FADs by boat should be regulated.

Main research needs were identified and these fall into two categories: Biology of the species (growth parameters, sexual maturity) to better calibrate the models and Socio-economic studies to contribute to the process of market regulation.

The future of this working group is unsafe after the end of the FAO-COPEMED project that has financed all the works done during the last 3 years. According to the responsible of the four teams they would be keen on continuing the work as far as they get funds and this matter is under the decision of the concerned countries. Considering that *C. hippurus* is included in the EC priority list and that for this area is a very important fishery, a certain budget would be available among the EC members, but regarding relative importance of the species in relation to other exploited species, it probably will not receive the appropriate attention. By the time being, only Tunisia is going to continue with the sampling program under their own resources, but the other countries have not a final decision on it yet it will depend on the availability of funds.

COPEMED is open to new proposals for short term and punctual coordination activities to support the working group for at least the time that the project will still be alive (mid 2005).

SC COMMENTS: The SC welcomed the work had been done and endorses the recommendations.

7. REVIEW OF ASSESSMENT METHODS

Relating to this issue three documents were presented.

Use of bottom trawl surveys data (program MEDITS) for stock assessment. Particular case of France (GSA 7 – Gulf of Lions and 8 - Corsica)

In the case of the Gulf of Lions and the eastern coast of Corsica, two approaches are proposed. It is thought that these approaches can be used over the whole MEDITS area, from Gibraltar strait to the Aegean sea. The first approach is classical and mainly based on the analysis of the trends in abundance indices, either in weight or in number, of the 36 species (fish, crustaceans and cephalopods) of the reference list. Some examples are given which can show the various trends of some species in both areas. Seven species were analysed: *Mullus barbatus, Mullus surmuletus, Merluccius merluccius, Aristeomorpha foliacea, Parapenaeus longirostris, Nephrops norvegicus* and *Pagellus bogaraveo*. The second approach is based on multispecies dynamic indicators both at the populations and community levels. For these indicators, reference directions are well established: we know whether fishing activities will increase or decrease the indicator and so we know the direction to be avoided. This approach has been developed on the data from various French bottom surveys and the particular example of the French Mediterranean waters is given.

WG comments: The WG endorses the multi-species and multi-indicator approach and moreover strongly recommends the future use of trawl survey data in connection with assessments based on landings and effort data.

SC COMMENTS: The SC welcomed the multi-species and multi-indicator approach and endorces the WG reccommendations

Estimation of Reference Parameters through Survival Analysis

Reference Parameters are estimated through the Survival Analysis based on trawl surveys data. Robustness of estimations is checked out with real and simulated data. A general methodology for the simulation of catches and survival is introduced. The total mortality and the effective age at first capture appear as very robust estimation against variations of natural mortality. The life expectancy has been proposed as a robust indicator of the survival. Preliminary results for the Spanish coast and Gulf of Lions (GSAs 1, 6 and 7) are consistent with the assessments presented at this and previous WGs. In particular the improvement in selectivity seems to be more effective than effort reduction, and that hake stock in Spanish coasts is in worse condition than in the Gulf of Lion.

The authors of the DSA method confirmed that during the last years some progress has been made in the direction of validating the method. The method has been tested with data sets of the Western Mediterranean and also from different areas of the world: Pacific Peruvian hake, demersal resources in NE Brasilian coast with very consistent results. The whole methodology is going to be published as a special issue of *Scientia Marina* within the present year.

Furthermore, part of these results has been presented to the two SCSA working groups held in April and May 2004: WG on Reference Points and WG of Demersal species. At the first WG, *Life expectancy* was identified as a robust indicator of survival which is a tool for the diagnosis of stock status as well as for simulation of different management strategies. Results of the analysis carried out for hake in the Gulf of Lions and that was presented at the Demersal WG pointed out that a change in gear selectivity would be more effective than an effort reduction since the present age at first capture is about 2 – 3 months.

WG comments: The WG welcomes this first application of the method to real data coming both from trawl surveys and commercial samplings and encourages the authors to present this analysis according to the WG requirements.

SC COMMENTS: The SC endorces the WG comments.

Estimation bottom trawl discards in the northwestern Mediterranean

An estimation of the discards produced by bottom trawling in the Mediterranean was presented. It is based on results from a number of research projects. The number of species affected by trawling is high, of the order of hundreds of species, and most of them are discarded. Discards represent a component of the fishing mortality that often cannot be taken into account in the assessment of the fishing resources when using commercial data. Discards in shallow waters are

higher than in deeper ones, both in number of species and in weight. The main reason for discarding is the lack of commercial value. Regarding the species with commercial value, the discarded catch consists of smaller individuals. In the study area, as in general in the Mediterranean, the landings of the target species show a clear seasonality

WG comments: the WG recognises the importance of discards estimation and recommends the inclusion of these estimates in the assessments, if possible in a way allowing obtaining separate F vectors from landed and discarded catches.

SC COMMENTS: The SC highlights the importance of this issue to be addressed for a more reliable assessment of the stocks and encourages the use of trawl survey data for the estimation of discards.

SC GENERAL COMMENTS:

- **The need to use trawl and survey data in parallel with the commercial data**
- **The use of typical VPA method was encouraged to be used by the scientists in the future**

8. PRESENTATION AND DISCUSSION ON THE SIMULATION TRIALS OF VARIOUS MANAGEMENT SCENARIOS APPLIED ON SOME MEDITERRANEAN FISHERIES PERFORMED BY THE BIO-ECONOMIC MODELLING (BEMMFISH PROJECT)

The theoretical background of the BEMMFISH EU funded project was presented as well as some preliminary results of some case studies. The case studies developed by the project are:

- Gulf of Lions hake fishery
- Western Mediterranean red shrimp fishery
- Tarragona small pelagics fishery
- Ligurian demersal fishery
- Adriatic small pelagics fishery
- Gulf of Saronikos hake and red mullet fishery

The case studies concerning the Gulf of Lions, the Western Mediterranean red shrimp fishery and the Saronikos Gulf were presented. It was also announced the preparation of Symposium in October with the stakeholders to present the tools produced by this project. Some precisions on the model were discussed.

9. REVISION OF THE SHARED STOCKS LIST

No new shared stocks were identified. The Table listing the shared stocks as adopted at the 28th Session of GFCM has been amended by deleting duplicated stocks (Annex 8).

10. REVISION OF THE PRIORITY SPECIES LIST

The priority species list was revised. The species *Pomatomus saltatrix* is proposed to be included in the species priority list.

11. GENERAL COMMENTS AND RECOMMENDATIONS

The SC considers that travelling and subsistence costs of facilitators and coordinators should be supported by GFCM.

12. NOMINATION OF CO-ORDINATORS FOR THE SC AND WGs

Due to reseignation of the current co-ordinator, the SC agrees to propose the nomination of Constantina Karlou-Riga as co-ordinator of sub-committee on stock assessment.

13. OTHER MATTERS

The SC was informed by the SCSI on the state of work referred to OUs in the Adriatic.

The establishment of a Working Group on selectivity was recommended by the WG on Demersals (see Annex 3). The Working Group on selectivity will have to address a common protocol of methodology in order to proceed with specific experimental work.

SC COMMENTS: The SC endorses the recommendation. However it notes that Terms of Reference for this WG should be given.

14. ADOPTION OF THE REPORT

The report was adopted on May 13, 2004

15. ANNEXES

1. Agenda
2. List of participants
3. WG Report on Demersals
4. Table of assessments
5. WG Report on Small Pelagics
6. Report of the Workshop on Reference Points
7. Report of the WG on ***Coryphaena hyppurus***
8. List of the shared stocks

ANNEX 1

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
(GFCM)
SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA)
Malaga (Spain), 10-12 May 2004

PROVISIONAL AGENDA

Coordinator: P. Oliver
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1. Opening of the meeting

2. Adoption of the agenda and arrangements of the session

3. Review and analysis of the assessments presented to the demersal Working Group (See excerpts of GFCM and SAC 2003 meetings in annexes 1 and 2 and report of WG_2003 in ftp:\\cucafera.csic.es\pub\scsa).

4. Review and analysis of the assessments presented to the small pelagics Working Group (See excerpts of GFCM and SAC 2003 meetings in annexes 1 and 2 and report of WG_2003 in ftp:\\cucafera.csic.es\pub\scsa).

5. Preliminary analysis of the report of the Reference Points Working Group meeting.

6. Review and analysis of the report of the Working Group on *Coryphaena hippurus*

7. Review of assessment methods

8. Presentation and discussion on the simulation trials of various management scenarios applied on some Mediterranean fisheries performed by the bio-economic modelling (BEMMFISH Project). See excerpts of SAC 2003 meetings in annex 2.

9. Revision of the shared stocks list. See list adopted in 2003 by GFCM in: ftp:\\cucafera.csic.es\pub\scsa.

10. Revision of the priority species list. See list adopted in 2003 by GFCM in: ftp:\\cucafera.csic.es\pub\scsa.

11. Summary of comments and recommendations addressed by the SCSA to SAC.

12. Nomination of co-ordinators for the SC and WGs

13. Other matters

14. Adoption of the report

For further information please contact Dr. Oliver (pere.oliver@ba.ieo.es).
FTP site: ftp://cucafera.icm.csic.es/pub/scsa/
Subscribing e-mail list: https://llistes.cmima.csic.es/listinfo/scsa
Sending an e-mail to the list scsa@icm.csic.es

ANNEX 2

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN (GFCM)
SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA)
Malaga (Spain), 10-12 May 2004

List of participants

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ANNEX 3

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

(GFCM)

WORKING GROUP ON DEMERSAL SPECIES

Màlaga, Spain, 6-7 May, 2004

OPENING OF THE MEETING

1. The fifth meeting of the SAC Working Group on Demersal Species of GFCM was held at Palacio de la Aduana, Màlaga from 6 to 7 May 2004.

2. The meeting was attended by 21 scientists from 7 countries and one representative from FAO and two from EU . The list of participants is attached as Appendix A.

3. The Agenda of the Working Group was adopted (Appendix B) and the list of documents was updated (Appendix C).

4. Two rapporteurs, Constantina Karlou-Riga and Enrico Arneri were designated. Mr Enrico Arneri was nominated chairperson of the meeting.

PRESENTATIONS TO AND DISCUSSIONS BY THE WORKING GROUP

5. 18 technical papers were presented and discussed by the Working Group.

6. Assessments for 14 stocks were presented covering 6 Geographical Subareas (GSAs), and 7 species. See Appendix D

7. Two types of documents were presented: (i) assessment documents and (ii) assessment-related documents. The conclusions and recommendations related to the assessment presented in each document and endorsed by the Working Group are listed below.

ASSESSMENT DOCUMENTS

Document n° 1: Stock assessment of hake (*Merluccius merluccius*) from the trawl fishery off the geographical sub area 01(Northern Alboran)

Document n° 2: Stock assessment of hake (*Merluccius merluccius*) from the trawl fishery off the geographical sub-area 05 (Balearic Islands)

Document n° 3: Stock assessment of hake (Merluccius merluccius) from the trawl fishery off the geographical sub-area 06 (Northern Spain)

8. **FISHERIES:** Hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries developed by around 800 vessels along the GFCM geographical sub-areas Northern Alboran Sea (GSA01), Balearic Islands (GSA05) and Northern Spain (GSA06). In last years, the annual landings of this species, which are mainly composed by juveniles living on the continental shelf, were ~4000 tons in the whole area. 95% of the landings come from trawlers.

9. **SOURCE OF MANAGEMENT ADVICE:** The state of exploitation was assessed applying a length cohort analysis (LCA) and yield per recruit (Y/R) analysis on a mean pseudo-cohort (2001-2003 for GSA05 and GSA06 and 2002 for GSA5), based on size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings. The input parameters set and the program (VIT) used were the same as previous assessments of the species in the area. Transition analysis were also performed, on a 20 year basis with constant recruitment, in order to simulate different management strategies directed to improve the exploitation pattern of this species in the area

10. **STOCK STATUS:** Growth overexploitation. Current level of B is very low compared to B_0.

11. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:** the WG noted that there are differences in the exploitation pattern in the three GSAs although the stock can be considered as unique. The need for sensitivity analysis and for an update of the growth and mortality parameters was raised, as well as the need to monitor discards mainly in GSA 01 and in the future to move to non equilibrium assessments. Transition analysis was made reducing the fishing effort by 20% and using 40mm square mesh size. The results showed that the increase in Y/R was higher after improving the selectivity than reducing fishing effort. There were gains in the second year after the application of this management measures. Assessment including also trawl survey data were encouraged (see general comments).The WG recommends:

- To improve the selectivity: in comparison with the 40 mm diamond mesh size the use of 40 mm square mesh size is more effective.
- To control the effort on nursery areas.

Document n° 4: Stock Assessment of red mullet (*Mullus barbatus*) from the trawl fishery off the geographical sub-area 01 (Northern Alboran)

Document n° 5: Stock Assessment of striped red mullet (*Mullus surmuletus*) from the trawl fishery off the geographical sub-area 05 (Balearic Islands)

Document n° 6: Stock assessment of red mullet (*Mullus barbatus*) from the trawl fishery off the whole geographical sub-area 06 (Northern Spain)

12. **FISHERIES:** Red mullets (*Mullus barbatus* and *Mullus surmuletus*) are one of the most important target species for the trawl fisheries developed by around 800 vessels along the GFCM geographical sub-areas Northern Alboran Sea (GSA01), Balearic Islands (GSA05) and Northern Spain (GSA06). In the last years, the annual landings of these species, which are mainly exploited in coastal areas on the continental shelf, were ~2200 tons in the whole area. Although both species are mixed in the official landings data, *M. surmuletus* predominates in the GSA05 catches (~80%), while in GSA01 and GSA06 the most important species is *M. barbatus* (~80%).

13. **SOURCE OF MANAGEMENT ADVICE:** The state of exploitation of these demersal resources was assessed by applying length cohort analysis (LCA) and yield per recruit (Y/R) analysis on a mean pseudo-cohort, based on size composition of trawl catches (obtained from on board and on port monthly samplings) and official landings. The software used to perform the analysis was the VIT programme and the input parameters sets were obtained from available previous assessments. Transition analysis was also performed in order to simulate different management strategies. The present work is the first attempt to assess the state of exploitation of red and striped mullets caught by trawlers in the whole Spanish Mediterranean coast.

14. **STOCK STATUS:** *Mullus surmuletus* in GSA 05 is fully exploited. *Mullus barbatus* in GSA 01 and 06 is overexploited. Growth overfishing was detected for *Mullus barbatus*.

14. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:** The exploitation pattern for *Mullus barbatus* is different in the two GSAs and this is due probably to different seasonal targeting by the fishermen. In the Alboran Sea (GSA 01) fishery is more concentrated on the recruitment. The WG noted that this was the first assessment of red mullets (*Mullus* sp.) stocks in these GSAs. The best available data were used while longer time series including catch from other gears will have to be used in the future. Transition analysis was made reducing the fishing effort by 20% and using 40mm square mesh size. The results showed that the increase in Y/R was higher after improving the selectivity than reducing fishing effort. There were gains in the second year after the application of this management measures. The need for sensitivity analysis and for an update of the growth and mortality parameters was raised (see general comments), as well as the need to monitor discards. The need of a vector of natural mortality was stressed. Assessment including also trawl survey data were encouraged (see general comments). The WG recommends:

- For *Mullus surmuletus*: do not increase the fishing effort.

- For *Mullus barbatus*: a more effective control in closed coastal areas in order to protect recruitment. Seasonal closures are encouraged.
- To improve the selectivity for both species with a more strict control of the legal mesh size, moreover, in comparison with the 40 mm diamond mesh size, the use of 40 mm square mesh size would improve the exploitation pattern.

Document n° 7 : Etat des stocks des principales ressources démersales en Méditerranée marocaine, *Mullus barbatus* and *Parapenaeus longirostris* in GSA 03.

15. **FISHERIES:** The main demersal resources are *Mullus barbatus* and *Parapenaeus longirostris*. They are target species for trawlers. The fleet consists of 120 trawlers. Trawler catches are landed mainly in three harbours: Nador (62.6%), Al Hoceima (23.2%) and M'diq (14.2%). Landings of these two species constitute 12% of the total demersal landings. *Mullus barbatus* is the target species in coastal areas while *Parapenaeus longirostris* is fished offshore in deeper waters. The two fishing activities partially overlap.

16. **SOURCE OF MANAGEMENT ADVICE:** An analysis of length frequency distribution obtained from sampling of landings has been performed by means of analytical models (VPA based on pseudocohort) for the main resources exploited by the Mediterranean fleet of Morocco. The Y/R analysis was utilised to test the behaviour of the populations to different exploitation levels. A vector of natural mortality was used to account for changes by age.

17. **STOCK STATUS:** *Mullus barbatus* is overexploited and *Parapenaeus longirostris* is fully exploited.

18. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:** the possibility of reducing the fishing mortality in coastal areas by moving the fleet activity further offshore was discussed with its implications on the level of exploitation of *Parapenaeus longirostris* : this was considered feasible only under a strict control of the fishing capacity. The WG recommends:

- A reduction of the fishing effort in coastal areas which could be achieved by transferring part of the fishing effort to more offshore fishing grounds.
- Enforcement of legal mesh size regulations and of coastal areas closures.

Document n° 8: VPA assessment of Mediterranean Spanish Aristeus stocks (2003): GSA 01 (Northern Alborán Sea).

Document n° 9: VPA assessment of Mediterranean Spanish Aristeus stocks (2003): GSA 05 (Balearic Islands)

Document n°10: VPA assessment of Mediterranean Spanish Aristeus stocks (2003): GSA 06 (Spanish Coast).

19. **FISHERIES:** There are no relevant changes to the description of the fisheries given in the 2003 WG report. However the overall landings decline of *A. antennatus* in recent years have been followed by a decrease of the number of trawlers fishing red shrimp. Long-term series of the landing and effort shows various phases, but the overall trend is clearly downward. Data series of mean sizes in the landings from 1996 to 2003 shows fluctuations about 26 and 24 mm CL for males. and 29 and 34 mm CL for females. *Aristeus* discards are negligible in this fishery. There is biological information on growth, maturity, length-weight coefficients and natural mortality rates applicable to the management units. The monthly sampling programme of the landings produces reliable length frequency distributions (LFDs.) and fishing effort figures. The data were considered to be adequate for an age-based assessment (after length/age conversion) that has been done.

20. **SOURCE OF MANAGEMENT ADVICE:** Size composition of landings from 1996 to 2003 was used to run a standard VPA. Extended Survivor Analysis was followed as a tuning method applying the Lowestoft VPA program on age groups generated by slicing the length distribution with L2AGE program. MFDP program was used for short time prediction and MFYPR was used for a yield per recruit estimation.

21. **STOCK STATUS:** VPA detected some sign of slight overexploitation.

22. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:** the WG welcomed the application of VPA as a non equilibrium assessment method. The assessment analysis by sex was considered as essential but for management purposes the assessment should be then merged, keeping in mind that the fishery is targeting females which are segregated by depth. Short term predictions suggest that at current level of fishing mortality the stock biomass will continue to decrease. Long term Y/R predictions show that females are overexploited with current F level well above Fmax. The Y/R curve is very flat topped in males. The WG noted that fishing mortality is not increasing but SSB is decreasing in short term predictions. Therefore indications are sometimes contradictory. The need to compare independent estimates of biomass from direct methods (trawl surveys) was strongly recommended. Taking into account also previous assessments the WG recommends:

- Do not increase the fishing effort.

Document n° 13 : Assessment of demersal resources in the Sardinian seas (GSA 11):the case studies of "giant red shrimp" and "red mullet"

23. **FISHERIES:** The red shrimp and the red mullet are commercially two of the most important species in the Sardinian seas where the biology, population dynamics, and feeding ecology have been studied intensively in the past fifteen years. During these last 10 years, in GSA 11, the trawling-fleet is remarkably changed. The change has mostly

consisted in a general increase of the number of vessels (from 62 in 1991 to 71 in 2000) and by the replacement of the old, low-tonnage wooden boats by larger steel boats. For the entire GSA an increase of 120 % and 50 % for boats over 70-100 Tons class and >100 Tons class respectively occurred. We also observe a decrease for the smaller boats (<30 GRT).

24. **SOURCE OF MANAGEMENT ADVICE:** the data refer to 10 summer trawl surveys carried out between 1994 and 2003. Density and biomass indexes were used. Length frequency distribution were break down in age groups. Total mortality Z was estimated with length converted catch curve analysis. For natural mortality Pauly's regression was used. The trend of the mortality rate has been correlated with the variation of the fishing effort recorded between 1994 and 2003.Y/R analysis was performed as a function of F and t_c. Assessment was performed considering both the whole GSA 11 and three zones with different exploitation levels.

25. **STOCK STATUS:** for giant red shrimp (*Aristaeomorpha foliacea*) the biomass shows a gradual increase while for red mullet (*Mullus barbatus*) shows an oscillating trend. The analysis of the yield per recruit for both species evidences the good ecological conditions of the resource. The estimated F levels suggest that the resource is close to full exploitation.

26. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:** The WG noted the different level of exploitation in the different zone inside the GSA11 and highlighted the good condition of the stocks but the possible local overexploitation of some zones. Moreover the strong increase in fishing effort since 1996 generated some concern. A system of temporarily closed areas can reduce local situations of overexploitation. The WG recommends:

- Do not increase the fishing effort.

Document n° 20 : Exploitation et ecobiologie du Serre, *Pomatomus saltatrix* dans le golfe de Gabes (Tunisie) GSA 14.

27. **FISHERIES:** *Pomatomus saltatrix* is caught by purse seine (55%), gill nets (40%) as well as bottom trawls (5%). Landings for 2003 were around 1000 tonnes.

28. **SOURCE OF MANAGEMENT ADVICE:** State of stock was assessed by applying a LCA using the VIT software.

29. **STOCK STATUS:** Fully exploited. Annual mean biomass was estimated at 1570 tonnes.

30. **WG MANAGEMENT ADVICE AND RECOMMENDATIONS:**

- Do not increase the fishing effort.

ASSESSMENT RELATED DOCUMENTS

Document n° 11: Use of bottom trawl surveys data (program MEDITS) for stocks assessment. Particular case of France (GSA 7 and 8)

31. **Summary:** In the case of the Gulf of Lions and the eastern coast of Corsica, two approaches are proposed. It is thought that these approaches can be used over the whole MEDITS area, from Gibraltar strait to the Aegean sea. The first approach is classical and mainly based on the analysis of the trends in abundance indices, either in weight or in number, of the 36 species (fish, crustaceans and cephalopods) of the reference list. Some examples are given which can show the various trends of some species in both areas. Seven species were analysed: *Mullus barbatus, Mullus surmuletus, Merluccius merluccius, Aristeomorpha foliacea, Parapenaeus longirostris, Nephrops norvegicus* and *Pagellus bogaraveo*. The second approach is based on multispecies dynamic indicators both at the populations and community levels. For these indicators, reference directions are well established : we know whether fishing activities will increase or decrease the indicator and so we know the direction to be avoided. This approach has been developed on the data from various French bottom surveys and the particular example of the French Mediterranean waters is given.

32. **WG comments:** The WG endorses the multi-species and multi-indicator approach and moreover strongly recommends the future use of trawl survey data in connection with assessments based on landings and effort data (see general comments).

Document n° 12 : Assessment of the stock status of hake *Merluccius merluccius*, red mullet *Mullus barbatus* and Norway lobster *Nephrops norvegicus* in Geographical Subarea 09 Ligurian, Northern and Central Tyrrhenian Sea.

33. An update of data relating to these three species were presented together with a series of approaches to the problem of Biological Reference Points. Trawl survey and commercial catches data were used, as well as additional information on the spatial distribution of fishing effort.

34. **WG comments:** The WG welcomes the exercise and encourages the presentation of this analysis according to the WG requirements.

Document n° 14 : Estimation of Reference Parameters through Survival Analysis

35. **Summary:** Reference Parameters are estimated through the Survival Analysis based on trawl surveys data. Robustness of estimations is checked out with real and simulated data. A general methodology for the simulation of catches and survival is introduced. The total mortality and the effective age at first capture appear as very robust estimation against variations of natural mortality. The life expectancy has been proposed as a robust indicator of the survival. Preliminary results for the Spanish coast and Gulf of Lions (GSAs 1, 6 and 7) are consistent with the assessments presented at this and previous WGs. In particular the improvement in selectivity seems to be more effective than effort reduction, and that hake stock in Spanish coasts is in worse condition than in the Gulf of Lion.

36. **WG comments:** The WG welcomes this first application of the method to real data coming both from trawl surveys and commercial samplings and encourages the authors to present this analysis according to the WG requirements.

Document n° 15 : Identifying nursery areas: a synopsis of case studies in the Strait of Sicily

37. **Summary**: A series of elaboration of trawl surveys data were presented aiming at the definition of nursery areas in the strait of Sicily (GSAs 15 and 16). Species covered are *Mullus barbatus, Merluccius merluccius, Parapenaeus longirostris, Pagellus erythrinus, Illex coindetii* and *Phycis blennoides*.

38. **WG comments:** WG welcomes the contribution and endorses the suggestion of establishing a common framework for the definition of nursery areas.

Document n° 16 : Estimation bottom trawl discards in the northwestern Mediterranean

39. **Summary**: An estimation of the discards produced by bottom trawling in the Mediterranean was presented. It is based on results from a number of research projects. The number of species affected by trawling is high, of the order of hundreds of species, and most of them are discarded. Discards represent a component of the fishing mortality that often cannot be taken into account in the assessment of the fishing resources when using commercial data. Discards in shallow waters are higher than in deeper ones, both in number of species and in weight. The main reason for discarding is the lack of commercial value. Regarding the species with commercial value, the discarded catch consists of smaller individuals. In the study area, as in general in the Mediterranean, the landings of the target species show a clear seasonality

40. **WG comments**: the WG recognises the importance of discards estimation and recommends the inclusion of these estimates in the assessments, if possible in a way allowing to obtain separate F vectors from landed and discarded catches.

Document n° 17 : Commercial application of a sort grid to reduce juvenile hake (Merluccius merluccius, L.) catches in the western Mediterranean demersal trawl fishery

This document was received but not presented.

Document n° 18: Genetic stock structure analysis revealed single population units in the Adriatic shared stocks of demersal species.

41. Two genetic research projects (financed in parallel by FAO-AdriaMed and the Italian Ministry of Agriculture and Forestry Policies) have been carried out to identify population status and structure within the Adriatic shared stocks of the demersal resources, which are bio-economically relevant for SCSA in the Mediterranean. The sampling and genetic methodologies adopted in the project were standardised as possible for all species by means of MEDITS samplings and microsatellite marker analysis. Genetic estimators for population status (i.e. genetic polymorphism in terms of allele diversity, heterozygosity, fitting of Hardy-Weinberg equilibrium) and structure (i.e. genetic differentiation in terms of fixation indexes, gene flow rates) were applied using dedicated statistical software. The species studied were *Sepia officinalis, Loligo vulgaris, Nephrops norvegicus, Lophius budegassa, Mullus barbatus, Merluccius merluccius* and *Solea vulgaris*.

42. **WG comments:** The WG welcomed the document and considered it as an important contribution to stock identification for assessment purposes.

GENERAL COMMENTS AND RECOMMENDATIONS

43. The need for the use of trawl survey data together with commercial sampling data to produce more complete and reliable assessments was repeatedly stressed.

44. The need to update biological parameters (e.g. growth and mortality) used in the assessment was highlighted. Sensitivity analysis due to uncertainty of natural mortality was suggested.

45. A common methodological framework for the estimation of mortality and growth parameters should be established.

46. The establishment of a Working Group on selectivity is recommended. This WG will have to address a common protocol of methodology in order to proceed with specific experimental work.

47. *Pomatomus saltatrix* is proposed to be considered for inclusion in the list of priority species.

48. No assessments of shared stocks have been presented.

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

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

51. The WG reminds the scientists that assessments must be presented in a complete way with all the data, parameters, results, conclusions and recommendations. All the documentation must be sent to the facilitator for dispatching in due time.

52. The documents produced by this meeting will be available at : ftp://cucafera.icm.csic.es/pub/scsa/

ANNEX 4

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
(GFCM)
SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA)
Malaga (Spain), 10-12 May 2004

Stocks assessed in 2004. Bold number and grey background: shared stock

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	
Sardina pilchardus	1		1			2	*									*	**1**							**5**
Engraulis encrasicolus	1					1	*		*			*	*	*		*	**1**							**3**
Mullus barbatus	1		1			1	*	*	*		1				*	*								**4**
Aristeus antennatus	1				1	1																		**3**
Merluccius merluccius	1				1	1	*	*	*						*	*								**3**
Aristeomorpha foliacea							*	*			1													**1**
Mullus surmuletus					1		*	*																**1**
Parapenaeus longirostris			1				*	*							*	*								**1**
Pomatomus saltatrix														1										**1**
Illex coindetii															*	*								**0**
Nephrops norvegicus							*	*	*															**0**
Pagellus bogaraveo							*	*																**0**
Pagellus erythrinus															*	*								**0**
Phycis blennoides															*	*								**0**
	5	**0**	**3**	**0**	**3**	**6**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**22**

* One or more papers with complementary information to assessments (biomass index trends, nurseries, distriburtion, etc.)

Summary of assessments

Total	22
GSAs	7
Species	9
Shared stocks	2

ANNEX 5

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. Fifteen 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

6. Twenty-two technical papers were presented and discussed by the Working Group.
7. These documents covered totally or partially 6 Geographic Sub-Areas (GSA) and two species.
8. 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

9. **Document n° 01. ANC-01 *Engraulis encrasicolus*. 2003**
10. **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.

11. **Document nº 3. SAR- 01. *Sardina pilchardus*. 2003**
12. **Document nº4 . SAR-06 North. *Sardina pilchardus*. 2001-2003**
13. **Document nº5 . 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 (L50) 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/Rmax and over-exploited with reference to Y/R0.1. 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.

14. Document nº6. 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).

15. Document nº 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.

16. Document nº 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.

17. Document nº 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.

18. **Document nº 10. 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.

19. Document nº 11. 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

20. Document nº 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.

21. Document nº 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 L_{50}. Data provided by 5 GSA's (12, 13, 14, 16, 17) show that the estimates of the L_{50} 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 (L50) 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 L50 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

22. Document nº 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.

23. Document nº 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 Catalonian 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.

24. Document nº 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.

25. Document nº 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 Catalonian 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

26. Document nº 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

27. Document nº 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).

28. Document nº 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.

29. Document nº 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.

ANNEX 6

GFCM – SAC
SUB-COMMITTEE STOCK ASSESSMENT
Malaga, May 10-12

Synthesis of the workshop on Reference Points
held in Rome on April 20-21, 2004

The workshop was attended by 60 participants. Besides the introducing talk, 14 communications were presented by researchers and 1 communication was presented by the fishermen associations.

The approaches illustrated in the communications could be subdivided as follows:

a) classical population dynamics modelling (single species), n°7 presentations;
b) empirical indicators of population (single and multispecies), n°4 presentations;
c) multispecies and ecosystem indicators; n°2 presentations;
d) ecosystem and composite indicators; n°1 presentation

One communication didn't deal with RPs issue but was aimed at suggesting a twin tools for fishing management.
The communication of the fishermen associations mainly underlined the needing of understandable RPs and the incorporation of social and economical issues in the advices.

The communications will be published on the journal Biologia Marina Mediterranea.

Reference points workshop – discussion session

The session was chaired by Giuseppe Lembo (Coordinator of the workshop), Alain Bonzon (GFCM secretary), Corrado Piccinetti (SAC Chairman), Riccardo Rigillo (Italian Directorate of Fisheries) and Matthew Camilleri acting as reporter. The former thanked the authors of the presentations made during the workshop and opened the discussion by putting forward a few pertinent questions:

1. Which are the indices and RP currently applied to Mediterranean fisheries, and which others have never been applied and why?
2. What level of reliability have the indices and RP used in the Mediterranean? How can this reliability be improved?
3. Has any multispecies index or MSRP ever been applied to the Mediterranean? If so, in what circumstances?
4. EAF is a main issue. There are some papers published on this topic but, have had any impact on assessment?
5. How can use common information from different areas or gathered with different methods to standardize indices and reference points?
6.- On the light of the previous items, which kind of recommendation, regarding indices and reference points, can be addressed to the SAC-GFCM?

There was consensus that reference points in the Mediterranean have so far been applied to stock assessment exercises and were not used within a management framework. It was noted that most of the papers presented during the workshop focused on biological reference points which needed to be assessed, on the basis of their characteristics, for their feasibility and usefulness in the precautionary approach. Namely the indicators should be characterised by the following desirable features:

g) easy compilation and processing procedures;
h) minimization of basic assumptions;
i) reliable performance with respect to interactions between fishery, environment and resources;
j) applicability to different scenarios;
k) comprehensibility for the stakeholders;
l) easy integration and comparison among indicators coming from different sources.

As far as the group was aware, mainly monospecific models have been used in the Mediterranean and problems are being encountered to translate the EAF and related models to management interventions.

On exploring the overall scenario, the group stated that the establishing of reference points should be an activity carried out by scientists but should be understood by fishers and other stakeholders. It was suggested that they should have three uses: (a) monitoring (b) management implementation (c) determination of state of stock / restoration. It was also noted that demersal stocks are more vulnerable and need focused attention with defined recovery plans which set target values or reference points.

It was proposed that initially limit reference points should be established in order to implement management interventions and target reference points could be considered at a later stage. The group believed that data should be analyzed on a large scale basis in order to smoothen out variability and that an integrated multispecies approach should be the preferred option.

Life expectancy was identified by some as a robust indicator of survival which is a tool to assess the well-being of the stock, as well as to simulate the effects of different management strategies. Total mortality was also identified as a suitable indicator to set a limit reference point and it was noted that trawl surveys are useful in this regard, since they provide interannual fluctuations in this parameter. It was also suggested that CPUE is itself a simple and reliable indicator.

The group discussed the often met unreliability of commercial catch data and the quality of data collected through direct and indirect methods, which depend on the sampling strategy employed. The issue of the reliability of indicators depends on what they are used for. Since there have been no applications of fisheries control rules using indicators and RPs, there is no history of experience to study. Caution was expressed in the use of specific modelling frameworks to generate RPs before a broader view of the situation is obtained. A method of examining a large number of indicators together is proposed as a preparatory approach before setting up a modeling framework.
Concern was also expressed with the use of “steady state” assumptions in modelling, such as Ecopath or Y/R models, there is a lot to be said for using empirical indicators that are easily understood by managers and fishermen.

The group stated that the uncertainty of reference points could be reduced through collaboration and sharing of data and experiences, as well as calibration of data. It added that whilst the indices presented at the workshop should be used as a foundation for future work on this subject, data and information originating from landings, direct methods and simulation should be retained and an effort should be made to integrate socio-economic aspects. It was emphasized that in using this approach, researchers must keep in mind that the ultimate goal is to manage fisheries and not to focus singly on biological aspects of stocks, whose status depends on several other biotic and abiotic influencing factors. Furthermore, the use of a "traffic light approach" for assembling different indicators into a baseline of information for management decision was suggested before going deeply into modelling on a narrow range of assumptions.

In trying to reach a conclusion, the group suggested that in addition to indicators and reference points for single different stocks, specific indicators for each fishery or Operational Unit should be identified (poly-indicator system), which would be understood by all stakeholders. Moreover, it was proposed that each reference point should undergo a robustness and / or sensitivity test before being applied.

The group pointed out that indicators and reference points could be obtained through catch assessment surveys and direct methods to get information mainly on the catch size spectrum (individual species and all species), mortality rates (e.g. Z_{med}, Z_{MBP}, $F_{0.1}$), recruit and spawner indices (e.g. R/S, SSB/SSB_0, SSB/B, B/R), abundance indices, condition factors and estimates of the area extend of the stocks surveyed. Further indicators could be derived by examining historical data sources for past changes in overall ecosystem indicators (e.g. pelagic/demersal ratios, piscivore/planktivore ratios, PPR-TL_{catch}), diversity indices as overall indicators of ecosystem change (e.g. BOI index), change in basic ecosystem productivity and other environmental variables such as meteorological data.

Finally, the working group strongly suggested that the SAC-GFCM should continue to promote the reference point issue as a priority research area in order to define clear management goals at regional level as soon as possible.

ANNEX 7

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN (GFCM)
SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA)
Malaga (Spain), 10-12 May 2004

WORKING GROUP REPORT ON *Coryphaena hippurus*

The recently established working group on *Coryphaena hippurus* presented the last advances on the work achieved in 2003 with the same data of the previous years (2000-2001), since no new sampling has been possible during the last year. The group has also presented the SCSA sheets B, P1, P2a, P2b, G, A1, A2, A3, D and Z.

More refined selection of starting parameters (i.e. Reference age, terminal fishing mortality and selection-at-age) after consultations withal the authors has allowed a second exploratory Separable VPA which lead to the results presented in the corresponding SCSA sheet A3 and which are not significantly different from those reached on the previous trials. Nevertheless we present them as is the only "assessment" done so far, but it has to be looked at with all the caution possible, taking into account that the data series is very short and incomplete and that very little is known on the growth dynamics of this species that is fished at the early stage of life: immature specimens, practically recruits. Therefore the state of the resource can be considered unknown at the moment. However, based on some other findings of this study, some recommendations in terms of management strategies can be stated:

- Genetic homogeneity of samples taken from the 4 areas, according to a study carried out at the beginning of the COPEMED-CORY program suggests that it comprises a single stock that should be managed in a coordinated way.
- The seasonal character of this fishery causes strong price fluctuations in the market that should be somehow regulated.
- The fishery should not be opened before middle August in the whole area to avoid fish <15 cm to be caught.
- The number of FADs by boat should be regulated.

Main research needs identified falls into two categories: Biology of the species (growth parameters, sexual maturity) to better calibrate the models and Socio-economic studies to contribute to the process of market regulation.

The future of this working group is unsafe after the end of the FAO-COPEMED project that has financed all the works done during the last 3 years. According to the responsible of the four teams they would be keen on continuing the work as far as they get funds and this matter is under the decision of the concerned countries. Considering that *C. hippurus* is included in the EC priority list and that for this area is a very important fishery a certain budget would be available among the EC members, but regarding relative importance of the species in relation to other exploited species, it probably will not receive the appropriate attention. By the time being, only

Tunisia is going to continue with the sampling program under their own resources, but the other countries have not a final decision on it yet it will depend on the availability of funds.

COPEMED is open to new proposals for short term and punctual coordination activities to support the working group for at least the time that the project will still be alive (mid 2005).

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet #0 Basic data on the assessment

Date	March 2004	Person in charge	Beatriz Morales-Nin & Manica Azevedo	Code	cory
Species Scientific name	Coryphaena hippurus	Species common name	Dolphinfish, llampuga, lampuki		

Data source

Geographical limits	1.1, 1.3, 2.2 FAO Mediterranean areas	Period of time	2000-2001

Description of the analysis

Type of data	Catch at age in numbers	Data source	Commercial fleet sampling in Malta, Sicily, Tunisia and Majorca
Method of assessment	Separable VPA	Software used	Lowesoft VPA-Suite (Darby & Flatman 1994)

Sheets filled out

B	P1	P2a	P2b	G	A1	A2	A3	Y	D	Z	C
X	X	X	X	X	X	X	X		X	X	

TS	TS1	TS2	TS3	TS4	AS	EP

Comments, bibliography, etc.

This summarizes the work carried out by the Program CORY in the framework of the FAO/COPEMED Regional Project to study dolphinfish fishery in Central-Western Mediterranean during 2000-2001 fishing seasons. This work represents the first joint analysis for the Mediterranean dolphinfish and was the first step in an integrated study. The tasks carried out under the Program were directed towards the collection of data for studies on the biology and fleet dynamics, on effort and catch levels, the estimation of the catch length composition and catch-at-age data. A considerable improvement on the knowledge of the biology of the species and the characterization of the fishing activity and exploitation was achieved. A preliminary assessment was carried out as an attempt to provide guidance on the management of dolphinfish in Mediterranean waters.

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet B Biology of the species

Code	CORY

Biology

Somatic magnitude measured (LH, LC, etc)	FL	Units	cm

Sex	all			
Maximum size observed	96		Reproduction season	June-September
Size at first maturity	60		Reproduction areas	Majorca, Sicily, Tunisia, Malta
Recruitment size	17		Nursery areas	Majorca, Sicily?

Parameters used (state units and information sources)

sex	all		
Growth model	Von Bertalanffy		
Data source	Massutí et al.1998		
L_∞ (growth)	102.5		
K (growth)	0.153 $month^{-1}$		
t_0 (growth)	-0.276 month		
length-weight relationship	Average for the 2001 values calculated on Mallorca, Tunisia,Malta and Sicily areas		
a (length-weight)	0.0000121		
b (length-weight)	2.9662		
sex ratio	68% females		
M	1.5 $year^{-1}$		

Comments

The fishery is based on immature juvenile fish, thus all the calculations were done for the whole population. Sex ratio refers to juvenile fish.
Tanaka method (1960) was used to calculate M. This value was tuned by the initial value of M=1.74 $year^{-1}$ (Massutí et al.1999) and the maximum longevity of 3 years, giving the value of M= 1.5 which was retained for calculations.
The maximum size is the one reported for this fishery, the maximum size landed by swordfish long lines is around 2 m.

SAC GFCM.
Subcommittee of Stock Assessment

Assessment form Sheet P1

General information about the fishery

Code	CORY
Page	

Data source	Sampling on ports	year(s)	2000-2001
Data aggregation (by year, average figures between years, etc.)	Annual average for each year by area Note that the fishery runs from August to December except in Tunisia and Sicily where starts in July and ends in January		

Fleet and catches (please state units)

gear	Fleet (# of boats)	catch (species assessed)	other species caught	discards (species assessed)	discards (other species caught)
FADs and surrounding net	Malta, Sicily, Majorca	tons	Pilot fish seriola		
Tunisia 2000	295 boats FADS70-170/boat	666			
Tunisia 2001	295 FADS70-170/boat	783			
Malta 2000	101 boats FADS130-338/boat	183			
Malta 2001	101 boats FADS130-338/boat	236			
Majorca 2000	45 boats FADS 30-40/boat	43			
Majorca 2001	45 boats FADS 30-40/boat	199			
Sicily 2001	225 boats FADS50-110/boat	129			
Total	666	2239			

Legal minimum size	Not fixed

Comments

The fishery is regulated by the season when the FADS are moored, generally middle August, the distance of the coast and the number of mooring sites. Generally each boat has one mooring site or maximum two. In Tunisia there is not a regulation and also the boats might have on board other gears and fish for other species, whereas during the fishing season in Majorca and Malta they are not allowed to fish with other gears. This fishery has not discards.
Pilot fish captures in Majorca have ranged from 0.9 30 tons between 1981 and 1996.

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2a Fishery by gear

Code	CORY
Page	

Data source	Majorca	gear	Surrounding net and FADs

Time series

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989
Catch	8	78	31	53	74	44	31	84	97
Minimum size									
Average size L_c									
Maximum size									
Fleet				50	44	51	48	44	44

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Catch	98	78	42	54	106	128	52	45	55
Minimum size						20	23		
Average size L_c									
Maximum size						64	64		
Fleet	48	48	44	46	42	46	37	42	45

Year	1999	2000	2001						
Catch	55	44	199						
Minimum size			29						
Average size L_c			41.15						
Maximum size			63						
Fleet	45	45	44						

Structure by size or age

ALK - Majorca + Tunisia + Sicily 2001 in numbers

AGE months	July	August	September	October	November	December
2	20033	542336	395887	30374	1025	2040
3	16699	580493	788963	131787	30955	5810
4	11683	355892	721286	189731	67415	6751
5	0	23712	406875	137780	49836	5000
6	0	22110	330266	122955	45631	4059
7	0	13447	266555	95736	29527	2966
8	0	2830	71203	63842	27260	1465

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2a Fishery by gear

Code	CORY
Page	

Data source	Tunisia	gear	Surrounding net and FADs

Time series

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989
Catch	64	255	290	228	283	205	260	253	269
Minimum size									
Average size L_c									
Maximum size									
Fleet									

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Catch	302	306	114	296	358	612	393	538	1145
Minimum size									18
Average size L_c									
Maximum size									67
Fleet									260

Year	1999	2000	2001			
Catch	918	669	748			
Minimum size	18	17	18			
Average size L_c						
Maximum size	75	83	74			
Fleet	295	295	295			

Structure by size or age

ALK - Majorca + Tunisia + Sicily 2001 in numbers

AGE months	July	August	September	October	November	December
2	20033	542336	395887	30374	1025	2040
3	16699	580493	788963	131787	30955	5810
4	11683	355892	721286	189731	67415	6751
5	0	23712	406875	137780	49836	5000
6	0	22110	330266	122955	45631	4059
7	0	13447	266555	95736	29527	2966
8	0	2830	71203	63842	27260	1465

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2a Fishery by gear

Code	
Page	

Data source	Sicily	gear	

Time series

Year	1995	1996	2001			
Catch Kg	433,000	377,000	129,000*			
Minimum size TL cm	24	30	22**			
Average size TL	45.8	45.5	41.2			
Maximum size TL cm	73	64	67			
Fleet	263	225	32*			

The 1995 and 1996 Catch was the total Sicilian catch. 2001 catch was only in the South-East Sicily (Marzamemi, Portopalo di Capo Passero and Linosa).

In 1995 and 1996 the fishing season was started last week of August. In 2001 the fishing season was started last week of July!

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2b Fishery by gear

Code	CORY
page	

Data source	Majorca	gear	FADS and surrounding net

Regulations in force and degree of observance of regulations

The fishing season is regulated by the time of FADs mooring (15th August) and by the obligation of the registered boats to fish only for dolphinfish during the fishing season.
The mooring areas must be off the 70 m isobath.There is a time closure around 14 h during weekends.
The main problem is the fishing of not registered boats on the FADs of other boats and the unreporting of landings.

Accompanying species (mean size)

Polyprion americanus 23-37 cm TL
Naucrates ductor 24 cm FL
Seriola dumerili 19 cm FL
Trachurus mediterraneus 5 cm FL
Balistes carolinensis 9.7 cm TL

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2b Fishery by gear

Code	CORY
page	

Data source	Tunisia	gear	FADS and surrounding net

Regulations in force and degree of observance of regulations

The fishing season of the dolphinfish starts officially August 15 and gets along until end of December beginning January. This activity concerns all the Tunisian coast of the north to the south.

Fishers use for its capture of the FADs that is installed from July and small size dolphinfish (17 to 20 cm) can be fished, during this month.

Problems that meet this activity are bound to the no knowledge of the exact number of the FADs used by every fisher, their site and young dolphinfish fishing. Currently some legislative measures are under survey to rationalize the management of this resource (authorization of fishing, knowledge of the number and the station of the FADs,….).

Accompanying species (mean size)

Seriola dumerilii (15 – 35 cm)
Naucrates doctor (20-25 cm)
Trachurus mediterraneus
Balistes sp

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet P2b Fishery by gear

Code	
page	

Data source	Sicily	gear	

Regulations in force and degree of observance of regulations

Any Regulations in force

Accompanying species

Seriola dumerili
Naucrates ductor
Tunnus spp.
Polyprion americanus
Balistes carolinensis
Schedophilus ovalis
Tetrapturus belone

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet G Indirect methods **Production model**

Code	Cory
Analysis #	1
Page	1

Data source	Landings (1981-2001) Malta and Mallorca	Gear	Surrounding net and FADs

Model characteristics

Type of model	**IFOX** (non equilibrium Production Model)	Fitting criterion	Least squares
Software	Splus	Bibliographi-cal source	Yoshimoto & Clarke 1993

Data from Malta + Mallorca combined

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992
Catch (t)	619	537,8	411,9	380,1	359,1	411,0	357,3	382,3	229,7
Effort(boats)	201	199	204	179	153	145	165	161	146
CPUE	3,078	2,702	2,019	2,124	2,347	2,835	2,166	2,375	1,573

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
Catch (t)	227,6	439,2	461,5	358,6	340,2	418,1	404,1	227,0	435,3
Effort(boats)	177	189	185	148	170	157	157	135	140
CPUE	1,286	2,324	2,494	2,423	2,001	2,663	2,574	1,681	3,109

Adjustment

RMS	4%

Results

Carrying capacity		a	
Growth rate		b	
Catchability			
MSY			
E_{MSY}		TAC_{MSY}	
$E_{0.1}$		$TAC_{0.1}$	
$E_{current}$			

Comments

Combined catch and effort (no of boats) data from Malta and Majorca were used to estimate CPUE for the period 1984-2001. The multiple linear regression model of IFOX was fitted to these data but besides a very poor goodness of fit (below 4%), non-significant estimates of some

of the coefficients, namely b3, were obtained. Therefore no further attempts were done to estimate MSY and other reference points or to fit other non-equilibrium production models.

It was recognized that for the Mediterranean dolphinfish fishery the number of boats is not an appropriate effort measure. It should be necessary to assess the number of FADs visited/day which in most cases is not available.

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet A1 Indirect methods: Jones LCA

Sex	M+F

Code	Cory
Analysis #	1

Model characteristics

Data	Size	Age
(mark with X)	X	

Model	Cohorts	Pseudocohorts
(mark with X)		X

Equation used	Jones LCA	Tuning method	Not possible
# of gears	1	Software	Lba99g.exe
$F_{terminal}$	$1.0y^{-1}$		

Population results (please state units)

	Sizes	ages		amount	biomass
Minimum	17 cm		Recruitment		
Average	31 cm		Average population		
Maximum	66+ cm		Virgin population		
Critical			Turnover		

Average mortality

		Gears					
	Total						
F_1	11.5						
F_2							
Z	16.0						

(F_1 and F_2 represent different possible calculations. Please state them)

Comments

Jones LCA was applied to the annual average catch length compostion of 2000-2001. In the year 2000 catch length compostion was only available for Malta and Tunisia while in 2001 data was also available for Majorca and Sicily. Input parameters were $M=1.5y^{-1}$, Linf=102.5cm, $K=1.834y^{-1}$ and L-W relationship parameters of a=0.0121g and b=2.9662. Trial runs were performed with terminal F of $1.0y^{-1}$ (option of F below M) and $F=1.5y^{-1}$ (F=M) to check the sensitivity of the model to input parameters. Average F values of $14.5y^{-1}$ (average for sizes 30-50 cm) and of 11.7y-1 (average for sizes 17-65 cm) were estimated. Besides the fact that short (only two years of data to compute the average catch compostion) and incomplete (partial data for 2000) data series was used, the equilibrium assumption of the Jones LCA method is considered too restrictive given the wide and complex dynamics of the Mediterranean Coryphaena being analysed.

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Assessment form Sheet A2

Indirect methods: data

				Code	Cory
sex	M+F	gear	Surrounding net and FADs	Analysis #	1

Data source	Landings from Tunisia, Malta, Mallorca and Sicily 2001 in numbers

Data:

L (cm)	July	August	Sept	Oct.	Nov.	Dec.
17	0	0	0	0	0	0
18	0	14808	0	0	0	0
19	0	24490	0	0	0	0
20	0	99244	3414	0	0	0
21	4611	328138	3620	0	0	0
22	4611	237493	6098	0	0	0
23	2305	191931	10768	0	0	0
24	16138	156452	23669	0	0	0
25	10375	107901	46487	0	0	0
26	6916	78430	39096	0	0	0
27	3458	54164	69221	47	78	0
28	0	41309	97874	7153	39	784
29	0	19794	137825	3958	0	1046
30	0	29982	111187	7987	233	523
31	0	19277	73296	6145	194	523
32	0	27201	86654	19288	0	654
33	0	20378	143587	11807	17	1177
34	0	10711	128913	16294	209	1046
35	0	11660	78780	21804	883	1177
36	0	11872	72236	21929	1068	1177
37	0	22285	117947	23274	1069	1307
38	0	10356	79236	30414	1190	915
39	0	5933	63095	22299	1747	1700
40	0	6445	68111	30370	1101	2615
41	0	1286	47482	23107	1129	1307
42	0	5416	40055	26000	1509	1438
43	0	0	43148	16729	3516	1584
44	0	1028	21630	15841	2222	1194
45	0	0	41689	16296	3574	1454
46	0	0	3619	11265	3275	393
47	0	0	4397	12460	2868	780
48	0	0	10464	10567	3244	1933
49	0	0	9897	14177	2949	906
50	0	0	8346	12627	2245	774
51	0	0	1034	10961	1969	393
52	0	0	517	7215	1281	388
53	0	0	4392	5184	1016	14
54	0	0	1807	5977	1318	23

55	0	0	1807	6740	1869	26
56	0	0	517	6114	99	120
57	0	0	1807	8919	624	114
58	0	1135	0	7080	320	226
59	0	0	0	3929	646	13
60	0	284	0	2576	403	271
61	0	0	0	4468	304	140
62	0	0	0	3404	0	3
63	0	0	0	1847	0	3
64	0	0	0	3994	0	3
65	0	1419	0	2140	0	2
66+	0	0	1331	2269	0	3

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Assessment form Sheet A3

Indirect methods: **VPA**

				Code	Cory
sex	F+M	gear	Surrounding net and FADs	Analysis #	
				Page	

Population in figures (2001, start of the month)

Month	July	August	September	October	November	December
2	1796235	1690230	675835	125806	50439	29012
3	1358224	1566367	984664	297956	85074	43942
4	729890	1182954	840149	399409	183838	69947
5	223924	633159	711169	389332	252591	152339
6	31218	197612	536510	446618	273324	214174
7	0	27550	153663	318948	322506	233296
8+	0	5798	32037	189895	244270	115434
Total	**4139491**	**5303671**	**3934028**	**2167963**	**1412042**	**858142**

Population in biomass (2001, start of the month, tonnes)

Month	July	August	September	October	November	December
2	165	202	178	45	22	10
3	124	201	338	157	62	24
4	62	163	373	260	157	47
5		229	365	307	252	120
6		76	268	447	316	191
7		13	80	327	348	189
8+		9	30	276	274	121
Total	**351**	**892**	**1630**	**1820**	**1430**	**701**

Fishing mortality rates (2001, month^{-1})

Month	July	August	September	Octobe r	November	December
2	0.0119	0.4153	0.694	0.2662	0.0129	0.0777
3	0.0132	0.4979	0.7773	0.3579	0.0708	0.1513
4	0.0172	0.3839	0.6441	0.3332	0.0629	0.1083
5	0	0.0406	0.3402	0.2288	0.04	0.0356
6	0	0.1265	0.3951	0.2006	0.0333	0.0205
7	0	0.7244	1.6793	0.2185	0.0186	0.0137
8+	0.0139	0.7244	1.6793	0.2185	0.0186	0.0137
Fbar (2-7)	0.007	0.3648	0.755	0.2675	0.0398	0.0678
Fbar/M	**0.06**	**2.92**	**6.04**	**2.14**	**0.32**	**0.54**
F=Y/B	**0.01**	**0.24**	**0.42**	**0.20**	**0.03**	**0.03**

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet D Diagnosis

Code	
Page	

Reference points (for further information see CADDY, 1996, *FAO Fish. Tecn. Pap*., 347)

Criterion	value	units	trend	Comments
B_{now}				
SSB				
B_{virgin}				
F_{now}				
F_{msy}				
$F_{0.1}$				
$F_{2/3msy}$				
F_{low}				
F_{med}				
F_{high}				
$F_{\% SPR}$				
TAC				
$TAC_{0.1}$				
Y_{now}				
MSY				
MBAL				

General state of resource: underexploited, overexploited, collapsed, unknown, etc.

Catch-at-age (on a monthly basis) was computed for 2001 (Tunisia, Malta, Majorca and Sicily). Length to age conversion of the catch length compositions was performed with a combined ALK. A plus group was set at age 8+ month. Separable VPA runs were carried out with the adopted natural mortality coefficient converted to month unit of time ($M=0.125$ month^{-1}) and assumed constant over ages and months. Several options regarding the reference age, i.e, the age at which the selection value is 1 (ages 3 and 4), the terminal fishing mortality, Ft (Ft=M=0.125 and 0.25) and the terminal selection-at-age, Sa (0.8, 1.0 and 1.5) were considered. The results showed quite similar values and patterns for the residuals at age providing little discrimination between the several options. Results from separable VPA for the run with reference age 3 and Ft=0.125 showed that residuals were not very high, in the range –2,2. Larger residuals were observed for ages 4/5 in July/August and for ages 5/6 and 6/7 in July/August and November/December. More importantly, however, was the increased residual trend observed for ages 5/6 and 6/7, indicating a time effect on those ages. However none of the other options removed this pattern. The sum of squared residuals was slightly lower for option Ft=0.125 and Sa=0.8 (25.18 for ref. age 3 and 25.06 for ref. age 4). These two options were used to run a VPA. The estimated mean weight-at-age in the catch (SOP corrected) was assumed for the mean weight-at-age in the stock. Estimates of recruitment, fishing mortality-at-age and total biomass were compared. Results were quite similar once again and are,

therefore, presented for option ref. age 3.

Particularities of the state of the resource: growth overexploitation, recruitment overexploitation, existence of inaccessible segments, trends observed, etc.

VPA tuning data is not available for this stock and, therefore, the results from this preliminary assessment should be interpreted with caution. Nevertheless, taking into account that the fishery catches mostly recruits (fish aged 0 years) and using as a reference an F strategy of F~M, the results indicate that in 2001 mortality rates might have been too high between August and October.

Risks

This stock is highly dependent on the recruitment strength and little is known about the dynamics of large size and older individuals.

SAC GFCM. Subcommittee of Stock Assessment	Assessment form Sheet Z Objectives and recommendations

Code	CORY
Page	

Management objectives

This fishery is based on age 0 (between 2 and 8 months of life fish), thus depending of the annual recruitment which can be very variable.
This highly migratory middle size pelagic fish seems to be a single stock in the central-western Mediterranean and should be managed together.
The measure of effort is difficult because the number of FADs and their permanence on the mooring places is very important, as it is related to the number of boats both measures have to be taken into account.
Sicily and Tunisia have the less regulated fishery starting the catches very soon on small fishes. A postponing of their fishery opening should be envisaged.

Management recommendations

Area closures	
Temporal closures	The fishery should not be open before middle August.
Effort limitation	The number of FADS by boat should be regulated.
Minimum size	The fish landed have a high price but opening the fishery in July causes that 15 cm fish are caught.
Technical steps concerning gear	The pelagic long lines capture reproductive adults of the species.
Quotas	
Market	This is a seasonal fishery, efforts should be dedicated to avoid very big catches causing prices to drop. Moreover, some processing to stabilise the market should be envisaged.

ANNEX 8

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN (GFCM)
SIXTH STOCK ASSESSMENT SUB-COMMITTEE MEETING (SCSA)
Malaga (Spain), 10-12 May 2004

Shared stocks

English common name	***Scientific name***	**Area**	**Countries**
Dolphin fish	*Coryphaena hippurus*	Western Mediterranean.	Italy, Malta, Spain and Tunisia
Horned octopus	*Eledone cirrhosa*	Adriatic Sea	Albania, Croatia, Italy and Serbia-Montenegro
Musky octopus	*Eledone moschata*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Anchovy	*Engraulis encrasicolus*	Gulf of Lions	France and Spain
Anchovy	*Engraulis encrasicolus*	Adriatic	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Anchovy	*Engraulis encrasicolus*	Aegean Sea	Greece and Turkey
European squid	*Loligo vulgaris*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Blackbellied angler	*Lophius budegassa*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Monkfish or angler	*Lophius piscatorius*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Hake	*Merluccius merluccius*	Gulf of Lions	France and Spain
Hake	*Merluccius merluccius*	Adriatic	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Hake	*Merluccius merluccius*	Sicily Channel	Italy, Tunisia, Libya and Malta
Hake	*Merluccius merluccius*	North Tyrrhenian and Corsica	Italy and France
Blue whiting	*Micromesistius poutassou*	Adriatic	Albania, Croatia, Italy and Serbia-Montenegro
Blue whiting	*Micromesistius poutassou*	North Tyrrhenian and Corsica	Italy and France and Serbia-Montenegro
Red mullet	*Mullus barbatus*	Adriatic	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Red mullet	*Mullus barbatus*		Corsica and Sardinia
Striped red mullet	*Mullus surmuletus*		Corsica and Sardinia
Norway lobster	*Nephrops norvegicus*	Adriatic	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Norway lobster	*Nephrops norvegicus*	North Tyrrhenian and Corsica	Italy and France
Black spot seabream	*Pagellus bogaraveo*	Alboran Sea and the Straits of Gibraltar	Spain and Morocco
Common pandora	*Pagellus erythrinus*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Common spiny lobster	*Palinurus elephas*		Corsica and Sardinia
Common spiny lobster	*Palinurus elephas*	Sicily channel	Tunisia and Italy
Pink spiny lobster	*Palinurus. mauritanicus*	Sicily channel	Tunisia and Italy
Deepwater rose shrimp	*Parapenaeus longirostris*	Adriatic Sea	Albania, Croatia, Italy and Serbia-Montenegro
Sardine	*Sardina pilchardus*	Adriatic	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Sardine	*Sardina pilchardus*	Aegean Sea	Greece and Turkey
Atlantic mackerel	*Scomber scomber*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Common cuttlefish	*Sepia officinalis*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Common sole	*Solea vulgaris*	Adriatic Sea	Albania, Croatia, Italy, Slovenia and Serbia-Montenegro
Sprat	*Sprattus sprattus*	Adriatic	Croatia, Italy, Slovenia
Albacore	*Thunnus alalunga*	All Mediterranean	All countries
Bluefin tuna	*Thunnus thynnus*	All Mediterranean	All countries
Swordfish	*Xiphias gladius*	All Mediterranean	All countries