GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES POUR LA MÉDITERRANÉE

# GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

## SCIENTIFIC ADVISORY COMMITTEE (SAC)

**Fifteen$^{th}$ Session**
**9-12 April 2013 (venue T.B.D.)**

# REPORT OF THE WORKING GROUP ON STOCK ASSESSMENT OF DEMERSAL SPECIES
**Split, Croatia 5-9 November 2012**

**OPENING SESSION (joint session for the two Working Groups on Demersal and Small Pelagic Species)**

1. The meetings of the SCSA Working Groups on Demersal and Small Pelagic Species (WGs) were held in Split, Croatia from 5 to 9 November 2012. Organized by the Croatian Institute of Oceanography and Fisheries and hosted at the Hotel Best Western Art. The two meetings were held in parallel in two different meeting rooms, except for the opening session that was addressed to the two groups together.

2. Ms Pilar Hernández, from GFCM Secretariat, welcome the participants and thanked them for attending and providing contributions to this meeting, as well as the Croatian authorities and the Institute for their kindness in hosting and arranging the meeting.

3. She informed of several changes in the functioning promoted by the Secretariat according to recommendations of last years by the WGs and the SAC. Those changes are the new format of the Stock assessment forms, the creation of an online platform for the exchange of information based on SharePoint and the nomination of the moderator or chairman within the WGs, elected among their participants. She then underlined that these changes had been promoted for the sake of improving the overall process of stock assessment which is the pillar for the subsequent management actions and that must be based on the best possible science and on the most reliable data.

4. She also introduced the new stock assessment forms and the structure of the report. She finished her intervention by thanking the four FAO Regional Projects: AdriaMed, CopeMed II, EastMed and MedSudMed for their continuous support, not only to the participation of experts but above all and most important for their efforts in carrying out joint assessments of shared stocks within the framework of their own annual working groups.

5. Mr Fabio Fiorentino, coordinator of the SAC Subcommittee on Stock Assessment addressed his welcome to the participants by acknowledging the effort deployed by member states given the difficulties most of them are facing and congratulated the group for keeping the number of assessment presented around 40 as in previous years, while regretting the absence of some national experts, in particular from Spain, Greece and Cyprus.

6. Mr Miguel Bernal, from GFCM Secretariat introduced the contents and functioning of the on line share-point to which all the participants were entitled to access, download and upload information and encouraged them to use it as the platform for the exchange of information and files during and after the meeting including for the joint production of this final report. The two working groups then separated to run their sessions in different rooms.

## INTRODUCTORY SESSION

7. The main objectives of the meeting were recalled: to give advice on the management of fisheries/stocks, based on assessments supported by data, biological parameters and methods agreed by the participants as stated in the meeting Terms of Reference (Appendix B). In cases of assessments that, for some reason, were considered to be preliminary, no advice is given but a strong effort will be done to identify paths to sort out problems with the aim of having agreed assessments on the near future. The Agenda with minor amendments on the order of presentation of some stocks was adopted as is included as Appendix A.

8. Mr Fabio Fiorentino was unanimously elected chairman of the 2012 Working Group on Demersal species. Ms Angélique Jadaud and Mr Tristan Rouyer were elected as rapporteurs for the fish species sessions, while Ms Beatriz Gujarro and Mr J. Luis Pérez were designated rapporteurs for the crustaceans sessions supported in the general coordination by Ms Pilar Hernández.

9. The session started with the presentation of all 27 participants from 10 countries (see Appendix B). Out of the 27 participants, 6 were from Italy, 3 from Spain, 2 from France, 2 from Tunisia, 2 from Romania, and 1 from each of the remaining 5 countries (Algeria, Bulgaria, Egypt, Montenegro and Morocco), 5 representatives of FAO Regional Projects, Miguel Bernal and Pilar Hernández from GFCM Secretariat.

10. Ms Pilar Hernández introduced the main conclusions and recommendations from the last two previous years with the aim to review the progress done in their regard by the national experts and by the GFCM Secretariat. Some advances were welcome namely the modifications on the stock assessment forms and the online platform as well as the considerations by most of participants of the agreed reference points. Some of the recommendations were considered still valid and were adopted for the work during the meeting.

## OVERVIEW OF ASSESSMENT PERFORMED AND STOCK STATUS

11. Overall, 28 assessments and one related work were presented of which 19 refereed to stocks of 11 fish species and 9 to stocks of 4 crustacean species. Of the 19 assessments on fish stocks, 6 refereed to *Merluccius merluccius*, 3 to *Mullus barbatus*, 2 to *Lophius budegassa* and 8 to 1 stock of the following species: *Mullus surmuletus, Pagellus erythrinus,*

*Pagellus bogaraveo, Saurida undosquamis,* one alien species of Egypt, *Solea solea, Squalus acaanthias, Merlangius merlangus* and *Psetta maxima*. From the 9 assessments on crustacean 4 stocks referred to *Parapenaeus longirostris*, 3 to *Aristaeus antennatus*, 1 to *Nephrops norvegicus* and 1 to *Squilla mantis*.

12. With respect to assessments by GFCM geographical sub-area, 21 assessments were confined within one subarea (4 assessments referred to GSA 05, 4 to GSA 06, 3 to GSA 07, 3 to GSA 17, 3 to GSA 29, 2 to GSA 18, 1 to GSA 01, 1 to GSA 25) and 7 assessments spanned more than one GSA (3 for GSAs 15-16, 2 for GSAs 01-03, 2 for GSAs 12-16)

13. Regarding methodologies, different models were used for the assessments (i.e. VPA, LCA, XSA, Y/R, production models, SS3, and predictive models) what is encouraging since it reflects the diversity of methodologies chosen by the scientists to cope with the different characteristics of species and the availability of data.

14. All the assessments were full assessments done beforehand. During the meeting, the general aspects of the assessments performed, including the methods and data used, the stock status and a summary of the resulting scientific advice all were thoroughly revised. The comments done by the Group to each stock are gathered at the end of each of the following individual reports and a Summary Table is presented as Appendix D.

15. Overall, 24 stocks were validated by the group as in overfishing status and 4 were considered preliminary for which advice to improve the analysis was also provided. The individual stock assessment reports are presented below whereas the separate stock assessment forms (published on the GFCM website) can be consulted for more information.

## STOCK ASSESSMENTS BY AREA AND SPECIES

**1. Stock**: European hake, *Merluccius merluccius*

**GSA:** 01

**Author(s):** Pérez-Gil J.L, González M., Torres P., García T., García C., Baro J., Meléndez M.J. and Acosta J.

**Fishery:** European hake, *Merluccius merluccius* (Linnaeus, 1758), is one of the target demersal species of the Mediterranean fishing fleets, largely exploited in GSA01 mainly by trawlers (95% landings) on the shelf and slope, and by small-scale fisheries using gillnets (3%) and long lines (2%) on the shelf (average 2009-2011).

The trawling fleet in the GSA01 area is made up of 183 boats, averaging 35 GRT and 176 HP. During the last years, an increase in landings was observed, starting in 2002 and reaching the maximum value in 2004, followed by stabilization in catches (around 300 t) during the period 2005-2008. Catches increase in 2009 reaching 648 t (the highest in the series) and decreasing slightly to 614 t in 2011.

**Data and parameters:** The state of exploitation of *Merluccius merluccius* in the GFCM geographical sub-area Northern Alboran Sea (GSA 01) has been assessed for the period 2003-2011. This assessment was performed with size composition of trawl catches (obtained

from on board and on shore monthly sampling) and official landings transforming length data to age data by slicing.

**Assessment method:** A VPA tuned with CPUE from commercial fleet and abundance indices from MEDITS trawl surveys, was carried out applying the Extended Survivor Analysis (XSA) method (Lowestoft program; Darby and Flatman 1994) over the whole period. A retrospective analysis and a yield per recruit (Y/R) analysis based on the exploitation pattern resulting from the XSA model and population parameters for the entire period was carried out.

**Model performance:** The retrospective analysis did not show any trend.

**Results:** The results show a decreasing trend in the last year both in recruits number and spawning stock biomass of the stock. Fishing mortality ($F_{bar1-3}$) decreases in the last year but still remain high. The Y/R analysis shows that the $F_c$[1] (1.5) exceeds the Y/R $F_{0.1}$ (0.28), $F_{40\%SPR}$ (0.27) and $F_{30\%SPR}$ (0.36) reference points. Currently, this stock is at about 3% of the maximum possible spawning stock biomass per recruit, this ratio must reach at least 39% to maintain the stock at precautionary levels. In addition, abundance surveys indices show a decreasing trend over the total historical series, therefore the abundance of the stock is considered low.

**Diagnosis of stock status**: Based on this assessment results, the *Merluccius merluccius* stock in the GSA 01 is in overfishing status.

**Advices and recommendation** From a precautionary approach and taking into account the estimated reference points MSY proxies ($F_{0.1}$, $F_{40\%SSB}$ and $F_{30\%SSB}$), a reduction of the current fishing mortality is recommended by reducing the effort activity and improving the selection pattern of the fishery.

**Discussion:** The group considered that the statement "low abundance" is very vague and proposed to find a quantitative way to support it. Time series are often short and do not provide the appropriate basis to set up a baseline for sound comparison.

16. These two remarks were raised by the group the first time for this stock, but they were recognized as applicable to many other cases. Therefore the two issues were discussed in the final general discussion and some agreements and recommendations were done to this respect and are included in the final section of this report. In general, it was suggested to use the full extent of the MEDITS survey data and CPUEs (and/or even catches) in order to look for potential trends that could provide a quantitative basis to assess whether abundance is low or not and also to include a plot of the spawning stock biomass against recruitment.

The WG endorsed the assessment and recommendations.

[1] $F_c=F_{current}$

**2. Stock**: European hake, *Merluccius merluccius*

**GSA:** 05

**Author(s):** Guijarro B., Rubio V., Valls M., González N., Ordines F. and Massutí E.

**Fishery:** In the Balearic Islands, commercial bottom trawlers develop up to four different fishing tactics, which are associated with the shallow shelf, deep shelf, upper slope and middle slope, mainly targeted to: (i) *Spicara smaris*, *Mullus surmuletus*, *Octopus vulgaris* and a mixed fish category on the shallow shelf (50-80 m); (ii) *Merluccius merluccius*, *Mullus* spp., *Zeus faber* and a mixed fish category on the deep shelf (80-250 m); (iii) *Nephrops norvegicus*, but with an important by-catch of big *Merluccius merluccius*, *Lepidorhombus* spp., *Lophius* spp. and *Micromesistius poutassou* on the upper slope (350-600 m) and (iv) *Aristeus antennatus* on the middle slope (600-750 m). The European hake (*M. merluccius*) is a target species for this fishery, mainly exploited on the deep shelf and upper slope, with annual landings oscillating between 50 and 190 t during the last decades. All hake catches from this area come exclusively from bottom trawlers.

**Data and parameters:** Size composition of commercial trawl catches and official landings (1980-2011), CPUE data from bottom trawl surveys (2001-2011) and from commercial fleet (2000-2011). Growth parameters from Mellon-Duval et al. (2009), maturity ogive from Spanish National Data Collection Programme. M vector from PRODBIOM.

**Assessment method:** Extended Survivor Analysis (XSA) and Yield per recruit analysis.

**Model performance:** XSA residuals did not show any trend.

**Results:** Stock abundance, stock biomass and recruitment showed oscillations for the entire data series, without any clear trend. The Y/R analysis gave the following results:

| | |
|---|---|
| Current Y/R | 32 g |
| Maximum Y/R | 61 g |
| $Y/R_{0.1}$ | 57 g |
| $F_c$ | 1.57 |
| $F_{max}$ | 0.283 |
| $F_{0.1}$ | 0.173 |
| Current B/R | 66 g |
| Maximum B/R | 323 g |
| $B/R_{0.1}$ | 467 g |

**Diagnosis of stock status:** The stock is subjected to overfishing.

**Advices and recommendation:** To reduce fishing mortality. The use of the information from the vessel monitoring system will help to improve the knowledge about the spatial distribution of the fishing effort.

**Discussion:** It was suggested to include a plot of the spawning stock biomass against recruitment.

The WG endorsed the assessment and recommendations.

**3. Stock**: European hake, *Merluccius merluccius*

**GSA:** 06

**Author(s):** García-Rodriguez M. and Pérez-Gil J.L.

**Fishery:** Hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries developed by around 600 vessels along the GFCM geographical sub-area Northern Spain (GSA 06). In last years, the average of the annual landings of this species, which are mainly composed by juveniles living on the continental shelf, were situated around 3350 t in the whole area.

**Data and parameters:** Analysis were performed from size composition of trawl and gillnetters catches (obtained from on board and on port monthly sampling) and official landings, transforming length data to age data by slicing (L2AGE program). In this assessment, a new set of parameters (fast growth hypothesis; García Rodriguez 2002) were considered and a natural mortality vector (PROBIOM, Caddy and Abella 1999) was applied.

**Assessment method:** The state of exploitation was assessed for the period 1999-2011 by means of a VPA Separable, tuned with CPUE from commercial fleet and abundance indices from trawl survey (MEDITS). Analysis was carried out applying the Extended Survivor Analysis (XSA) method (Lowestoft suite; Darby and Flatman 1994) over the period 1999-2011. A yield by recruit analysis was performed using the EXCEL workbook provided by JRC IPSC (H.J. Rätz). A deterministic short term prediction for 2012 to 2014 was performed using the EXCEL workbook provided by JRC IPSC (H.J. Rätz). Medium term predictions for a 10 years period were implemented in R (www.r-project.org) using the FLR libraries and based on the results of the Extended Survivor Analyses obtained. A retrospective analysis was carried out to check the accuracy and bias of the estimates (F, SSB and Recruitment). The Lowestoft Retrospective VPA program with F shrinkage was employed.

**Model performance:** The retrospective analysis did not show any trend.

**Results:** The general results are similar to those obtained in previous assessments. Exploitation is based on very young age classes, mainly 0 and 1 year old individuals, with immature fraction dominating the landings. A decreasing trend, both in landings and yields is detected over the studied period, with a small recovery since 2007. Total biomass of the stock decreases slowly, being fluctuating at around the 8,700 t. The SSB represents only a 13% of the total biomass in average, showing an increasing trend along the period. Recruitments are declining since 1999 onwards meanwhile F slowly decreases in the last years. The predictive model suggested that in all scenarios of F variations (current F, $F_{0.1}$ and 30% reduction of current F) the stock is projected to increase in spawning biomass (particularly under the first and third scenario, even though this estimation includes a great deal of uncertainty which reflects the considerable uncertainty in recent and future year-class strengths, as well as current absolute biomass levels. In all cases catches are also expected to increase, even though in the first and third scenario there is first a short term decrease of the yields in 2010-2013 after which the yield increases).

**Diagnosis of stock status:** By comparing $F_{0.1}$ and $F_{max}$ against $F_c$, taking as reference $F_{bar}$ over 2007-2011, it can be concluded that the resource is subjected to overfishing.

**Advices and recommendation:** A reduction in trawling fishing effort, along with a reduction of gillnet and long lining effort, in the context of a multi-annual management plan taking into account the multi-species landings of the trawl is recommended.

**Discussion:** The assessment was found to contain contradictions, as the SSB increased while the recruitment decreased over the studied time period. The group considered that an explanation to this pattern should be provided. Several leads have been proposed by the group, such as checking changes occurring in the fisheries (effort over time for each gear), comparing recruitment data to the age 0 MEDITS index, comparing the CPUEs to the MEDITS index and compare the outputs of the separable VPA to a classical VPA run. In that context, the statement "low level of SSB" does seems not make complete sense.

The WG endorsed the assessment and recommendations.

**4. Stock**: European hake, *Merluccius merluccius*

**GSA:** 07

**Author(s):** Jadaud A., Guijarro B., Rouyer T. and Massutí E.

Fishery: Hake (*Merluccius merluccius*) is one of the most important demersal target species for the commercial fisheries in the Gulf of Lions (GFCM-GSA07). In this area, hake is exploited by French trawlers, French gillnetters, Spanish trawlers and Spanish long-liners. Around 220 boats are involved in this fishery and, according to official statistics, the total annual landings for the period 1998-2011 have oscillated around an average value of 2,230 t (1,362 t in 2011). In the past 10 years, the fishing capacity of the French trawlers in GSA 07 has progressively declined with a number of boats that decreased by nearly 30% over the period. Because of the large decline of small pelagic fish species in the area, in 2009 the trawlers fishing small pelagic have diverted their effort on demersal species. It is important to notice that some management measures for French trawlers have been taken in 2011; reduction in the number of boats, 13 boats destroyed in 2011, a measure that will continue in 2012; temporary closure of 1 month per year for the trawlers in 2011, 2012. The French trawler fleet is the largest in number of boats and catch (44 and 72%, respectively). The length of hake in the trawler catches has an average size of 21 cm TL. The second largest fleet is French gillnetters (~39 and 14% respectively, average size 39 cm TL), followed by Spanish trawlers (~11 and 8%, respectively, average size 24 cm TL), and Spanish long-liners (~6 and 6%, respectively, average size 52 cm TL). The hake trawlers exploits a highly diversified species assemblage: Striped mullet, Red mullet, Anglerfish, Black-bellied anglerfish, European conger, Fourspotted megrim, Poor cod, Soles, horned octopus, squids, Gilthead seabream, European seabass, Seabreams, Blue whiting, Tub gurnard.

**Data and parameters:** The information used for the stock assessment consisted in annual size composition of catches (estimated from monthly or quarterly sampling in the main landing ports), official landings and biological parameters estimated from data collected for the DCF by IFREMER in the GSA 7 (2003-2010). These parameters, length-weight relationship, sex-ratio and maturity ogive, were computed using INBIO (R scripts developed by IEO). The growth parameters came from tagging experiments developed by IFREMER in

the area (Mellon-Duval et al, 2010). The vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet (Abella et al. 1997).

**Assessment method:** For the period of the study (1998-2011), the methodology applied was a tuned virtual population analysis (VPA), applying the Extended Survivor Analysis (XSA) method considering, as tuning fleet French MEDITS campaign indices. The software used was FLR. For 2011, a yield per recruit (Y/R) analysis was performed.

**Model performance:** XSA retrospective analysis did not show any trend.

**Results:**

| | |
|---|---|
| Current Y/R | 0.05 |
| Maximum Y/R | 0.11 |
| $Y/R_{0.1}$ | 0.12 |
| $F_c$ | 1.65 |
| $F_{max}$ | 0.30 |
| $F_{0.1}$ | 0.15 |
| Current B/R | 0.09 |
| Maximum B/R | 0.40 |
| $B/R_{0.1}$ | 0.71 |

**Diagnosis of stock status:** The stock is in an overfishing status and is characterized by growth overexploitation with periodically higher recruitments (1998, 2001-2002 and 2007) which ensured the sustainability of the stock at a very low level of abundance. Since 2007, the recruitment has reached the lowest level of the historical series 1998-2011.

**Advices and recommendation**:
Management advice and recommendations:
To reduce growth overfishing:
- Improve the fishing pattern of the trawl to arise the minimum length of catches equal to the minimum legal landing size
- close nursery areas at least temporally (see doc. "Nursery area for hake for the Gulf of Lions" - p33, SAC 2010 report)
- Reduce the effort of trawl, from reducing time at sea, number of fishing boats, engine power, Bollard pull and/or trawl size
To avoid recruitment overfishing:
- Reduce the effort of longliners and gillnetters in order to increase (or at least maintain) the SSB.
- Establish temporal closures for longliners and gillnetters during the period of maximum spawning (end of autumn and beginning of winter, main peak of spawning period)

Freeze of the effort in the Fishery Restricted Area.

**Discussion:** As a general recommendation it was noted that comments such as the one about management measures currently in force such as destruction of boats, temporary closures for trawlers, and others should be included in the stock assessment forms as well as in the report. It was also suggested to show a plot of the size distributions at least for the last three years, which could help to identify trends as well as a plot of the spawning stock biomass against recruitment.

The WG endorsed the assessment and recommendations.

**5 Stock**: European hake, *Merluccius merluccius*

**GSA:** 12, 13, 14, 15 and 16

**Author(s):** Ben Meriem S., Fiorentino F., Arneri E., Ceriola L., Gancitano V., Widyan K., Knittweis L., Jarboui O. and Mifsud R.

**Fishery:** Hake, *Merluccius merluccius*, is one of the most important demersal target species of the commercial fisheries in the Strait of Sicily and North of Tunisia (GFCM-GSA12-16). In this area, hake is exploited by 5 fishing fleet components: Italian coastal trawlers, Italian distant trawlers, Tunisian trawlers, Tunisian gillnets and Maltese trawlers. Annual landings of hake for 2010-2011 is around a mean value of 2,000 t. Trawlers hake's fishery exploits a highly diversified species assemblage: Striped mullet (*Mullus surmuletus*), Red mullet (*Mullus barbatus*), Angler (*Lophius piscatorius*), Black-bellied angler (*Lophius budegassa*), European conger (*Conger conger*). Length catches of hake range between 8 and 66 cm total length (TL), with an average size of 20 cm TL.

**Data and biological parameters**:
The information used for the assessment of the stock consisted of annual size composition of catches (estimated from monthly or quarterly sampling in the main landing ports), official landings and biological parameters estimated from data collected in the GSA12-16 (2010-2011) by Tunisia, Italy and Malta. *M. merluccius* is a long live species with a slow growth rate. Growth hake is characterized by a wide literature revealing that growth remains among the oldest problems studied until today (Bouhlal 1975; Aldebert 1981; Aldebert and Carries 1989; Orsi Relini et al. 1989; Oliver 1991; Recasens 1992; Aldebert and Morales-Nin 1992; Morales-Nin and Aldebert 1997; Morales-Nin et al. 1998; Morales-Nin and Moranta 2004; Ferraton 2007; Courbin et al. 2007). This species has posed and still poses some problems in estimating the growth rate. The parameters used for the assessment of the stock are L-W relationship, sex-ratio, growth parameters and maturity ogive. This information comes from previous studies carried out on this species in the MedSudMed area (GSA 12-13-14-15-16).

**Assessment method:** For the period of the study (2010-2011), the methodology applied was a LCA, carried out with ANALEN and VIT software to calculate the fishing mortalities and population abundance. An Y/R analysis was also performed.

**Results:**

| | |
|---|---|
| Current YR | 66,14 |
| Maximum Y/R | 142,93 |
| $Y/R_{0.1}$ | 138,71 |
| $F_c$ | 0.69 |
| $F_{max}$ | 0.25 |
| $F_{0.1}$ | 0.19 |
| Current B/R | 76,47 |
| Maximum B/R | 2161 |
| $B/R_{0.1}$ | 943,17 |
| Current SSB/R | 76,33 |
| $SSB/R_{0.1}$ | 815,26 |
| SSB/R virgin | 1989 |

**Diagnosis of stock status:** Stock is in overfishing status and low abundance. The stock is characterized by growth overexploitation.

**Advices and recommendation**:
To reach $F_{0.1}$, current fishing mortality should be reduced by more than 80% in optimistic scenario.
- The fishing pattern is essentially oriented to the juvenile fraction, so to reduce growth overfishing, management of this species should be oriented towards increasing direct and indirect selectivity pattern of the trawl in order to increase the minimum length of catches up to the minimum legal landing size.
- Reduce the effort of trawlers targeting especially the juvenile fraction of the stock, from reducing time at sea, number of fishing boats, engine power.
- It is not excluded that the stock is shared with adjacent subareas so it's recommended to proceed to joint assessment integrating CopeMed Area.

**Discussion:** The group commented that since two growth hypotheses as it presented, the choice between the two different growth hypothesis is not clear. It was suggested that the hypothesis with a higher $L_\infty$ could be favored.

The WG considered this assessment preliminary because of the shortness of the time series considered. Two years of data were available.

**6. Stock:** European hake, *Merluccius merluccius*

**GSA:** 18

**Author(s):** Spedicato M.T., Bitetto I., Lembo G., Carbonara P., Casciaro L., Facchini M.T. (COISPA); Milone N., Ceriola L. (AdriaMed project); Joksimovic A., Ikica Z., Kasalica O., Djurovic M. (Institute of Marine Biology, Kotor); Kolitari J., Gjurgji I., Kroqi G. (University of Tirana, Albania)

**Fishery:** *Hake* is one of the most important species in the Geographical sub-area 18 representing about 20% of landings from trawlers. In 2011 the landings of hake were about 3,792 t in the west side with the higher production from trawlers (3,258 t) followed by longliners (534 t). Along the east side the production from trawlers in 2011 was about 439 t divided by 37 t from Montenegro and 402 t from Albania.

**Data and parameters:** Standardized LFD abundance indices ($N/km^2$), whole GSA 18 (MEDITS data 1996-2011, Data Collection Framework). Length structure of landings and production by fishing segment (for west side from DCF, east side within a pilot study in the framework of AdriaMed project). The scenario of growth for sex combined: $L_\infty$=104 cm, k=0.2, $t_0$=-0.01. Natural mortality was adjusted accordingly. Length-weight relationship: a=0.0043, b=3.155 sex combined. Maturity ogive with $L_{m50\%}$= 33.4 cm ± 0.15 cm.

**Assessment method:** SURBA software and VIT software. In addition, the Y/R analysis was implemented in VIT for the calculation of $F_{0.1}$.

**Model performance:** The methods were used in a complementary and integrated way. Consistency between results and inputs and life history parameters was cross-checked among methods and with inputs.

**Results:** MEDITS data showed a sharp increase of recruitment in 2005 and thereafter a level similar or higher than the past years. In 2008 a new though lower peak was observed. No trends were detected. SURBA: Total fishing mortality showed a decreasing trend to 2004 and then an increase in 2005 and 2006, thereafter the level was similar to the beginning of the time series. On the average, the mean F was around 1. VIT: Catches and mortality are dominated by the trawl fishing system. In the fast growth scenario the Y/R analysis indicates a current level fishing mortality of 0.92. The target reference point $F_{0.1}$ is 0.21.

**Diagnose of stock status:** The stock is in overfishing and thus it is necessary to consider a considerable reduction of the fishing mortality to allow the achievement of $F_{0.1}$.

**Advices and recommendations:** Given the results from this analysis, based on the whole information from the area, it is necessary to consider that a remarkable reduction of the fishing mortality is necessary. The reference point $F_{0.1}$ can be gradually achieved by multiannual management plans that foresee a reduction of fishing mortality through fishing limitations. As observed in 2011, the fishing mortality from the Italian bottom trawlers represents about 80% of the total F in the GSA and that of the Italian longlines is accounting for about 9.5%, with an overall percentage of about 90%, while Montenegrin trawlers account only for about 1% of the F exerted on hake in the GSA and Albanian trawlers of about 9.7%. Moreover, the production of hake in GSA 18 is split in 12.5% caught by Italian longlines, 77.2% by Italian trawlers, about 1% by Montenegrin trawlers and about 9.4% by Albania trawlers.

**Discussion:** The discussion highlights SURBA and VIT year-by-year analysis.

The WG endorsed the assessment and recommendations.

**7. Stock:** Common Pandora, *Pagellus erythrinus*

**GSA:** 15-16

**Author(s):** Knittweis L., Gancitano V. and Colloca F.

**Fishery:** Common Pandora is an important demersal fishery resource through the Mediterranean, including in the Strait of Sicily. Trawling is carried out on the continental shelf of the Central Mediterranean throughout the year, and catches include common Pandora (*Pagellus erythrinus*), pink shrimp (*Parapenaeus longirostris*), Norway lobster (*Nephrops norvegicus*), giant red shrimp (*Aristaeomorpha foliacea*), violet shrimp hake (*Merluccius merluccius*), violet shrimp (*Aristeus antennatus*), scorpionfish (*Helicolenus dactylopterus*), grater forkbeard (*Phicys blennioides*), red Pandora (*Pagellus bogaraveo)* and monkfish (*Lophius* spp.). In addition to trawling, common Pandora is targeted by several artisanal gears, including set gillnets, trammel nets, pots and traps and set longlines. Considering data from both GSAs combined, catches by the OTB fleet have declined in 2006-2011, whilst catches from the artisanal fleet have remained stable since 2008. Trawlers were responsible

for 80% of common Pandora landings in 2011. On average the Maltese fleet was responsible for only 3% of total landings in GSAs 15 and 16 in 2006-2011.

**Data and parameters:** Data coming from DCF for the period 2006-2011 were used to run an XSA, tuned with fishery independent data (i.e. MEDITS abundance indices for 2006-2011). Total landings data for both bottom otter trawlers (OTB) and artisanal fleet segments (trammel nets, GTR and set bottom longlines, LLS) was available for both GSA 15 and 16. Landings at length information for GSA 16 was used to infer length frequency distributions of landings in GSA 15 since landings at length information in GSA 15 was only available for 2011 and only for trammel nets (GTR)/set bottom longlines (LLS). Discards at length data was only available for 2010 and 2011 for OTB in GSA 16, and this information was used to reconstruct discards data for GSA 16 in 2006-2009 as well as for GSA 15.

The following biological parameters were used for obtaining the input data of the final XSA run:

| |
|---|
| VBGF: $L_\infty$ = 18.0 (cm, total length); k = 0.56; $t_{0=}$ -1.0 |
| L-W: a = 0.007; b=3.046 |
| Mortality at age vector: $Age_1$= 0.59, $Age_2$ = 0.22, $Age_3$ = 0.14, $Age_4$ = 0.09, $Age_5$ = 0.08, $Age_6$ = 0.07, $Age_{7+}$ = 0.07 (ProdBiom estimate) |
| Weight at age vector (kg): $Age_1$ = 0.040, $Age_2$ = 0.083, $Age_3$ = 0.136, $Age_4$ = 0.194, $Age_5$ = 0.253, $Age_6$ = 0.310, $Age_{7+}$ = 0.433 |
| Maturity at age: $Age_1$= 0, $Age_2$ = 1.0, $Age_3$ = 1.0, $Age_4$ = 1.0 |

**Assessment method:** The assessment was performed using length cohort analysis (LCA) as implemented in VIT4Win (Lleonart and Salat 1992, 1997). An XSA was performed using MEDITS number at age from GSA 15 and 16 for tuning.

**Model performance:** Due to departure of catch structure from the other years, VIT results of 2009 were not considered consistent with the pseudo cohort approach and were not considered for the analysis. XSA was run setting shrinkage at 0.5, 1.0, and 2.0. Results were similar with all three settings; the model with shrinkage of 1.0 was adopted as final model since it produced the smallest residuals, with no major trend in their distribution.

**Results:** An XSA (Extended Survivor Analysis) assessment was carried out during EWG 12-10 using catch data as well as survey data (the latter for tuning purposes) collected under the DCR/DCF from 2006 to 2011. According to the XSA analysis SSB (combined sex) has shown a consistent decline in 2006-2011 from 1,500 to 550 t. The XSA estimates of recruitment showed a decreasing trend from 11 million to 1 million in 2006-2010. However in 2011 there was an increase in recruitment to 5 million. The current fishing mortality estimated by XSA for ages 2-7 was 0.72.

**Diagnose of Stock status:** On the basis of the VIT analyses performed a technical reference point was given, corresponding to $F_{0.1}$ (ages 2-7) = 0.30 as a proxy of $F_{MSY}$. The current fishing mortality estimated by XSA for ages 2-7 (0.72) is higher than $F_{0.1,}$ thus overfishing of the stock of common Pandora in GSA 15 and GSA 16 is currently taking place. As a consequence F needs consistent reduction from the current F towards the candidate limit reference point for long term sustainability based on $F_{0.1}$.

**Advices and recommendations:** Based on the results of the XSA performed, a reduction of about ~60% of the fishing mortality is needed to reach the technical target reference point $F_{0.1}$; at present both SSB and recruitment show clear decreasing trends. A progressive reduction of current F through consistent effort reduction and an improvement in current exploitation patterns are recommended. In this context a multi-annual management plan to be implemented at GSA 15 and 16 taking into account the effects of the different gears targeting different life stages of common Pandora is advisable.

**Discussion:** The VIT analysis showed an anomaly in 2009. The origin of this anomaly should be explained, and also why this anomaly has not been observed when running the XSA analysis. In addition the XSA analysis was applied on 6 years data while the maximum age was 7 years, which does not allow the analysis to cover a complete cohort. At least 7 years should be needed to an adequate XSA run. The VIT analysis has been applied on single years, while the GFCM recommendations specify that years should be lumped together when using this approach. This remark was also addressed at the end of the sessions and a general recommendation is done in the last section of this report. The sensitivity of the results to the use of yearly or lumped data should be tested.

The WG endorsed the assessment and recommendations.

**8. Stock:** Common sole**,** *Solea solea*

**GSA:** 17

**Author(s):** Scarcella G., Fabi G., Grati F., Polidori P., Domenichetti F., Bolognini L., Punzo E., Santelli A., Strafella P., Brunetti B., Giovanardi O., Raicevich S., Celic I., Bullo M., Sabatini L., Franceschini G., Mion M., Piras C., Fortibuoni T., Vrgoc N., Despalatovic M., Cvitković N., Pengal P. and Marceta B.

**Fishery:** The Italian fleets exploit common sole with *rapido* trawl and set nets (gill nets and trammel nets), while only trammel net is commonly used in the countries of the eastern coast. Sole is an accessory species for otter trawling. More than 80-90% of catches come from the Italian side. Landings fluctuated between 1,000 and 2,300 t in the period 1996-2011 (data source: FAO-FishStat and 2012 official data call).The main Italian *rapido* trawl fleets of GSA 17 are sited in the following harbours: Ancona, Rimini and Chioggia. The Italian artisanal fleet in GSA 17, accounted for around 500 vessels widespread in many harbours along the coast. They use gill net or trammel net especially from spring to fall and target small and medium sized sole (usually smaller than 25 cm TL). The eastern part of the basin contributes for about the 10-20% of the total landings, with on average 8 t from Slovenia and 200 t from Croatia. *Rapido* trawl landings were traditionally dominated by small sized specimens; they are basically composed by 0+, 1 and 2 year old individuals. Set net fishery lands mostly the same portion of the population, while the otter trawl fishery, exploiting wider fishing grounds, shows a different size distribution of the landings. In the eastern part of the basin common sole is exploited mainly by set netters using trammel net. The catch composition, as suggested by preliminary data collection started in 2010 by Croatian colleagues in the framework of Primo Project, is dominated by adult.

**Data and parameters:** The information used for the assessment of the stock consisted of common sole landings estimated in respectively from the FAO Capture Production (GFCM

Area) 1970-2010 database and in the framework of Italian and Slovenian Official Data Collection submitted in the data call 2012, with Croatian data provided in the Croatian Primo Project and biological parameters estimated from data collected in the GSA 17 from SoleMon project. Abundance and biomass indexes from this *rapido* trawl survey were computed using ATrIS software, which also allowed drawing GIS maps of the spatial distribution of the stock, spawing females and juveniles. The natural mortality has been assumed as a vector using the Probiom approach.

**Assessment method:** XSA, SURBA and Statistical Catch at Age using SS3 assessments, together with a steady state VPA using VIT-model were applied. Input data were provided by the Italian and Slovenian DCF official data call, and from the Croatian Primo Project. Tuning data were collected during the SoleMon survey.

**Model performance:** The residuals and retrospective analyses did not show particular discrepancies.

**Results:**

| | |
|---|---|
| Current Y/R | |
| Maximum Y/R | 0.054 |
| $Y/R_{0.1}$ | 0.048 |
| $F_c$ (XSA) | 1.43 |
| $F_{max}$ | 0.46 |
| $F_{0.1}$ (Yield software) | 0.26 |
| Current B/R | |
| Maximum B/R | |
| $B/R_{0.1}$ | |

**Diagnosis of stock status:** Considering the results of the analyses conducted the common sole stock in GSA 17 is subjected to overfishing, being the current F (2011) estimated with different model comprised between 0.73 and 1.43 and higher than the proposed reference point ($F_{0.1}$ = 0.26 as a proxy of $F_{MSY}$).

**Advices and recommendation:** A reduction of fishing pressure would be recommended, also taking into account that the exploitation is mainly orientated towards juveniles and the success of recruitment seems to be strictly related to environmental conditions. This could be achieved by a two-months closure for *rapido* trawling inside 11 km (6 nm) offshore along the Italian coast, after the fishing ban. Moreover, information provided by VMS will be useful in order to quantify the fishing effort of *rapido* trawlers in such area and period. Finally, specific studies on *rapido* trawl selectivity are necessary. In fact, it is not sure that the adoption of a larger mesh size would correspond to a decrease of juvenile catches. The same uncertainty regards the adoption of square mesh.

**Discussion:** The group considered the use of the SS3 method as a good initiative. Comparisons of outputs with classical approaches should be done.

The WG endorsed the assessment and recommendations.

**9. Stock:** Blackspot seabream, *Pagellus bogaraveo*

**GSA:** 01 and 03

**Author(s):** Belcaid S., Benchoucha S., Pérez Gil J.L., Gil Herrera J., González Costas F., García Prieto F., Talbaoui E.M., El Arraf S., Hamdi H., Abid N., Malouli Idrissi M., Lamtai A., Bernardon M., Camiñas J.A., Fernández I.d.L.

**Fishery:** Blackspot seabream, *Pagellus bogaraveo* is one of the most important demersal target species of the longline commercial fisheries in the strait of Gibraltar area (GSA 01 and 03). These longliners accounted for 99 vessels in Spain and 102 longliners in Morocco. 435 artisanal boats catch in a few amounts this species in Morocco. The blackspot fishery is carried out at 200-700 m depth. The gear used is the longline known as "voracera" in both countries. All vessels of GSAs 01 and 03 perform daily fishing trips. Landings are distributed in commercial categories, owing to the wide range of sizes and for market reasons. The main landings ports are Tarifa, Algeciras and Conil (Spain) and Tangier for longliners and Ksar Sghir and Dikky for artisanal fishery (Morocco). The landings Catch available from Tarifa port are catches (1984-2011), landings length distributions (1995-2011), fishery footprint and CPUE from observers (2005-2009) and from the Location and Track System for Andalusian Fishing Vessels (SLSEPA) of the Junta de Andalucía. In Spain, landings showed an increase from 1983 to a maximum in 1994. Since then landings have decreased, except in 1996 and 1997, reaching the lowest value of the recent years in 2002. From 2003 onwards it showed an increasing trend setting the highest value of the last years in 2009, when landings started to decrease again. In Morocco, in the past years, the longliners fleet was more or less stable while the artisanal fleet has increased in the 2009-2011 period. Since 2001, the effort and catches are available at the port of Tangier and both have increased until 2011. CPUE increased until 2005 and in the period 2005-2009 was more or less stable. From 2010 onwards, a decrease of CPUE was observed. Length catches in Morocco range is 24-58 cm (total length) and the majority of the catches range is 29-41 cm. Length catches in Spain ranged between 26 and 58 cm (total length) and the majority of the catches range is 29-44 cm. Some trawlers catch in a few amounts Blackspot as a by-catch in both countries. The Spanish and Moroccan fisheries are targeting this species in almost the same area.

**Data and parameters:** LCA assessment with the Moroccan and Spanish length frequencies (2009-2011) were used with the VIT software. The biological parameters (growth and L-W relationship) used are from Gil, 2006. The natural mortality was assumed constant for all ages, length classes and years (M=0.2). Female $L_{50}$ maturity was assumed = 35.73 cm. Different values for F terminal were tried in the VIT program (0.3, 0.5 and 0.8). Yield Per Recruit (YPR) analysis (Beverton and Holt 1957) and a Spawning Stock Biomass per Recruit analysis (Gabriel et al. 1989) was used for calculating the biological reference points $F_{max}$, $F_{0.1}$ and $F_{40\%}$ with the output results of the VIT using a value of 0.5 for F terminal. An assessment was also run by the Depletion-Corrected Average Catch (DCAC) model using the catches from 1983 to 2011. The values of the parameters being used for DCAC were: M=0.2, $F_{MSY}$ to M=0.8, the depletion delta=0.47 and $B_{MSY}/B_0$=0.4.

**Assessment method:** For lengthy frequencies (GSA 01+03, period 2009-2011), the methodology applied was the software VIT. For the catches (1983-2011), the Depletion-Corrected Average Catch (DCAC) was used.

**Model performance:** The two models gave good results and then same tendency for the *Pagellus bogaraveo* stock status.

**Results:**
VIT and DCAC

| | Total |
|---|---|
| Current Y/R | 310.624 |
| Maximum Y/R | 346.192 |
| $Y/R_{0.1}$ | 70.4658 |
| $F_{max}$ | 0.295 |
| $F_{0.1}$ | 0.113 |
| Current B/R | 1642.315 |
| Maximum B/R | 3201.521 |
| $B/R_{0.1}$ | 2920.453 |
| $F_{40\%MSY}$ | 0.120 |
| $Y/R_{40\%MSY}$ | 74.409 |

| Age | Mean F 2009-2011 | F-01 | F-Max | F at 40 %MSP | DCAC |
|---|---|---|---|---|---|
| 1 | 0.001 | 0.001 | 0.002 | 0.001 | |
| 2 | 0.080 | 0.046 | 0.122 | 0.050 | |
| 3 | 0.305 | 0.177 | 0.464 | 0.189 | |
| 4 | 0.274 | 0.159 | 0.417 | 0.170 | |
| 5 | 0.173 | 0.100 | 0.263 | 0.107 | |
| 6 | 0.139 | 0.081 | 0.212 | 0.086 | |
| 7 | 0.185 | 0.107 | 0.281 | 0.115 | |
| 8 | 0.240 | 0.139 | 0.365 | 0.149 | |
| 9 | 0.500 | 0.290 | 0.761 | 0.310 | |
| Fbar (2-6) | 0.194 | 0.113 | 0.295 | 0.120 | |
| Catches (tons) | 411 | 473 | 538 | 481 | 331 |

**Diagnosis of stock status:** Stock is in overfishing status ($F_c$=0,194 higher than $F_{0.1}$=0.113 and $F_{40\%MSY}$=0.120) and overexploited (MSY=331 t lower than Y at $F_{0.1}$=473 t and Y at 40%=481 t).

**Advices and recommendation**:

- The actual effort level should be reduced to set the fishing mortality level to a more sustainable value.
- Rationalize the management of this resource by establishing the same or similar management measures in both countries (Morocco and Spain).

**Discussion:** Three scenarios on $F_{terminal}$ were presented for the VIT analysis. The rationale behind the choice of the retained $F_{terminal}$ could be stated more clearly, even though results were qualitatively similar. It was also noted that the reference points obtained by the Yield per recruit approach could be compared to those obtained from the three scenarios using VIT. Finally, it was noted that overfishing should be assessed based on biomass.

The WG endorsed the assessment and recommendations.

**10. Stock:** Striped red mullet, *Mullus surmuletus*

**GSA:** 05

**Author(s):** Guijarro B., González N., Rubio V., Valls M., Ordines F. and Quetglas A.

**Fishery:** In the Balearic Islands (western Mediterranean), commercial trawlers develop up to four different fishing tactics, which are associated with the shallow shelf, deep shelf, upper slope and middle slope (Guijarro and Massutí 2006; Ordines et al. 2006), mainly targeted to: (i) *Spicara smaris*, *Mullus surmuletus*, *Octopus vulgaris* and a mixed fish category on the shallow shelf (50-80 m); (ii) *Merluccius merluccius*, *Mullus* spp., *Zeus faber* and a mixed fish category on the deep shelf (80-250 m); (iii) *Nephrops norvegicus*, but with an important

by-catch of big *M. merluccius*, *Lepidorhombus* spp., *Lophius* spp. and *Micromesistius poutassou* on the upper slope (350-600 m) and (iv) *Aristeus antennatus* on the middle slope (600-750 m). The striped red mullet, *M. surmuletus*, is one of the target species in the shallow shelf, although it is also caught in the deep shelf. It is also the target species of part of the artisanal fleet, being caught during the second semester of the year mainly by trammel nets but also by gillnets.

**Data and parameters:** Size composition of commercial trawl catches and official landings (2000-2011), CPUE data from bottom trawl surveys (2001-2011) and from commercial fleet (2000-2011). Growth parameters, lenght-weigth relationship and maturity ogive obtained in the area from monthly Biological samplings in the Spanish National Data Collection Programme. M vector from PRODBIOM.

**Assessment method:** Extended Survivor Analysis (XSA) and Yield per Recruit analysis.

**Model performance:** XSA residuals did not show any trend.

**Results:** XSA results show a slightly decreasing trend, significant for stock abundance, stock biomass and recruitment, but not for SSB.

| | |
|---|---|
| Current Y/R | 17.3 g |
| Maximum Y/R | 17.4 g |
| $Y/R_{0.1}$ | 15.2 g |
| $F_c$ | 0.714 |
| $F_{max}$ | 1.422 |
| $F_{0.1}$ | 0.229 |
| Current B/R | 65.7 g |
| Maximum B/R | 54.9 g |
| $B/R_{0.1}$ | 105.7 g |

**Diagnosis of stock status:** The stock is subjected to overfishing.

**Advices and recommendation:** To reduce fishing mortality. The use of the information from the vessel monitoring system will help to improve the knowledge about the spatial distribution of the fishing effort.

**Discussion:** No particular comments were done.

The WG endorsed the assessment and recommendations.

**11. Stock:** Red mullet, *Mullus barbatus*

**GSA:** 07

**Author(s):** Jadaud A., Guijarro B., Rouyer T. and Massutí E.

**Fishery:** In the Gulf of Lions (GFCM-GSA 07), red mullet (*Mullus barbatus*) is exploited by both French and Spanish trawlers. Information on French gillnetters is available from 2011. The French gillnetters are suspected to have fished red mullet in the past, but no data is

available to quantify their catches. Around 200 boats are involved in this fishery. According to official statistics, the total annual landings for the period 2004-2011 have oscillated around an average value of 190 t. The French gillnetters represent nearly half of the boats (45%), followed by the French (41%) and Spanish trawlers (14%). In terms of landings, most catches were coming from the French trawlers (74%), followed by the French gillnetters (13%) and the Spanish trawlers (13%). The mean modal lengths in the catches of the French trawlers and gillnetters, and Spanish trawlers were 13.8, 17.5 and 14.8 cm, respectively. Length at first capture is about 7 cm. Catch is mainly composed by individuals of age 0 and 1, while the oldest age class (5+ group) is poorly represented. Catch rates showed oscillations over the period assessed. It is important to note that some management measures for French trawlers have been taken in 2011; reduction in the number of boats, with 13 boats destroyed in 2011, which will continue in 2012; temporary closure of 1 month per year for the trawlers in 2011 and 2012. In GSA 07, the trawl fishery is a multi-specific fishery. In addition to *M. barbatus*, the following species can be considered important by-catches: *Merluccius merluccius, Lophius* sp.*, Pagellus* sp.*, Trachurus* sp.*, Mullus surmuletus, Octopus vulgaris, Eledone* sp.*, Scyliorhinus canicula, Trachinus* sp.*, Triglidae, Scorpaena* sp.

**Data and parameters:** Size composition derived from French and Spanish trawlers and from the French gillnetters were used, transforming number at length into number at age by knife edge slicing. In the absence of stock specific parameters, growth parameters were taken from GSA 09 (Ligurian and North Tyrrhenian Sea) and length/weight parameters from French National DCF programme. Natural mortality was estimated using PROBIOM (Abella et al. 1997).

**Assessment method:** The assessment of this stock has been carried out by means of Extended Survivor Analysis (XSA) for the period 2004-2011, calibrated with fishery independent survey abundance indices (MEDITS), and yield-per-recruit (Y/R) for the period 2009-2011. The software used was FLR.

**Model performance:** Considering the retrospective analysis, F and SSB do not show any particularity. Recruitment seems to be overestimated certainly due to high recruitment values in 2006 and 2010.

**Results:**

| | |
|---|---|
| Current Y/R | 10.65 |
| Maximum Y/R | 10.72 |
| $Y/R_{0.1}$ | 9.8 |
| $F_c$ | 1.26 |
| $F_{max}$ | 2.50 |
| $F_{0.1}$ | 0.5 |
| Current B/R | 28.25 |
| Maximum B/R | 23.03 |
| $B/R_{0.1}$ | 39.5 |

**Diagnosis of stock status:** The stock is in an overfishing status (high fishing mortality and intermediate abundance) with periodically higher recruitments (2006 and 2010).

**Advices and recommendation**: Reduce effort of trawl, by reducing the time at sea, the number of fishing boats, the engine power, the Bollard pull and/or trawl size.

**Discussion:** No particular comments were made.

The WG endorsed the assessment and recommendations.

**12. Stock:** Red mullet, *Mullus barbatus*

**GSA:** 15-16

**Author(s):** Colloca F., Knittweis L., Gancitano V. and Fiorentino F.

**Fishery:** Red mullet (*M. barbatus*) is one of the main demersal resources of coastal fisheries of GSA 15 and 16. It is exploited by otter trawlers and small-scale vessels using trammel-nets, along with other several shelf species, such as *Mullus surmuletus, Merluccius merluccius, Pagellus spp., Uranoscopus scaber, Raja spp., Trachinus spp., Octopus vulgaris, Sepia officinalis, Eledone spp.* and *Lophius spp*. Landings data collected within the Data Collection Framework (DCF) showed a decrease from 1,409 t in 2005 to 608.5 t in 2011. More than 95% of the annual landing is due to bottom otter trawlers. The contribution of the Maltese fleet was less than 5% in 2005-2011. The annual amount of discards, estimated within the DCF for trawlers smaller than 24 m LOA, ranged between 32 and 117 tons in the period 2006-2011 in GSA 16. The effort of Italian otter trawlers of 12-24 m LOA remained quite constant (800,000 - 10,000.000 KW day$^{-1}$) in 2004-2011. A decreasing pattern was evident for both Italian and Maltese small scale vessels (6-12 m) equipped with trammel nets.

**Data and parameters:** Standardized LFD abundance indices (N/km$^2$), of the GSAs 15 and 16 (MEDITS data 2002-2010, DCF). Annual catches and their length/age structures by fleets and fishing segment (trawlers, small-scale vessels) for the period 2006-2011. Growth parameters, maturity and natural mortality at age are showed in the following tables.

Growth parameters and length-weight relationship

| Sex | $L_\infty$ | k | $t_0$ | a | b |
|---|---|---|---|---|---|
| F | 23.61 | 0.45 | -0.80 | 0.0134 | 2.9419 |
| M | 20.16 | 0.57 | -0.80 | 0.0176 | 2.8226 |

Proportion of mature

| Age | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5+ |
| 0.1 | 0.9 | 1 | 1 | 1 |

Natural mortality

| Age | 1 | 2 | 3 | 4 | 5+ |
|---|---|---|---|---|---|
| M | 1 | 0.6 | 0.42 | 0.36 | 0.33 |

**Assessment method:** DCF data (age distribution of landings and discards) for bottom trawlers and trammel nets covering the period 2006-2011 were used to run an XSA, tuned with fishery independent data (i.e. MEDITS abundance indices for 2006-2011). Single survey exploratory SURBA 2.2 model run was carried out fitting constant catchability (1.0 for all ages) at age over the MEDITS data 2002-2011.

**Model performance:** In 2006-2011, the SSB declined from 2,167 to 1,147 t in 2011. MEDITS survey indices, analyzed using SURBA, showed an increasing of relative SSB from 1994 to 2006 followed by a decline in 2007-2011. The recruitment also showed a decreasing trend from 134.6 million in 2006 to 64.9 million in 2011. The total biomass consequently declined in the same period from about 3,500 t to 1,510 t. XSA estimates of $F_{bar0-4}$ and $F_{bar1-5}$ showed a reduction since 2006 with the lowest values estimated in 2011 ($F_{0-4}$=1.3).

**Results:** In 2006-2011, the SSB declined from 2,167 to 1,147 t in 2011. MEDITS survey indices, analyzed using SURBA, showed an increasing of relative SSB from 1994 to 2006 followed by a decline in 2007-2011. The recruitment also showed a decreasing trend from 134.6 million in 2006 to 64.9 million in 2011. The total biomass consequently declined in the same period from about 3,500 t to 1,510 t. XSA estimates of $F_{bar0-4}$ and $F_{bar1-5}$ showed a reduction since 2006 with the lowest values estimated in 2011 ($F_{0-4}$=1.3).

**Diagnose of Stock status:** The WG proposed $F_{0.1}$ = 0.45 as proxy of $F_{MSY}$ and as the exploitation reference point consistent with high long term yields. Taking into account the results obtained by the XSA analysis (current $F_{0-4}$ is around 1.3), the stock is considered exploited unsustainably (overfishing).

**Advices and recommendations:** The WG recommends the relevant fleets'effort and/or catches to be reduced until fishing mortality is below or at the proposed $F_{MSY}$ level, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries considerations. The current high discarding rate of juveniles of the 0 group needs to be reduced by improving the trawl net selectivity (i.e. adoption of sorting grids) and through the reduction of fishing effort on the continental shelf in autumn.

**Discussion:** The discussion was focused on the identification of stock units in the Strait of Sicily. Red mullet is a typical coastal resources, the peculiarity of the Strait of Sicily (two shelves - the European and the African ones-separated by narrow deep bottoms) supports the hypothesis of the existence of different subpopulations in the area and thus the occurrence of a stock unit confined in GSAs 15 and 16. The WG discussed the recent change in the exploitation pattern of the trawl fleet of the 12-24 m LOA which can justify the observed decline in fishing mortality in recent years. SURBA displayed an increase in biomass, but the analysis showed a general decrease in the stock. It was noted that the survey data has a longer time extent that allowed to display a long-term increase, whereas the analysis captured a short-term decrease. It was suggested to consider the difference in time-scale.

The WG endorsed the assessment and recommendations.

**13. Stock:** Black-bellied anglerfish, *Lophius budegassa*

**GSA:** 07

**Author(s):** Jadaud A., Guijarro B., Rouyer T. and Massutí E.

**Fishery:** In this area, *Lophius budegassa* is exploited by French and Spanish trawlers. Around 127 boats are involved in this fishery and, according to official statistics, total annual landings for the period 2005-2011 have oscillated around an average value of 252 t (324 t in

2011). The French trawlers fleet is the largest (77% of the boats) and makes most of the catches (87%). The length in the French trawler catches ranges between 18 and 80 cm total length (TL), with an average size of 32 cm TL. The Spanish trawlers is smaller (23% of the boats and 13% of the catch), the length in the catch is in the range 14-77 cm TL, with an average size of 30 cm TL. The trawlers fishery exploits a highly diversified species assemblage: Hake (*Merluccius merluccius*), Striped mullet (*Mullus surmuletus*), Red mullet (*Mullus barbatus*), Black-bellied angler (*Lophius budegassa*), European conger (*Conger conger*), Poor-cod (*Trisopterus minutus capelanus*), Fourspotted megrim (*Lepidorhombus boscii*), Soles (*Solea* spp.), horned octopus (*Eledone cirrhosa*), squids (*Illex coindetii*), Gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*), Seabreams (*Pagellus* spp.), Blue whiting (*Micromesistius poutassou*) and Tub gurnard (*Chelidonichtys gurnardus*).

**Data and parameters:** LCA was computed using DCF data of commercial landings (2009-2011). The growth and maturity parameters used for the assessment come from the GSA 06. The vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet (Abella et al. 1997).

**Assessment method:** Length cohort analysis (LCA) was performed using VIT program (Lleonart and Salat 1992) for the years 2009, 2010 and 2011 to provide an overview of the current state of exploitation for black-bellied anglerfish in GSA 07. This method was used as the results from a preliminary XSA run were not considered to be reliable. Eight age classes were considered, the last one being a plus group. For the year 2011, a yield per recruit (Y/R) analysis was performed.

**Model performance:**
The angler fish stock has been assessed for the first time:

- XSA runs yielded F estimates that were lower than for the VIT run, whereas spawning stock biomass estimates were higher than for the VIT runs.
- Results from the XSA were furthermore found quite unstable due to the lack of tuning data to calibrate XSA
- The biological parameters used were coming from GSA 06.

It was generally found that this preliminary run was not robust enough to be reliable and trusted and therefore VIT results were used for defining the status of the stock. However, integrating a survey index and a few extra years in XSA could lead to its use for the assessment of this stock in the future. Overall, given the shortness of the data used, the lack of fisheries-independent data and the uncertainty in the biological parameters, the results have to be considered with caution and therefore this analysis considered as preliminary.

**Results:**

| | |
|---|---|
| Current Y/R | 97.3 |
| Maximum Y/R | 117.6 |
| $Y/R_{0.1}$ | 113.1 |
| $F_c$ | 0.97 |
| $F_{max}$ | 0.36 |
| $F_{0.1}$ | 0.29 |
| Current B/R | 129.1 |
| Maximum B/R | 343.3 |
| $B/R_{0.1}$ | 474.1 |

**Diagnosis of stock status:** Following the Y/R methodology, in 2011 $F_{0.1}$=0.292 and $F_{2-4}$=0.972, the stock seems to be in an overexploitation status. But as stated previously this assessment was considered preliminary.

**Advices and recommendation:** The angler fish stock has been assessed for the first time and the assessment is considered preliminary. Hence, no management advice can be given.

**Discussion:** The authors wanted to keep this assessment as preliminary although 3 years of VIT analysis was considered enough to accept the assessment. However, because of the lack of information on biological parameters and fisheries independent data, this assessment was kept preliminary.

**14. Stock:** Black-bellied anglerfish, *Lophius budegassa*

**GSA:** 15-16

**Author(s):** Fiorentino F., Gancitano V., Colloca F. and Knittweis L.

**Fishery:** In the Strait of Sicily (central Mediterranean Sea) black-bellied anglerfish is a high value commercial species. It is fished almost exclusively by trawlers operating mainly on the outer shelf-upper slope, together with other important species, such as *Mullus* spp.*, Pagellus* spp.*, Merluccius merluccius, Zeus faber, Raja* spp*, Eledone* spp.*, Illex coindetii, Todaropsis eblanae, Parapenaeus longirostris* and *Nephrops norvegicus*. In the last three years the landings of both the Italian and Maltese trawlers ranged between 250 and 285 t, the Italian landings amounting to more than 98% of the totals.

**Data and parameters:** Data coming from DCF for the period 2002-2011 were used to run a SURBA (i.e. MEDITS abundance indices by age for 2002-2011). Age structure of the landings in 2009 to 2010 was used to assess stock status through a pseudo-cohort analysis using the VIT software.

The following biological parameters were used to obtain the input data of the final SURBA and VIT runs:

| |
|---|
| VBGF: $L_\infty$ = 72.0 (cm, total length); k = 0.17; $t_{0=}$ -0.41 |
| L-W: a = 0.0174; b=2.9376 |
| Mortality at age vector: $Age_1$= 0.78, $Age_2$ = 0.34, $Age_3$ = 0.25, $Age_4$ = 0.21, $Age_5$ = 0.19, $Age_6$ = 0.17, $Age_{7+}$ = 0.16 (PRODBIOM estimate). |
| Weight at age vector (kg): $Age_1$ = 117.2, $Age_2$ = 319.9, $Age_3$ = 607.9, $Age_4$ = 953.5, $Age_5$ = 1329.8, $Age_6$ = 1714.3, $Age_{7+}$ = 2090.6 |
| Maturity at age: $Age_1$= 0, $Age_2$ = 0, $Age_3$ = 1.0, $Age_4$ = 1.0, $Age_5$ = 1.0, $Age_6$ = 1.0, $Age_{7+}$ = 1.0 |

**Assessment method:** The assessment was performed using length cohort analysis (LCA) as implemented in VIT4Win (Lleonart and Salat 1992, 1997), SURBA and Beverton and Holt total mortality estimator to assess the current Fishing mortality. Yield per recruit analyses were performed by using VIT and Yield Packages. This last approach included uncertainty in BRP estimation.

**Model performance:** The SURBA run was not found satisfactory, as a large uncertainty was observed.

**Results:** According to SURBA estimates, SSB clearly increased from 2002 to 2006, showing thereafter a slight decrease. The first estimates of absolute values of SSB obtained by VIT, ranged between 540 (2010) and 980 (2009) t. However, in the absence of proposed biomass management reference points, the WG is unable to fully evaluate the status of the stock spawning biomass in relation to these. According to SURBA estimates, recruitment remained quite stable from 2002 to 2008, followed by an increase in 2009 and 2010, and a large decrease in 2011. Absolute values of recruits at age 1 obtained by VIT in 2009 and 2010 were around 1 million of recruits per year. However, in the absence of proposed management reference points, the WG is unable to fully evaluate the status of the recruitment in relation to these. The $F_c$ ($F_{1-7}$) obtained by the VIT analysis was around 0.30. These level of F were supported also by the results obtained of the Beverton and Holt total mortality estimator calculated on trawl surveys data.

**Diagnose of Stock status:** $F_{0.1}$ = 0.16 was proposed as proxy of $F_{MSY}$ and as the exploitation reference point consistent with high long term yields. Taking into account the results obtained by the VIT analysis (current $F_{1-7}$ is around 0.30), the stock is considered in overfishing.

**Advices and recommendations:** Based on the results of the VIT, the WG recommends the relevant fleets' effort or catches to be reduced until fishing mortality is below or at the proposed $F_{MSY}$ level, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries considerations.

**Discussion:** A good consistency was noted between the F estimated by VIT and those by Beverton and Holt mortality estimator. It was also noted that $F_{max}$ is not a very reliable reference point as it is hard to estimate. The SURBA run was not found satisfactory, as a large uncertainty was observed.

The WG endorsed the assessment and recommendations.

**15. Stock:** Brush tooth lizard fish, *Saurida undosquamis*

**GSA:** 26

**Authors:** El-Haweet A.A.K., Mahmoud H.H. and Riga C.

**Fishery:** Family *Synodontidae* is represented in the Egyptian Mediterranean waters (GSA 26) by two species: *Saurida undosquamis* and *Synodus saurus*. Brush tooth lizard fish, *Saurida undosquamis* is considered important demersal target species of the commercial fisheries in Egypt (GFCM-GSA 26), it represents about 70% (1,944 t) of the total catch of the family during 2011 which nearly equal to 3% of the total Egyptian Mediterranean landed catch. It is exploited by the fishing trawlers, 1,102 vessels (according to the official statistics) 1,076 vessels of them are from 12 to 24 m. long and the rest are lower than 12 m. long. The size of the fish samples ranged between 10 cm and 37 cm and the mean length is 19.71 cm.

**Data and parameters:** The information used for the preliminary assessment of the stock considered of catch length structure, length weight relationship, total length at the end of each year of life, von Bertalanffy growth parameters, sex ratio, the values of (total and fishing mortalities), survival rates, length at first sexual maturity, yield per recruit, biomass per recruit, biological reference points. The vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet.

**Assessment method:** For the period of study (7-2011 to 8-2012), the methodology applied indirect methods: Length cohort analysis and Beverton and Holt Yield per Pecruit analysis (FiSAT and VIT4Win and ProdBiom, 2009).

**Results:**

| | |
|---|---|
| Current Y/R | 32.657 |
| Maximum Y/R | 37.979 |
| $Y/R_{0.1}$ | 36.316 |
| $F_c$ | 0.588 |
| $F_{max}$ | 0.44 |
| $F_{0.1}$ | 0.29 |
| Current B/R | 56.669 |
| Maximum B/R | 124.848 |
| $B/R_{0.1}$ | 170.22 |

**Diagnosis of stock status:** The results (the current fishing level of the lizard fish is higher than the biological reference points ($F_{0.1}$ and $F_{max}$)) indicating that, the lizard fish *Saurida undosquamis* stock in GSA 26 is overexploited.

**Advices and recommendation:**
- Reduce the fishing mortality to $F_{0.1}$ by limitation of fishing activities.
- Improve the selection pattern of the trawl fishery.

**Discussion:** Two different methods were used to estimate natural mortality. It was noted a small difference between the natural mortality for age 1 and the last age. Since this assessment is new, it was suggested to use a broad range of methods to test how M estimates vary. It was also suggested to look into separating the artisanal fisheries.

The WG endorsed the assessment and recommendations.

**16. Stock:** Red shrimp, *Aristeus antennatus*

**GSA:** 05

**Author(s):** Carbonell A., Guijarro B., Gazá M. and Ordines F.

**Fishery:** In the Balearic Islands, commercial bottom trawlers develop up to four different fishing tactics, which are associated with the shallow shelf, deep shelf, upper slope and middle slope, mainly targeted to: (i) *Spicara smaris*, *Mullus surmuletus*, *Octopus vulgaris* and a mixed fish category on the shallow shelf (50-80 m); (ii) *Merluccius merluccius*, *Mullus* spp., *Zeus faber* and a mixed fish category on the deep shelf (80-250 m); (iii) *Nephrops norvegicus*, but with an important by-catch of big *Merluccius merluccius*, *Lepidorhombus*

spp., *Lophius* spp. and *Micromesistius poutassou* on the upper slope (350-600 m) and (iv) *Aristeus antennatus* on the middle slope (600-750 m).

**Data and parameters:** Size composition of commercial trawl catches and official landings (1992-2011), CPUE data from bottom trawl surveys (2001-2011) and from commercial fleet (1992-2011). Growth parameters, length-weight relationship and maturity ogive obtained in the study area from Spanish National Data Collection Programme. M vector as scalar.

**Assessment method:** Length cohort analysis (VPA and Y/R) for a pseudocohort 2007-2011 and Separable VPA and Extended Survivor Analysis (XSA) for 1992-2011.

**Model performance:** XSA residuals for bottom trawl fleet showed high values, so this tuning fleet was excluded from the model. XSA residuals did not show any trend.

**Results:** Stock abundance, stock biomass and recruitment showed a clear decreasing trend between 1992 and 1997. Since then, the stock parameters showed certain stability, with oscillations along the rest of the years, but without any clear trend. F showed oscillations along the data series, with higher values in general before 1999 than after this year.

| | |
|---|---|
| Current Y/R | 7.65 g |
| Maximum Y/R | 8.09 g |
| $Y/R_{0.1}$ | 7.46 g |
| $F_c$ | 1.285 |
| $F_{max}$ | 0.661 |
| $F_{0.1}$ | 0.331 |
| Current B/R | 11.21 g |
| Maximum B/R | 18.49 g |
| $B/R_{0.1}$ | 27.80 g |

**Diagnosis of stock status:** The stock is subjected to overfishing.

**Advices and recommendation:** To reduce fishing mortality. A possible management measure would be protecting the recruitment, by reducing temporally fishing time during the recruitment period at the beginning of autumn.

**Discussion:** From the time series the stock seems to be in a low abundance period. As $F>F_{0.1}$, the management recommendations should be reducing the fishing mortality.

The WG endorsed the assessment and recommendations.

**17. Stock:** Red shrimp, *Aristeus antennatus*

**GSA:** 06 (partial: Catalonia only)

**Author(s):** Gorelli G., Sardá F. and Company J.B.

**Fishery:** The fishery of the *Aristeus antennatus* is one of the most important in the Western Mediterranean and in the GSA 06 in particular. It is a very valuable species and in some ports of Catalonia it represents up to 50% of the economical incomes, accounting for 8% of total

landings. A recent study identified one single genetic stock in the whole Western Mediterranean (Fernández et al. 2011). However, a great part of the stock dwells in areas not available to fishery (below 1000 m), and the degree of mixing between the exploited and the unexploited part of the stock is unknown. This stock assessment covers the portion of the stock exploited by the catalan fleets, and the years considered were 2008, 2009 and 2010. In Catalonia, the *Aristeus antennatus* is fished exclusively by bottom trawling at depths between 300 and 850 m depth. The total number of vessels exploiting the resource in the whole area varies between 70 and 100, depending on the season. There is no specific regulation for this fishery, which is subject to the common regulation for trawlers in the area. During the last few years the fishing effort has slightly decreased, due to decreased number of vessels. The total catches decreased throughout the period studied, being 677 t in 2008, 625 in 2009 and 486 in 2010. CPUE decreased as well. The mean size in the landing was very different between females (28 mm cephalotorax length) and males (19 mm cephalotorax length) and the sex ratio was 81% of females. There is no discard for this species. The most common by-catch species are *Phycis blennoides, Micromessistius potassou, Lophius piscatorius, Pasiphaea multidentata*; the most common discarded species are *Lampanyctus crocodilus, Galeus melastomus, Scylorhinius canicula, Pasiphaea sivado, Etmpopterus spinax, Dalatias licha.*

**Data and parameters:** The information we used for this assessment was the length frequency data collected monthly during 2008, 2009 and 2010, and the total catches for the same years that were available from the database of the Autonomous Government of Catalonia. The biological parameters used were the ones previously calculated by Demestre and Lleonart (1993) in the same study area, which included length-weight relationship parameters, von Bertalanffy equation parameters, natural mortality, and maturity ratios per size. Since biological parameters were very different between sexes, the analysis were performed on the two sexes separately, and afterwards results were combined.

**Assessment method:** We performed an LCA analysis based on pseudo-cohorts (VIT, Lleonart and Salat 1997) assuming steady state. Afterwards a Yield per Recruit analysis was run, based on LCA results.

**Results:** Length Cohort Analysis results shown per year, from 2008 to 2010, for females and males separately and the two sexes combined.

| | FEMALES | | | MALES | | | SEXES COMBINED | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 |
| Recruits (millions) | 77 | 65 | 53 | 27 | 17 | 14 | 105 | 82 | 67 |
| Recruits (t) | 114 | 135 | 94 | 29 | 42 | 25 | 143 | 178 | 119 |
| Average pop (millions) | 94 | 82 | 63 | 26 | 14 | 11 | 119 | 96 | 74 |
| Average pop (t) | 1067 | 1068 | 724 | 91 | 71 | 48 | 1157 | 1139 | 772 |
| Vir. Biomass (t) | 3473 | 3049 | 2250 | 185 | 146 | 109 | 3659 | 3195 | 2359 |
| SSB (t) | 836 | 870 | 565 | 69 | 68 | 41 | 905 | 938 | 606 |
| Mean Age | 1.5 | 1.6 | 1.5 | 1.1 | 1.5 | 1.3 | 1.4 | 1.6 | 1.5 |
| Mean Length | 27.1 | 29.1 | 27.5 | 17.7 | 21.2 | 19.6 | 25.1 | 27.9 | 26.3 |
| Mean $F_c$ | 0.98 | 1.24 | 1.29 | 0.94 | 1.70 | 1.11 | — | — | — |

Yield per Recruit analysis results shown per year, from 2008 to 2010, for females and males separately.

| | | FEMALES | | | MALES | | |
|---|---|---|---|---|---|---|---|
| | | Factor F | F | Y/R | Factor F | F | Y/R |
| 2008 | $F_0$ | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 |
| | $F_{0.1}$ | 0.46 | 0.45 | 7.40 | 0.78 | 0.73 | 1.67 |
| | $F_c$ | 1.01 | 0.98 | 8.14 | 1.01 | 0.94 | 1.77 |
| | $F_{max}$ | 1.03 | 1.01 | 8.14 | — | — | — |
| | $F_2$ | 2.00 | 1.96 | 7.76 | 2,00 | 1,88 | 1.93 |
| 2009 | $F_0$ | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 |
| | $F_{0.1}$ | 0.41 | 0.51 | 7.95 | 0.51 | 0.87 | 2.30 |
| | $F_c$ | 1.01 | 1.24 | 9.00 | 1.01 | 1.70 | 2.63 |
| | $F_{max}$ | 1.17 | 1.45 | 9.02 | — | — | — |
| | $F_2$ | 2.00 | 2.48 | 8.80 | 2.00 | 3.41 | 2.82 |
| 2010 | $F_0$ | 0.00 | 0.00 | 0.00 | 0.00 | | 0,00 |
| | $F_{0.1}$ | 0.38 | 0.49 | 7.81 | 0.74 | 0.82 | 2.11 |
| | $F_c$ | 1.01 | 1.29 | 8.57 | 1.01 | 1.11 | 2.26 |
| | $F_{max}$ | 0.88 | 1.13 | 8.58 | — | — | — |
| | $F_2$ | 2.00 | 2.58 | 8.06 | 2.00 | 2.22 | 2.44 |

**Diagnosis of stock status:** The stock appeared to be subject to overfishing in all the years assessed, with current values of F ($F_c$) being above the reference point $F_{0.1}$.

**Advices and recommendations:** Basing our advice on the evaluation of females, which made up for 81% of the catches, we recommend to decrease the fishing mortality of 59% in order to reach the reference point $F_{0,1}$ level (this percentage was calculated using the average value of $F_c$ and $F_{0.1}$ for the three years assessed).

**Discussion:** $F_{max}$ as reference point should be avoided and the use of $F_{0.1}$ is recommended. As $F_c > F_{0.1}$, the stock is in overfishing situation. Thus, a reduction of F should be proposed.

The WG endorsed the assessment and recommendations.

**18. Stock:** Red shrimp, *Aristeus antennatus*

**GSA:** 06

**Author:** Esteban A.

**Fishery:** The number of harbours with red shrimp landings is 19 for the whole area, with a total number of 130 trawlers. Trawl fleet fishing effort of the GSA 06 is quite stable for the period studied with small variations of the number of vessels in the recent years. Vessel total length is comprised between 12-24 m. The cod end mesh size used since 2010 correspond to a 40 mm squared or 50 mm diamond. The net was rigged two doors between 500-800 kg. Trawl fleet in GSA 06 does daily trips with an unique haul directed to the red shrimp, with a duration between 5-7 hours. Landings fluctuate between 308 t in 2005 and 743 t in 2009. In 2011 landings were 737 t. Discards of the red shrimp are null.

**Data and parameters:** Size composition of commercial trawl catches and official landings, CPUE data from MEDITS surveys and commercial fleet. Growth parameters, L-W and age-length relationships were taken from Garcia-Rodríguez M. (2003).

**Assessment method:** LCA and Y/R, VPA and XSA. The male and female length distributions for year (1996-2011) were split using L2 age, slicing ICES package to ages. It was run a tuned VPA and XSA for male for male and for male and female together. In addition, a yield-per-recruit (Y/R) analysis (NOAA Fisheries Toolbox v 3.1.1) was applied on the mean pseudo-cohort 1996-2011 for the GFCM geographical sub-area Northern Spain (GSA 06). Effort in days represents effort by trip. Tuning data series was made using the Santa Pola harbor like a reference fleet and MEDITS GSA 06 trawl surveys.

**Model performance:** Retrospective analysis and log catchability residuals show that XSA analysis is consistent.

**Results:** The comparison between VPA and XSA of 2010 and 2011 assessments showed small differences with continuous slight decreasing values for the Spawning Stock Biomass, Recruitment and Total Biomass. Yield per Recruit analysis were made for the average size distribution landings for male and female together for the years 1996-2011, assuming the current steady state exploitation pattern. Results of equilibrium Y/R and SSB/R estimated the current exploitation close to the maximum. $F_c$= 1.16 $F_{max}$= 0.89 $F_{0.1}$= 0.56 (squared mesh).

**Diagnosis of stock status:** The stock is in overfishing status. Exploitation rate show a high F and the stock abundance is intermediate.

**Advice and recommendations:** According to Yield per Recruit a reduction of about a 51% in current fishing mortality is needed to reach the level of $F_{0.1}$.

**Discussion:** The WG questioned the reasons of performing two different assessment for the same area. The differences between both assessments are: (i) CSIC assessment covered 2008-2010, and length sampling and landings only from Catalonia (GSA 06 North) and (ii) IEO assessment covered 1992-2011, length sampling from the South of the GSA, landings and surveys abundance indices from all the GSA (both North and South). Although IEO also has length sampling information from the North, it only covered recent years (from 2007), so these data were not included in this assessment, although they would be included in the future. It should be important to compare the information from the north and the south: growth parameters, size composition and landing patterns. If they are very different, it would make sense to perform two assessments separately. If not, a single assessment for the entire GSA 06 should be presented.

**Nursery areas:** It is assumed that a great part of the recruitment is in inaccessible areas for the fleet, so it is not necessary to suggest protecting them.

The WG endorsed the assessment and recommendations.

**19. Stock:** Deep-water pink shrimp, *Parapenaeus longirostris*

**GSA:** 01, 03 and 04

**Autors:** Benchoucha S. Pérez Gil J.L., Ainouche N., Jarboui O., Baro J., Elouamari N., Ben Merien S., Hamida C., García T., Bernardon M., Camiñas J.A. and Fernández I.d.L.

**Fishery:** The deep-water pink shrimp *Parapenaeus longirostris* is of great importance in terms of total landings and economic value for the countries bordering the Alboran Sea (Algeria, Morocco and Spain) largely exploited almost exclusively by trawl. The total number of the trawlers in the area is over 738 corresponding 502 to Algeria, 115 to Morocco and 121 to Spain. Landing of *P. longirostris* is estimated to 1,528 t. Many species are targeted with the deep water pink shrimp in the GSAs 01, 03 and 04. The most species landed are *Mullus* spp*., Merluccius merluccius, Boops boops, Gadus poutassou, Octopus vulgaris, Sepia* spp. and other crustaceans and molluscs. In Algeria, trawl fleet targeting several demersal species including *P. longirostris,* have the following average characteristics: 19 m LOA, 449 HP and 45 GRT. In Morocco, the average power of the trawlers is 325 HP, the mean length of the boats is 20 m and the average of the tonnage is 50 GRT. In Spain, the fleet ranged between 43 and 55 GRT, the highest engine power ranges between 190 and 290 HP. The evolution of the catches and the CPUE show the same trends in Algeria, Morocco and Spain. Trawlers total catch of *P. longirostris* in this area vas 1,558 t in 2011, the fishing effort is 84,579 fish days and the mean CPUE is about 24.13 kg/fd. The catch and the CPUE trends show a decrease from 2003 to 2008. Amelioration was observed in 2009. A decrease was observed again for the rest of the period.

**Data and parameters:** The data used for the assessment of the stock were the length frequency distribution from commercial landings and surveys for Morocco and Spain. The biological parameters were estimated from data collected in each country and combined to obtain a common data of L-W relationship, sex-ratio and maturity ogive. The natural mortality (M) vector used was from the literature (Abella et al. 2002). The catch data and CPUE used corresponded to GSA 01, 03 and 04 from 2003 to 2011 excepted for Algeria whose data are until 2010.

**Assessment method:** A length cohort analysis (LCA) and a virtual population analysis (VPA) were performed in a first step for all length-size composition and run a Yield per recruit analysis using the VIT software. A second method, the "Biodyn" production model based on the Schaeffer model, updated and performed by Mr. Pedro Barros (FAO, CECAFE Shaeffer production model) was the global one, was applied to the stock in Algeria, Morocco and Spain region.

**Model performance:** Both analytical and global analysis shows the same trend.

**Results:**
Results of the LCA (VIT).

| Reference Point | F | YPR | SSBR |
|---|---|---|---|
| $F_0$ | 0 | 0 | 34.86 |
| $F_{0.1}$ | 0.3746 | 2.5913 | 10.55 |
| $F_{max}$ | 0.6356 | 2.768 | 5.72 |
| $F_c$ | 1.135 | 2.602 | 2.69 |

Results of the "Biodyn" production model.

| Index of abundance | $F_c/F_{MSY}$ | $F_c/F_{0.1}$ | $F_c/F_{MSY}$ | $B_c/B_{0.1}$ | $B_c/B_{MSY}$ | R |
|---|---|---|---|---|---|---|
| First analysis : Indices of abundance of scientific campaigns in Morocco (kg/h) | 26% | 41% | 37% | 52% | 57% | 0.921 |
| Second analysis : Indices of abundance of scientific campaigns in Spain (kg/km²) | 40% | 32% | 29% | 118% | 129% | 0.589 |
| Third analysis : CPUE of the commercial fishing targeting this species in Morocco (kg/fd) | 113% | 17% | 15% | 170% | 187% | 0.625 |
| Fourth analysis : CPUE of the commercial fishing targeting this species in Algeria (kg/fd) | 120% | 15% | 13% | 172% | 189% | 0.871 |
| Fifth analysis : CPUE of the commercial fishing targeting this species in Spain (kg/fd) | 125% | 263% | 236% | 10% | 11% | 0.767 |

**Diagnosis of stock status:** the analytical analysis shows that the stock is in overfishing status. From the first model, the actual level of fishing mortality ($F_{bar}$= 1.135) is higher than the values calculated for the $F_{MSY}$ proxy ($F_{0.1}$ = 0.48). The obtained results from the global model indicate that the deepwater pink shrimp stock is overexploited, with captures that exceed the natural production of the stock. Current biomass represents only 11% of the target biomass and the fishing mortality exceeds 2.6 times the target mortality.

**Advices and recommendation:** By taking into account results of the evaluations and the predictive model used and with the intention of allowing the recovery of the stock to its optimal level, a reduction of 50% of the current fishing mortality in the trawl fisheries targeting *P. longirostris* is recommended.

- The actual effort level in the trawl fisheries should be reduced to adjust the current fishing mortality to levels more in agreement with the sustainability values, with $F_{0.1}$ as reference point (Schaeffer model).
- According to the projection coming from the production model, the reduction of the fishing mortality (F) at the mentioned level could permit the recovery of the *P. longirostris* stock in 4-5 years.
- Data from Algeria and Morocco on length-frequency distribution at landing are necessary and should be provided for the next year to improve the joint database used in the analyses carried out by the SG, with partial support of CopeMed II if necessary.

**Discussion:** Production model has been applied to a very short data series, which does not reflect the oscillations characteristic of a longer period. However, as the landings are not very flat, the results could be considered quite reliable.

The WG endorsed the assessment and recommendations.

**20. Stock:** Deep-water pink shrimp, *Parapenaeus longirostris*

**GSA:** 06

**Author(s):** Pérez-Gil J.L., Quintanilla L.F., Herrera E. and Vivas M.

**Fishery:** Deep-water pink shrimp (*Parapenaeus longirostris*) is one of the main crustacean species for trawl fisheries in the GFCM geographical sub-area Northern Spain (GSA 06). It is an important component of landings in some ports and occasionally a target species of the trawl fleet composed of approximately 260 vessels that operates on the upper slope. The annual landings (Y) showed a very sharp decrease at the beginning of the times series, from the maximum observed in 2001 (331 t) to the minimum observed in 2004 (76 t). Landings remained relatively stable during the period 2005-2010, fluctuating between 102 and 141 t, and decreased in 2011 reaching up 92 t that are the lowest in the last seven years.

**Data and parameters:** The assessment was carried out using official landings and data on the size composition of trawl catches for the years 2001-2011. Catch-at-length data were converted into catch-at-age data by cohort slicing procedures.

**Assessment method:** The state of exploitation of this stock was assessed by means of VPA Extended Survivor Analysis (XSA) (Shepherd 1999). The software used was the Lowestoft suite (Darby and Flatman 1994) and FLR (Fisheries Libraries in R). The XSA tuning was performed using abundance index series from MEDITS trawl surveys and CPUEs from commercial fleet. Yield-per-Recruit analysis (Y/R) was conducted based on the exploitation pattern resulting from XSA model and population parameters. Several reference points were estimated based on this Y/R analysis. Retrospective analysis was applied in the XSA model in order to check the robustness of the assessment. Stochastic short term projections assuming equilibrium conditions and 10-20% reduction in F were also produced.

**Model performance:** Using male and female together, log catchability residuals show small fluctuations more accused in first age class. The retrospective analysis doesn't show great dispersion over the years and in general, the structure is similar in all the cases (male, female and male-female together).

**Results:** XSA results show that both total biomass (B) and spawning biomass (SSB) followed a decreasing trend from 2001 to 2004 with a drastic decline during the first year. After this decrease, B and SSB have stabilized with slight fluctuations over the last 7 years (2005-2011). Fishing mortality ($F_{2-4}$) also shows a decreasing trend from 2001 to 2004 (1.9 and 0.7 respectively) and stabilizes during the 2005-2011 period with slight variations that ranges between 0.8 and 1.2. Recruitment (R) shows strong fluctuations over the time series. Since 2001, when the maximum was observed, the pink shrimp stock in GSA06 has suffered a fairly strong decrease in landings, spawning biomass and total biomass. Current indicators represent respectively 28% (Y), 55% (SSB) and 51% (B) of the values observed ten years ago. Y/R analysis shows that the $F_{ref} = F_c$ (1.08) exceeds the Y/R $F_{0.1}$ reference point (0.34).

**Diagnosis of stock status:** Based on this assessment results, the *Parapenaeus longirostris* stock in GSA06 is subjected to overfishing.

**Advices and recommendation:** From a precautionary approach and taking into account the estimated reference point $F_{MSY}$ proxy $F_{0.1}$, a reduction of fishing mortality about 70% to reach

$F_{0.1}$ is recommended. The deep-water pink shrimp fluctuations found in the GSA 06 are in agreement with that observed in other areas of the Mediterranean and it is assumed that environmental conditions can affect the stock in addition to fishing mortality.

**Discussion:** No specific comments were done.

The WG endorsed the assessment and recommendations.

**21. Stock:** Deep-water pink shrimp, *Parapenaeus longirostris*

**GSA:** 12-16

**Author(s):** Ben Meriem S., Fiorentino F., Colloca F., Arneri A., Ceriola L., Gancitano V., Jarboui O. and Knittweis L.

**Fishery:** Trawlers targeting *P. longirostris* operate on the continental shelf of the Central Mediterranean throughout the year, and catches often include Norway lobster (*Nephrops norvegicus*), giant red shrimp (*Aristaeomorpha foliacea*), hake (*Merluccius merluccius*), violet shrimp (*Aristeus antennatus*), scorpionfish (*Helicolenus dactylopterus*), greater forkbeard (*Phicys blennioides*), red Pandora (*Pagellus bogaraveo),* common Pandora (*Pagellus erythrinus*) and monkfish (*Lophius* spp.). Scientific data available indicates that exploitation by the fishing fleets of Tunisia, Malta, Libya and Italy is targeting a single shared stock of deep water rose shrimp. Sicilian coastal trawlers (LOA between 12 and 24 m) targeting deep water rose shrimp are based in seven harbours along the southern coasts of Sicily. These trawlers operate mainly on short-distance fishing trips, which range from 1 to 2 days at sea, and fishing taking place on the outer shelf and upper slope. With 250 registered vessels, this is the largest component of the fleet targeting rose shrimp in 2009. Sicilian trawlers over 24 m in length have longer fishing trips, which may have a duration of up to 4 weeks. These vessels operate offshore, in both Italian and international waters of the Central Mediterranean. In 2009, 140 such vessels were active. In the Maltese Islands small vessels measuring 12 to 24 m in length target rose shrimp at depths of about 600 m. Fishing grounds are located to the north and north-west of Gozo, as well as to the west and south-west of Malta. Catches are primarily destined for the local market. The number of trawlers targeting rose shrimp increased from 7 in 2005 to 12 in 2009, with some vessels fishing in international waters. Tunisian trawl vessels which target rose shrimp measure around 24 m in length, and operate primarily in Northern Tunisia where 90% of the country's total *P. longirostris* catches originate. The great majority of these catches are landed in the town of Bizerte and Kelibia. The number of Tunisian trawlers targeting rose shrimp has increased from 40 in 1996 to around 70 in 2009.

**Data and parameters:** Catch matrices from Italy (OTB 12-24 m and OTB >24), Malta and Tunisia for 2007, 2008, 2009, 2010 and 2011. MEDITS number at age from GSA 15 and 16. The parameters used were an average of growth parameters and length-weight relationships from SAMED (2002) and Ben Meriem (unpublished). Females: $L_\infty$ = 42.705, k = 0.67, $t_0$ = -0.208, a = 0.0029, b = 2.48185. Male: $L_\infty$ = 33.56, k = 0.73, t0 = -0.13, a = 0.00345, b = 2.4096. The M range was estimated between 1.05 (females) and 1.20 (males).

**Assessment method:** The assessment was performed using length cohort analysis (LCA) as implemented in VIT4Win (Lleonart and Salat 1992, 1997). Analyses were performed

separately on length frequency distributions of males and females and by keeping fleet segments separate. Current mean F and exploitation pattern were assessed using the steady state LCA by length on LFD of 2007, 2008 and 2009 raised to the total landings. LCA and Y/R values by sex and year were combined to obtain a single value for both the sexes by using an average, weighed by sex ratios. Trend of abundance indices from MEDITS in GSA 15 and 16. Preliminary XSA was performed using for tuning MEDITS number at age from GSA 15 and 16.

**Model performance:** Results of VIT on the mean pseudocohort (2007-2011), in terms of $F_{0.1}$ (1.22) are very consistent with those obtained assessing pseudocohort year by year (range= 1.10-1.36 with median value 1.20). A sensitivity analysis was carried out to test the effect of the von Bertalanffy's growth equation parameters k and natural morality (M) on Y/R estimates. Results showed that changing M and k has a pronounced effect on yield per recruit estimates when the variation is in the opposite direction. Biomass per recruit and spawning stock biomass per recruit in contrast are strongly affected when the change is in the same direction. XSA estimation was not considered reliable, mainly due to the shortness of the time series (only five years).

**Results:** Current values of F (mean overall size classes contributing to the 90% of catches) showed a progressive increase from 2007 (F=0.81) to 2011 (F= 1.65). The results of the assessment revealed an exploitation pattern catching an high fraction of juveniles.

**Diagnose of Stock status:** The WG proposed $F_{0.1}$ = 1.22 as proxy of $F_{MSY}$ and as the exploitation reference point consistent with high long term yields. Taking into account the results obtained by the LCA analysis (current $F_{0-3}$ was around 1.5-1.6 in 2010 and 2011), the stock is considered in overfishing.

**Advices and recommendations:** Maintaining the current exploitation pattern, characterized by high catches of undersized shrimps from small trawlers, and considering $F_{0.1}$ as target reference points, a reduction between 20 and 28% was recommended. An improvement of exploitation pattern of Italian small trawlers is needed. To contribute to this objective the protection of nurseries areas from towed gears was recommended.

**Discussion:** The sensitivity analysis for different shrinkages showed great differences for $F_{BAR}$. Low shrinkage values constrain a lot the data to the tuning data series. Also, the shrinkage years are too large (5), so this should be improved. A longer time series of data is needed to improve the performance of XSA. The opportunity to use the standardized abundance indices from trawl surveys to make more robust the conclusion of the assessment was outlined. The results of intercalibration experiment, carried out in July 2011 in the Strait of Sicily within the framework of the MedSudMed project, to standardize the catch rates of Tunisian vessel with that used in Italian and Maltese trawl surveys, make possible to assess stock dynamics including spatial aspects over the whole area of distribution of the stock.

The WG endorsed the assessment and recommendations.

**22. Stock:** Deep-water pink shrimp, *Parapenaeus longirostris*

**GSA:** 18

**Author(s):** Bitetto I., Carbonara P., Casciaro L., Ceriola L., Djurovic M., Facchini M.T., Gjurgji I., Joksimovic A., Ikica Z., Marković O., Kolitari J., Kroqi G., Lembo G., Milone N. and Spedicato M.T.

**Fishery:** Deep-water rose shrimp is important species in demersal trawl fishery of the whole Geographical Sub Area 18. In 2011 the landings of deep-water rose shrimp were about 863 t in the west and 27 t from Montenegro and 328 t from Albania from the east side.

**Data and parameters:** Standardized LFD abundance indices ($N/km^2$), whole GSA 18 (MEDITS data 1996-2010, Data Collection Framework). Length structure of landings and production by fishing segment (for west side from Data CF, east side within a pilot study in the framework of AdriaMed project). Growth for sex combined: slow ($L_\infty$ = 46 mm CL, k = 0.6 and $t_0$ = -0.2). Length-weight relationship: a=0.003409, b=2.434 sex combined. Natural mortality as vector by age. Maturity ogive with $L_{m50\%}$= 18.3 mm ± 0.1 mm.

**Assessment method:** VIT software for pseudocohort analysis and the R-routine developed at SGMED working group for the medium term predictions. In addition, the Y/R analysis implemented in the VIT for the calculation of $F_{0.1}$. In the medium term forecast F was rescale by age to 2009-2011 data using $F_{bar}$ 0-2. The recruitment was set as geometric mean of 2009-2011: 717648 (thousands). Four scenarios were set: reaching $F_{0.1}$ in 2015, in 2020, a regular reduction of 10% by year and status quo.

**Model performance:** the methods were used in a complementary and integrated way. Consistency between results and inputs and life history parameters was cross-checked among methods and with inputs.

**Results:** MEDITS data showed that the abundance of this shrimp was steadily growing from 1999 to 2005 than a decreasing was observed in 2006-2007 followed by a new increase in 2008 and 2009, while in 2010 and 2011 the abundance is decreasing again. VIT Mortalities on the age groups 1 and 2 was higher. The Y/R analysis indicates a current level fishing mortality of 1.45. The target reference point $F_{0.1}$ is 0.68. R routine SGMED showed a catch reduction till 2015 (annual reduction of F=22%) to achieve $F_{0.1}$ and a slightly level of catches compared to the current one in the long terms under the reduction scenario to 2020 (year reduction 9%). Similar performance was observed in the reduction scenario of 10% by year. The spawning stock biomass was in any scenario improving.

**Diagnose of Stock status:** The stock is in overfishing and thus it is necessary to consider a considerable reduction of the fishing mortality to allow the achievement of $F_{0.1}$.

**Advices and recommendations:** The BRPs can be gradually achieved by multiannual management plans requiring a more sharp reduction in the short term than in the medium term. However, a more gradual reduction will very likely imply lower social and economic costs, without hampering the sustainability objective. The objectives of a more sustainable harvest strategy could be achieved with a multiannual plan based on a reduction of fishing mortality through fishing activity limitations and possibly fishing capacity decreasing. It is however necessary to consider that most part (71%) of the total F in the GSA is exerted by

the Italian fleet, while Montenegrin trawlers account only for about 1.7% of the F exerted on the GSA and Albanian trawlers of about 27.1%. Contribute of each country to the total production in the GSA 18 is: Italy 71%; Albania 26%; Montenegro 3%.

**Discussion:** The discussion highlights that when the time series of landings is short and tools as VIT are used the application of the model year by year, as performed in this assessment, is preferable. The effects on catches of the reduction scenario in the medium terms would improve if also the beneficial effect on the spawning stock biomass was incorporated. It is important to receive by the relevant Committee and experts also economic considerations on the forecasts performed under different management scenarios.

The WG endorsed the assessment and recommendations.

**23. Stock:** Norway lobster, *Nephrops norvegicus*

**GSA:** 05

**Author(s):** Guijarro B., Valls M., González N., Rubio V., Ordines F. and Massutí E.

**Fishery:** In the Balearic Islands, commercial bottom trawlers develop up to four different fishing tactics, which are associated with the shallow shelf, deep shelf, upper slope and middle slope, mainly targeted to: (i) *Spicara smaris*, *Mullus surmuletus*, *Octopus vulgaris* and a mixed fish category on the shallow shelf (50-80 m); (ii) *Merluccius merluccius*, *Mullus* spp., *Zeus faber* and a mixed fish category on the deep shelf (80-250 m); (iii) *Nephrops norvegicus*, but with an important by-catch of big *M. merluccius*, *Lepidorhombus* spp., *Lophius* spp. and *Micromesistius poutassou* on the upper slope (350-600 m) and (iv) *Aristeus antennatus* on the middle slope (600-750 m). The Norway lobster (*N. norvegicus*) is mainly caught in the upper slope, with annual landings oscillating between 5 and 35 t. All Norway lobster catches from this area come exclusively from bottom trawlers.

**Data and parameters:** Size composition of commercial trawl catches and official landings (2002-2011) and CPUE data from bottom trawl surveys (2001-2011). Growth parameters and maturity ogive from GSA 09. M vector from PRODBIOM.

**Assessment method:** Extended Survivor Analysis (XSA), retrospective analysis, sensitivity analysis and Yield per recruit analysis.

**Model performance:** Retrospective analysis showed some underestimation for R and SSB for some years, while the opposite for F. Sensitivity analysis allowed the choose of the most adequate shrinkage ages. XSA residuals for the tuning fleet did not show any particular trend, although for some ages they were slightly high.

**Results:** XSA results show stability along the data series, with a significant increasing trend for some of the parameters (stock biomass and spawning stock biomass) and no significant trend for the others (abundance and recruitment).

| | |
|---|---|
| Current Y/R | 3.9 g |
| Maximum Y/R | 4.1 g |
| $Y/R_{0.1}$ | 3.7 g |
| $F_c$ | 0.447 |
| $F_{max}$ | 0.259 |
| $F_{0.1}$ | 0.134 |
| Current B/R | 15.7 g |
| Maximum B/R | 22.4 g |
| $B/R_{0.1}$ | 33.4 g |

**Diagnosis of stock status:** The stock is subjected to overfishing.

**Advices and recommendation:** To reduce fishing mortality. The use of the information from the vessel monitoring system will help to improve the knowledge about the spatial distribution of the fishing effort.

**Discussion:** Current value of F has been pointed out as intermediate when compared with last year, in which it showed a maximum. However, last year F is a very unstable estimation; there is some uncertainty, so it was proposed to use last 2-3 years to make the comparison. Results from the retrospective analysis show that F estimations are not very stable. For this reason, the WG proposed to take the results of this assessment with caution.

The WG endorsed the assessment and recommendations.

**24. Stock:** Mantis shrimp**,** *Squilla mantis*

**GSA:** 17
**Author(s):** Scarcella G., Fabi G., Grati F., Polidori P., Domenichetti F., Bolognini L., Santojanni A., Angelini S., Pengal P., Marceta B., Piccinetti C., Manfredi C., Giovanardi O., Raicevich S., Celic I., Bullo M. and Sabatini L.

**Fishery:** Mantis shrimp, *Squilla mantis*, ranks first among the crustacean landed in the Adriatic ports. In this area, mantis shrimp is exploited by bottom otter trawl, gillnet and *rapido* trawl. About 400 bottom otter trawlers exploit this resource all year round. The Italian annual landing for 2011 was due for 63% to bottom trawl (2,399 t), for 30% to gillnet (1,136 t) and for 7% to *rapido* trawl (251 t). The Slovenian annual landings are much lower (less than 4 t) while in Croatian landings statistics the species is absent. The total landing showed a stable trend in the period 2007-2011, with a maximum value in 2010 (4,564 t) and a minimum in 2011 (3,786 t). According to the data collected in 2011 in the framework of DCF, discard represented 16% (721 t) of the total catch. The species is mainly landed by the trawl fleet (OTB) fishing on the continental shelf. The main species caught in GSA 17 associated with mantis shrimp are *Sepia officinalis*, *Trigla lucerna*, *Merluccius merluccius*, *Mullus barbatus* and *Eledone* spp. Trawl catch is mainly composed by age 1 and 2 individuals while the older age classes are poorly represented in the catch. As concerns artisanal fisheries, *S. mantis* is a by-catch (only in few cases it also targeted) of gillnetters

targeting *Solea solea*, especially during spring-summer seasons in the coastal area. The species is not present in the list of shared stock of GFCM.

**Data and parameters:** The information used for the assessment of the stock consisted of annual size composition of Italian and Slovenian catches from 2007-2011 obtained from the DCF. The growth and length weight parameters come from Froglia et al. (1996). The growth parameters are (these were estimated from the mean values for separated sex considering a sex ratio of 0.5): $L_\infty$ 41.53, k 0.490 and $t_0$ -0.015; the length weight parameters are a 0.0025 and b 3.045. The vector of natural mortality by age was calculated from Chen and Watanabe's method (1989). The terminal fishing mortality is obtained using the catch curve built on SoleMon survey 2011 ($F_{term}$=1.13).

**Assessment method:** Assessment carried out using a VPA steady state approach (VIT-model) for the 2011. A Separable VPA (Lowestoft package) was used for the time series 2008-2011; the last ages and years F (fishing mortality rates) have been considered from the VIT model results, while the terminal F has been estimated from a catch curve applied to the SoleMon survey data. For 2011, a Y/R analysis was performed using VIT.

**Model performance:** Log catchability residual plots were produced and no major conflict between ages seems to appear.

**Results:**

| | |
|---|---|
| Current Y/R | 2.01 |
| Maximum Y/R | 2.29 |
| $Y/R_{0.1}$ | 1.83 |
| $F_c$ | 0.93 |
| $F_{max}$ | 1.06 |
| $F_{0.1}$ | 0.50 |

**Diagnosis of stock status:** Stock is subjected to overfishing. Considering the results of the analyses conducted, the mantis shrimp in GSA 17 is exploited unsustainably, being the current F (2011) estimates with VIT model and separable VPA respectively of 0.93 and 1.00, higher than the proposed reference point ($F_{0.1}$ = 0.50 as a proxy of $F_{MSY}$). Moreover the decreasing trends observed for recruitment and SSB in the VPA results and for relative abundance and biomass in MEDITS survey, have to be taken into consideration as a state of stress of the stock.

**Advices and recommendation:** A reduction of fishing pressure would be recommended. The relevant fleets' effort or catches (demersal otter trawl fishing fleet) should be reduced until fishing mortality is below or at the proposed reference level ($F_{0.1}$), in order to avoid future

loss in stock productivity and landings. This should be achieved by means of a multi-annual management plan taking into account mixed-fisheries considerations.

**Discussion:** No specific comments were done.

The WG endorsed the assessment and recommendations.

**25. Stock:** Spiny/Picked Dogfish**,** *Squalus acanthias*

**GSA:** 29

**Author(s):** Radu G. and Maximov V. with consultancy for data from STECF/BS stock assessment working group.

**Fishery:** Picked dogfish inhabits the whole Black Sea shelf at the water temperatures. It undertakes extensive migrations. In autumn feeding migrations are aimed at the grounds of the formation of the wintering concentrations of anchovy and horse mackerel in the vicinity of the Crimean, Caucasus and Anatolian coasts. With their disintegration picked dogfish disperses all over the shelf. Reproductive migrations of viviparous picked dogfish take place towards the coastal shallows with two peaks of intensity – in spring and autumn. The autumn migration for reproduction covers more individuals usually (Radu and Radu 2008). In the North-western Black Sea in the waters of Ukraine and Romania in depth from 70-80 m down to 100-120 m abundant wintering concentrations of picked dogfish are also observed, where they are located on the grounds of whiting and sprat concentrations (Kirnosova and Lushnicova 1990).

In the Black Sea the largest catches of picked dogfish are along the coasts of Turkey, although this fish is not a target species of fisheries, being yielded as by-catch in trawl and purse seine operations mainly in the wintering period. In the 1989-1995 annual catches of Turkey are 1,055-4,558 t (Shlyakhov and Daskalov 2008). In subsequent years, they have decreased about 2 times and did not exceed 2,400 t. In the waters of Ukraine most of picked dogfish is harvested in spring and autumn months by target fishing with gill-nets of 100 mm mesh-size, long-lines, and as by-catch of sprat trawl fisheries. As in Turkish waters, in the last 20 years the maximum annual catches of picked dogfish are observed in 1989-1995, reaching 1,200-1,300 t. After 1994 the catches went down being between 20 and 200 t. In the rest of countries picked dogfish is harvested mainly as by-catch, annual catches are usually lower than the Ukraine. The maximum annual catches of picked dogfish in 1989-2005 were: Bulgaria - 126 t (2001), Georgia - 550 t (1998), Romania - 52 t (1992), Russian Federation - 183 t (1990).

In Turkey picked dogfish lost its commercial importance in recent years. In the last 20 years, the decrease of dogfish landing may be may be due to over-fishing (Demirhan, PhD Thesis). Piked dogfish is a major demersal predator, reaching in the Black Sea the length of about 1.50 m. According to investigations conducted in former USSR waters, Kirnosova, (1993) found that the piked dogfish maximum age is 20 years. Age and length, at which 50% of individuals are mature, are 10.49 years and 87.57 cm for males and 11.99 years and 102.97 cm for females, respectively. Mean biennial fecundity is 19.4 eggs and 12.9 pups. The linear relationship between fecundity and length is: $F_e = 0.09 \times TLp + 2.12$ ($r = 0.5$) for pups and $F_e = 0.27 \times TLp - 21.59$ ($r = 0.7$) for eggs (Demirhan and Seyhan 2007).

**Data and parameters:** The information used for the assessment of the stock consisted of annual size composition of catches, official landings and biological parameters estimated from data collected in the GSA 29 (1989-2011) and 2011. These parameters were L-W relationship, sex-ratio, maturity ogive, $L_\infty$, k, $t_0$. The vector of natural mortality by age was calculated from Caddy's formula using the PROBIOM Excel spreadsheet (Abella et al. 1997) and scalar M by Pauly's formula.

**Assessment method:** It was used the VIT program for estimation of abundance and fishing mortality and YPR-LEN (NOAA Fisheries Toolbox Version 3.1) for obtaining the reference points for dogfish in the Black Sea. The program VIT is conceived for the analysis of fisheries where the available information is limited. The VIT software was applied to assess population parameters based on pseudocohort analyses of average 1989-2011 data and 2011 data. The two scenarios were run with the following parameters: $L_\infty$ = 157cm; k = 0.12; $t_0$ = -1.31; a = 0.0117; b = 2.769; M = 0.15

**Results:** From average of the catches by countries in the last 23 years (1989-2011), have been obtained $F_c$ = 0.255, and SSB = 410,579 t, while for 2011 data the $F_c$ = 0.262, SSB = 35,263.

| Reference Points | F | YPR | SSB/R | TSB/R |
|---|---|---|---|---|
| $F_0$ | 0.000000 | 0.000000 | 19036.640242 | 27482.638943 |
| $F_{0.1}$ | 0.227000 | 1630.065081 | 7333.681895 | 15746.881160 |
| $F_{max}$ | 1.100000 | 1854.713847 | 1905.248354 | 10231.715141 |
| $F_{25\%MSP}$ | 0.389000 | 1790.293295 | 4768.058109 | 13161.086947 |

Mean $F_c$ = 0.255 for the period 1989-2011
Mean $F_c$ = 0.262 for 2011

**Diagnosis of stock status:** Comparing the obtained results it seems that in a period of 20 years the stock biomass has decreased almost of 30 times. On the other hand historical estimates for 1972-1992 (including a period of pre-industrial exploitation) using XSA and tuned by survey data have shown maximum SSB of about 100,000 t (Daskalov 1998) that is 4 times less than the average SSB estimated here for 1989-2011. We estimated $F_{0.1}$ = 0.227 ($F_{MSY}$ proxy) as a limit reference point consistent with high long term yields and low risk of fishery collapse for dogfish in the Black Sea. Taking into account that the current F = 0.262 the stock is considered to be overexploited.

**Advices and recommendation**:
Gaps that need to be addressed in the near future include:
- Low quality of the input data for assessments (in terms age and size composition, fishing effort, CPUE and research surveys);
- The lack of quality survey information deteriorates the estimates of the current population parameters (abundance and mortality) in stock assessments and decreases the reliability of the short term predictions and management advice;
- Insufficient knowledge of stock units;
- Lack of knowledge, evaluations and monitoring programs for assessing the IUU and discards;

- Lack of reliable frameworks of assessing and standardizing of the commercial fleets fishing effort and CPUE

Management advice and recommendations

- Reducing fishing mortality;
- Improve selection pattern;
- Close spawning seasons in spring and autumn;
- Obligation for pregnant females to be discarded;
- Regional management measures.

**Discussion:** It is noted that enough data seems to be available to carry out a run using VPA, or at least to run VIT on a yearly basis. It was also noted that this species seems to undergo a sharp decrease that does not translate very clearly on the yield per recruit diagram. The problem of the estimation of age has been raised as well as the difference in methodology with neighboring countries, which makes difficult the use of data.

The WG endorsed the assessment and recommendations.

**26. Stock:** Whiting, *Merlangius merlangus euxinus*

**GSA:** 29

**Author(s):** Radu G. and Maximov V. with consultancy for data from STECF/BS stock assessment working group.

**Fishery:** In the Black Sea, the whiting is one of the most abundant species among the demersal fishes. It does not undertake distant migrations, spawning mainly in the cold season within the whole habitat area. The whiting produces pelagic juveniles, which inhabit the upper 10-meter water layer for about a year. The adult whiting is cold-living, preferring temperatures 6-10 ºC. Fishes at the age less than 6 years are predominant in the whiting populations, the older year classes are found in catches individually. It occurs all along the shelf, dense commercial concentrations are formed by 1-3 year old fishes in the water down to 150 m depth, most often at 60-120 m depths (Radu and Radu 2008). Such concentrations on the shelf of Bulgaria, Georgia, Romania, the Russian Federation and Ukraine not do form every year, appearing at periods of 4-6 years - in the years of appearance of highly productive year classes. The problem of units for whiting stocks in the Black Sea has not been settled yet. Fisheries experts from the Black Sea Commission specify the stock as shared that is although this fish does not make long migrations; its whole stock (or two different stocks – Eastern and Western) is exploited by each Black Sea country in their waters and for its adequate assessment the analysis of the regional data is required. So, the problem of quantity and location of whiting stock units in the Black Sea is not solved. At present whiting stocks belong to the groups of shared ones. In Bulgaria, Georgia, Romania, the Russian Federation and Ukraine whiting is very rarely the target species for fisheries and yielded as by-catch during trawl fisheries for other fish species or while non-selective fisheries with fixed nets in the coastal sea areas. Official statistics in all Black Sea countries does not reflect the true capture of whiting which is much higher than reported one. Turkey is the only country in the region, where the annual target trawling fisheries for this fish is conducted. In 1996-2005 its annual catches varied from 6 thousand t to 19 thousand t, making on average 10.8 thousand t. As compared with 1989-1995, when mean annual catch of whiting was equal to 17.6 thousand t, the tendency towards reduction of both its catches and CPUE is observed. Also,

the whiting represents a complementary catch of the Romanian and Bulgarian fishermen. The level of fishing productivity is different from year to year, depending on the fishing effort (number of boats, nets, effective fishing days) and on the evolution of the hydro-climatic conditions and the anthropogenic factors (Radu et al. 2006, 2010, 2011). Overall, in the last years, the whiting population was homogenous, the length ranging between 40 and 230 mm/2.03-82.92 g, the dominant classes being those of 90-145 mm/5.50-23.84 g. The average body length was 107.45 mm, and the average weight 10.58g (Maximov et al. 2009), (Radu et al. 2006, 2010, 2011). The analysis of age components during the entire Romanian fishing season emphasized the presence of individuals aged between $0;0^+$ to $5;5^+$ years, with a domination of individuals aged between $2;2^+$ years and $3;3^+$ years.

**Data and parameters:** The information used for the assessment of the stock consisted of annual size composition of catches, official landings and biological parameters estimated from data collected in the GSA 29 (2000-2011) and 2011. These parameters were L-W relationship, sex-ratio, maturity ogive, $L_\infty$, k, $t_0$. The vector of natural mortality by age was calculated from Caddy's formula using the PROBIOM Excel spreadsheet (Abella et al. 1997) and scalar M by Pauly's formula.

**Assessment method:** It was used the VIT program for estimation of abundance and fishing mortality and YPR-LEN (NOAA Fisheries Toolbox Version 3.1) for obtaining the reference points for whiting in the Black Sea. The program VIT is conceived for the analysis of fisheries where the available information is limited. The VIT software was applied to assess population parameters based on pseudocohort analyses of average 2000-2011 data and 2011 data. The two scenarios were run with the following parameters: $L_\infty$ = 31.65 cm; k = 0.23; $t_0$ = -1.193; a = 0.0065; b = 3.004; M = 0.462

**Results:** From average of the catches by countries in the last 11 years (2000-2011), have been obtained $F_c$ = 0.479, while for 2011 data the $F_c$ = 0.375.

| Reference Points | F | YPR | SSB/R | TSB/R |
|---|---|---|---|---|
| $F_0$ | 0 | 0 | 19.20354 | 25.28113 |
| $F_{0.1}$ | 0.352 | 3.318282 | 7.154227 | 11.49944 |
| $F_{max}$ | 0.525 | 3.480953 | 4.676611 | 8.440517 |
| $F_{50\%MSP}$ | 0.24 | 2.914306 | 9.618898 | 14.42066 |

**Diagnosis of stock status:** As the estimated F =0.375 exceeds $F_{MSY}$= 0.352, we classify the stock of whiting in the Black Sea as being exploited unsustainably. Given that this is not a highly migratory species we may conclude that the resident population is more exploited in the southern part (Turkish waters) than in the rest of the Black Sea. If we consider the recommendation of the EWG 12-16 as $F_{MSY} \leq 0.4$, the two results obtained by us, $F_c$ (2011) = 0.375 and $F_c$ (2000-20011) = 0.479 oscillate around of the value of $F_{MSY}$ = 0.4. In this case, we can consider that the stock is fully exploited.

**Advices and recommendation**:
Gaps that need to be addressed in the near future include:
- Limitations in performing of scientific surveys;
- Insufficient training in assessment methods;
- Lack of harmonisation in data collection and age reading, insufficient knowledge of stock units, and lack of monitoring programs for assessing the IUU and discards.

Management advice and recommendations:

- Reducing fishing mortality;
- Improve selection pattern;
- Regional management measures
- Recommends to organize workshop(s) for inter-calibration of age readings between scientists in the region, and harmonisation of the frameworks and methods of sampling of commercial fisheries and scientific surveys.

**Discussion:** It was noticed that the discards for this species were very high.

The WG endorsed the assessment and recommendations.

**27. Stock:** Turbot**,** *Psetta maxima*

**GSA:** 29

**Author(s):** Panayotova M.

**Fishery:** Turbot (*Psetta maxima*) is the one of the most important demersal fish species in the Black Sea. In the area, turbot stock is exploited by all 6 countries – Bulgaria, Romania, Turkey, Ukraine, Russia and Georgia. In 2010, in EU waters operated 1,118 boats with gillnets, in Turkey – 225 trawlers and vessels with gillnets. Data regarding the number of fleet operated on turbot in the rest of the countries are not available. According to the official landings statistics, the average turbot catches amounts at 1,330.3 t over the period 1989-2010. The turbot is often caught as a by-catch of sprat fishery, long lines and purse seiners fishery. Misreporting and illegal catches also occur. The minimum landing size in Bulgaria and Romania is 45 cm (total length), Ukraine – 35 cm (standard length), Turkey – 40 cm (total length).

**Data and parameters:** Input data for the assessment of the stock include catch at age data set compiled from national statistics by countries for the period 1989-2010. They do represent officially reported landings and do not include any discards and unreported catches. Assessment and qualitative assumptions about the IUU (Illegal, Unregulated and Unreported) fishing of turbot were made and rates of the Potential Unreported Catch in 2002-2010 were estimated. Historic catch at age data set is compiled from Prodanov et al. (1997) for the period 1970-1988. The mean weights at ages in the stock for the period 1989-2010 were assumed equal to the catch weights at age in the landings due to lack of data. Theoretical weights (Ivanov and Karapetkova 1979) were used to estimate stock biomass in 1970-1988. An average natural mortality (M) of 0.19 is applied in all ages and years. Maturity ogive was prepared based on historical Bulgarian data for the period 1970-2006. For the period 2006-2010, maturity ogives data by countries were averaged by age groups. The XSA was tuned with different combinations of the 4 series of CPUE from Bulgarian, Romanian, Ukrainean and Turkish fleet, ages 2-10+ over the period 1987-2010.

**Assessment method:** Extended Survivors Analysis (XSA) under FLR and the technique "shrinkage to the mean" was applied for assessing the stock of turbot in 1970-2010. Yield per Recruit method was applied for long term predictions.

**Model performance:** The retrospective analysis, based on official landings data, consistently underestimate recruitment and SSB and show no systematic effect on fishing mortality. The

retrospective runs based on landings with IUU catches included, underestimate recruitment, SSB and overestimate fishing mortality.

**Results:**

| | Harvest | Yield | Rec | SSB | Biomass |
|---|---|---|---|---|---|
| $F_{0.1}$ | 0.17844 | 0.89752 | 1 | 5.79186 | 6.76672 |
| $F_{max}$ | 0.3422 | 0.97406 | 1 | 3.47528 | 4.42888 |
| spr.30 | 0.25992 | 0.96068 | 1 | 4.3754 | 5.33956 |
| MSY | 0.3422 | 0.97406 | 1 | 3.47528 | 4.42888 |

**Diagnosis of stock status:** Relative stock size indices from surveys and two XSA estimations indicate that the stock is at a historic low which significantly increases the risk of fisheries collapse. Uncertainties regarding the actual landings impose to interpret the XSA assessment results only in relative terms, i.e. they are considered indicative of trends only. Recruitment has increased since 2003 but this has not yet materialized in a significant increase in SSB.

**Advices and recommendation**:

- Reduction of catches to the lowest possible level.
- Harmonization of management regulations and technical measures between all Black Sea countries in terms of fisheries closures.
- Harmonize the methodologies and approaches for data collection between coastal states.
- Estimation of IUU fisheries.

**Discussion:** The assessment presented showed many improvements that lead to an in-depth analysis of the state of the stock with long-term historical data. There is some uncertainty on the earlier part of the data, but effort has been invested in gathering the best available data. It has been suggested to include a stock recruitment curve. The choice of biological parameters could be explained in more details.

The WG endorsed the assessment and recommendations although it has to be noted that data are up to 2010. 2011 assessment was, according to author, under revision and could not be presented to the WG on time.

**28. Stock:** Red mullet, *Mullus barbatus*

**GSA:** 17

**Author(s):** Angelini S., Belardinelli A., Carpi P., Cingolani N., Colella S., Croci C., De Felice A., Donato F., Isajlović I., Martinelli M., Marceta B., Panfili M., Pengal P., Santojanni A., Vrgoc N. and Arneri E.

**Fishery:** In the Adriatic, red mullet is mainly fished by bottom trawl nets from both Italian and Croatian fleet. Smaller quantities are also caught with Italian trammel-nets and gill nets. Slovenian catches are low: the highest catches between 2006 and 2011 were 2 t reported in 2007. A closure of 45 days in late summer have been enforced in 2011-2012 for the Italian fleet. Before 2011 the closure period was 30 days in summer. Along the Croatian coast bottom trawl fisheries is mainly regulated by spatial and temporal fisheries regulation

measures, and about 1/3 of territorial sea is closed for bottom trawl fisheries over whole year. Also bottom trawl fishery is closed half year in the majority of the inner sea.

**Data and parameters:** Landings data for the Italian fleet were reported through the Data Collection Framework, while Croatian data comes from official statistics of Fisheries Department. Catch data by length and age were available for the Italian fleet from 2006 to 2011, while landings data by length were available for the Croatian fleet for the same time period. Discard data were also available for the Italian fleet for 2010 and 2011 (the amount of discard for the Croatian bottom trawl fisheries is negligible). The proportion of discard for each age class averaged between 2010 and 2011 has been applied to the previous years, to include a discard estimate in the catch at age matrix. Besides, the average between the percentage of discard on the overall catches in 2010 and 2011 has been added up to the total landings in the previous years, to include a complete time series of discards in the analysis. Italian ALKs were used to convert length frequency distributions from the Croatian fleet into catch at age data.

The growth parameters used are the following:

Time series: 2006-2011

| Parameters | $L_\infty$ | k | $t_0$ | a | b |
|---|---|---|---|---|---|
| | 26.86 cm | 0.295 y- | -1.1 | 0.009 | 3.076 |

The M vector by length was obtained from ProdBiom (Abella et al. 1997):

Time series: 2006-2011

| Age | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| M | 1.60 | 0.84 | 0.37 | 0.29 | 0.26 |

MEDITS abundance indices have been used to tune the XSA analysis. The numbers at age were obtained slicing the numbers at length in the survey with ALKs from Italian commercial samplings.

**Assessment method:** Length cohort analysis (LCA) and Extended Survivor Analysis (XSA).

**Model performance:** This is the first time an XSA assessment for red mullet has being carried out in GSA 17. The present XSA assessment has to be considered as a preliminary and an experimental one since there are still adjustment to do and since the statistic for q should be improved. For example, a power time weighting has been applied since there were convergence problem: nevertheless, this is usually uncommon for short time series. Besides, the number at age obtained can be improved by using monthly ALKs. The Working group believes this assessment has to be considered in conjunction with the LCA output and the indications given from the MEDITS data.

**Results:** MEDITS: the signals coming from the MEDITS survey are all positive, with a stable biomass and a really high recruitment estimated for the 2012. **LCA**: The stock biomass at the beginning of the year estimated for 2011 is 23,954 t, while the average biomass at sea is 4,293 t. The bulk of the catches is concentrated between 9 and 15 cm. The estimated F for red mullet in 2011 reaches very high value for the Italian fleet (up to 2), in particular for specimens between 15 and 17 cm, while the fishing mortality estimated for the Croatian fleet not only increases for much bigger individuals (from 17 cm), but it remains also at lower values. **XSA**: SSB follow a slight decreasing trend starting in 2008 from 9000 t to 6300 t in 2011. Similar considerations can be applied to the trend in total biomass, which decreased

from 50000 t in 2008 to 25000 tonnes in 2011. The recruitment increases from 2009 to 2011, reaching the value of 1400000 thousands. $F_{bar}$ (ages 1 to 3) shows a fluctuating pattern, with a maximum in 2008 ($F_{bar}$ = 0.734). Since 2009 the F is slightly increasing and reaches a value of 0.54 in 2011.

**Diagnose of Stock status:** $F_{0.1}$ and $F_{max}$ were estimated by the means of a Yield per recruit analysis (YPR) and are equal respectively to 0.234 and 0.408. The $F_c$ is equal to 0.864. The exploitation rate (age 0-4) from the XSA analysis for 2011 is lower than 0.5

**Advices and recommendations:** LCA analysis evidenced the different fishing patterns of the two fleets, which is also determined by the behavior of the species. The Italian fleet is clearly targeting recruitment; besides, the $F_c$ for the Croatian fleet is between $F_{0.1}$ and $F_{max}$ while the $F_c$ for the Italian fleet is above both reference points, showing a possible situation of growth overfishing. Nevertheless, an exploitation rate (F/Z) of 0.4-0.5 is on the safer side for a demersal stock.

The fishing mortality is high on part of the stock and the biomass trends are rather stable. Taking into account the different exploitation pattern, it could be wise to reduce the fishing mortality on the recruitment and this could be obtained by a prolongation of the closed season for trawling along the Western Adriatic coast where in autumn age 0 recruits born in summer are concentrated.

**Discussion:** High fluctuations with exceptional year with very strong recruitment are an established feature of the *Mullus barbatus* stock in the Adriatic Sea. There is a discrepancy of trends between the XSA results and the MEDITS data on the total biomass estimates and on the SSB estimates: the spawning stock biomass and the stock biomass are decreasing in the last year in XSA, and the recruitment sees an increase in the last couple of years, whilst the signals coming from the MEDITS survey are all positive, with a stable biomass and a really high recruitment estimated for the 2012. Nevertheless, due to the discrepancy between the XSA results and the signals from the MEDITS survey, and due to the uncertainty in the model settings the WG is not able to give advice and this should be considered as a preliminary assessment.

## PRESENTATION AND DISCUSSION OF ASSESSMENT RELATED WORKS

17. There was 1 presentation of assessment-related work, prepared by CopeMed II: "Advances in preparing a joint assessment of European hake, *Merluccius merluccius*, stock for GSAs 01, 02, 03 and 04 of the GFCM (Algeria, Morocco and Spain).

European hake, *Merluccius merluccius*

**GSA:** 01, 02, 03 and 04

**Author(s)**: Benchoucha S., Pérez Gil J.L., Ainouche N., Jarbui O., Baro J., Elouamari N., Ben Meriem S., Hamida C., García T., Bernardon M., Camiñas J.A. and Fernández I.d.L.

**Fishery:** Due to its market value, production and its wide distribution in several Mediterranean countries, the European hake (*Merluccius merluccius*) is a major shared resource in the Alboran Sea (GSAs 01, 02, 03 and 04). *M. merluccius* is a demersal species

characterized by a wide depth distribution, being found at depths ranging, highly appreciated by fishermen and consumers. It is a key species in the trophic chain occupying a high position among the predators of the demersal community. In Algeria, in 2010, the total number of trawlers was 502. The greater part of the European hake production is provided by trawlers. In 2010, the *M. Merluccius* production by trawl was 270 t, which represents 93% compared to 18.537 t landed by artisanal fleet. In Morocco, the number of trawlers operating is 115. The port of Nador is the most important in terms of *M. merluccius* production. In the period 2003-2011, the mean annual *M. merluccius* production was 218 t. Two peaks in 2000 and 2006 with productions of 464 and 547 t were observed. In Spain there is not a fishery targeting *M. merluccius* in GSA 02. Annual landings from GSA 02 represented about 1% of the total landings (all species). The number of trawlers targeting *M. merluccius* in GSA 01 was 134. In the period 2002-2011, the average annual landings of this species were 448 t. The port of Almeria had the largest number of boats with an average of 40 units.

**Data and parameters:** Relevant data issues discussed were data availability in terms of fisheries characteristics, catch, effort, biological length at maturity and demographic parameters as length frequency structure, biomass and abundance (from trawl surveys). Trends in landings, availability and frequency of national statistics, studies conducted on the species in each country, importance of the by-catch, socioeconomic information of *M. Merluccius* fishery and stocks assessment methodologies were debated. The SG agreed on using available data from Morocco and Spain (2007-2010) for running the software VIT for the *M. merluccius* stock assessment exercise. The SG decided not to include Algerian data in the analysis as only information from 2012 was available. The length cohort (LCA) and a yield per recruit (Y/R) analysis using a mean pseudo-cohort (2007-2011, GSAs 01 and 03). Tree values of f terminal were used (0.5, 1 and 1.5). The value of 0.5 was used for running a yield pre recruit and SSB per recruit.

**Assessment method:** For lengthy frequencies (GSA 01+03, period 2007-2010), the methodology applied was the software VIT.

**Model performance:** The VIT gave a good tendency for the *Merluccius merluccius* stock status.

**Results:**
VIT

| Reference Point | F | YPR | SSBR |
|---|---|---|---|
| $F_0$ | 0 | 0 | 18.3633 |
| $F_{0.1}$ | 0.488 | 2.35 | 5.9798 |
| $F_{max}$ | 0.8399 | 2.5201 | 3.4602 |
| $F_{40\%SSB}$ | 0.3746 | 2.1657 | 7.4604 |
| $F_c$ | 1.148 | 2.4798 | 2.5 |

**Diagnosis of stock status:** The actual level of fishing mortality ($F_c$ = 1.148) is higher than $F_{0.1}$ = 0.48 which indicates that the stock is in overfishing status.

**Advices and recommendation** (in terms of research and, when possible in terms of management):

- To reduce by 50% the fishing mortality in the current trawl fishery.

- To perform joint genetic analysis and research on *M. merluccius* in Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04) to identify if there is a single common *M. merluccius* shared stock.
- To complete the information on *M. merluccius* stock in Algerian GSA 04 to join Algerian data to the GSAs 01 and 03 to cover all the study area.
- To improve the national database it was stressed that monthly biological data from Algeria and Morocco on length-frequency distribution at landing are necessary for the assessment and should be provided for the next meeting of the SG. If necessary, partial support of CopeMed II could be provide to complete some series.
- The organization of a meeting with the Sicily Strait area (CopeMed and MedSudMed SG) to analyze the possibility in comparing the biological and fisheries data and performing a joint evaluation on the *M. merluccius* stock if possible.
- The SG agreed that biological and fisheries data in each country used for the assessment (biological parameters, demographic structure, etc.) should be uploaded to the CopeMed web (Regional Networks and databases).
- The next assessment should be based on VPA (not in equilibrium) tuned by effort data from commercial fleets and independent indices from surveys.
- To continue working in improving the data to carry out a *M. merluccius* joint stock assessment before the 2013 meeting of the WG of Demersal Species of the SCSA.

**Discussion:** It has been noticed that growth parameter from Morocco was very low.

The WG acknowledged the effort of this joint assessment and endorsed all the research recommendations.

## GENERAL COMMENTS AND REMARKS

Gathered from the discussions held during the sessions after each stock presentation, the following general comments and remarks were summarized and reported here as they can be applicable to all current and future assessments.

18. When advising a reduction of a certain percentage in fishing mortality to reach agreed value of reference point this reduction should not be directly translated to a reduction of the same percentage of fishing effort as the assumption of proportionality is not always met. The WG considered more appropriate to propose fishing effort reduction through multiannual management plans and always taking into consideration the socio-economic impact of the proposed measures.

19. The fact that MEDITS survey is only carried once a year, may affect the accuracy on the recruitment strength estimates by SURBA. The effect of removing age 0 data should therefore be checked, or at least the sensitivity of results to the weighting of this age.

20. Including a plot of the spawning stock biomass *vs.* recruitment, even with short time series can give some insight on the level of spawning stock biomass that ensures a “safe” recruitment.

## CONCLUSIONS AND RECOMMENDATIONS

21. Twenty-eight stock assessment done beforehand were revised by the Working Group. Four of them were considered preliminary and 24 were validated by the working group, all of which were assessed as in overfishing status. One of the stocks assessed was, for the first time a Lessepsian species commercialized in Egypt (*Saurida undosquamis*). Three of the 28 stocks belong to the Black Sea area. A Summary Table is presented as Appendix D to this report.

22. A thorough revision of the Stock Assessment Forms was undertaken by the working group and substantial amendments were proposed that are gathered in the new version included as Appendix E to this report.

23. The utilization of the GFCM SharePoint has been proved as a very useful tool to transmit information in both directions from the participants to the coordinator and either way. All efforts must be put on the improvement of the quality of data that are becoming part of this new information portal. The initiative was welcome by the Group and recommendation to continue using it to finalize the report and to keep it as a continuous source of information was done although some participants expressed their wish to keep the full data sets contained by the new SAFs with a certain level of accessibility and expressed concern about publishing them in the GFCM website as it has been regularly done in the past.

24. The way the scientific advice is provided in the Stock Assessment Form (SAFs) was discussed and a new proposal was done that takes into consideration the need for ranking the stock status both based on fishing mortality as well as on biomass level. The resulting proposals are listed below and the final accepted format was included in the last page of the stock assessment form template in Appendix E. It is recommended that after adoption by the Subcommittee on Stock Assessment and the SAC be used starting in 2013.

25. **On the framework for empirical reference points on relative level of biomass:**
Since most of assessments were based on yield per recruit analyses, very few analytical biomass based reference points ($B_{MSY}$ or $B_{0.1}$) were estimated.

In order to create an evaluation framework that take into consideration the level of stock biomass, the WG recommended to analyze the time series of biomass indices either from scientific surveys or CPUEs from commercial fisheries to look for a quantitative basis to assess whether abundance is low or not. This analysis could be useful in assessing the trend of standing stock and in this respect the WG recommended the use of 33$^{rd}$ percentile of time series of biomass indices as empirical reference value of an indicator of current level of biomass at sea (Halliday et al. 2001; Ungaro et al. 2006; Caddy 2010).

In particular:

- Values lower or equal to the 33$^{rd}$ percentile of biomass index in the time series will be considered as with relative low biomass (**L**).
- Values falling within this limit and 66$^{th}$ percentile will be considered as with relative Intermediate biomass (**I**)
- Values higher than the 66$^{th}$ percentile will be considered as with relative high biomass (**H**)

The above thresholds are proposed as provisional reference values framework to evaluate the current relative level of stock biomass index. When the index of a given year is below the 33rd percentile the stock is assessed as overfished. This reference value will be updated accordingly on an annual basis.

26. **On the assessment of level of overfishing:**
Due to the fact that most of stocks are evaluated by a yield per recruit analysis, few classical biological reference points are used in WG assessments. The agreed criteria to assess a stock status according to fishing mortality stated that a stock is in overexploitation if the current F is higher than the $F_{0.1}$. Considering that most of the demersal stocks were assessed as in overexploitation status, the need to rank the different levels of overexploitation or overfishing was raised.

When $F_{0.1}$ (the agreed proxy of $F_{MSY}$) from a Y/R model is used as Limit Reference Point (LRP), the following provisional operational approach is proposed:

- If the ratio $F_c/F_{0.1}$ is below or equal to 1.33 the stock is in light overfishing status (**LO**);
- If the ratio $F_c/F_{0.1}$ is between 1.33 and 1.66 the stock is in intermediate overfishing status (**IO**);
- If the ratio $F_c/F_{0.1}$ is equal or above to 1.66 the stock is in high overfishing status (**HO**).

27. **On the use of VIT combining years or on a yearly basis:**
Concerning the use of pseudo-cohort approach in stock assessment (for example the VIT package), the group proposed that the previous recommendation of this WG (from 2010) to lump data of several years would be revised and further discussed. In cases suspected to be in overexploitation, yearly VIT estimates should be used as an exploratory phase, as supported by literature (Rätz et al. 2010) and by experiences gathered by WG. This approach allows evaluating the stock status by considering the variability of parameters by year during the whole study period and identifying anomalies or changes in recruitment or exploitation patterns.

28. **On the use of XSA and VPA in general:**
Virtual Population Analysis (VPA) works better when applied on long time series. As it converges back in time, the older parts of the time series estimates (e.g., fishing mortality) are more reliable than those of more recent years. However, it is on the last ones that the fisheries scientist are more interested. It is therefore important to check the stability of estimates and their sensitivity to the parameters used to tune the VPA. Running the VPA with various reasoned combinations of parameters helps to decide on which one to use for the final run. Particularly shrinkage parameters have a great effect on the recent years estimates thus, sensitivity tests should be done for this parameter. There is no formal minimal number of years to use for the VPA, but it makes sense to use data that are long enough to cover a full-convergent period. As a rule of thumb, it was suggested to use data that, at least, span more years than the older age in the catch at age matrix. The VPA user manual and other guidelines such as those from FAO: http://www.fao.org/docrep/003/x9026e/x9026e00.htm provide a more detailed description on how to check the validity and the reliability of the analysis carried out using the VPA, such as the retrospective analysis.

29. **On the use of surplus production models:**
In cases for which data are not structured (length/age), and if available time series is long enough to gather contrasts reflecting substantial changes in fishing effort, the use of surplus production models can be an alternative or complementary approach to the diagnosis in data poor contexts.

30. **On the stock unit identification:**
The WG recommended giving attention to stock unit aspect when assessing stock status. The need to improve the knowledge on the stock boundaries and its relation with the GSA in the Mediterranean was stressed.

31. **On the description of the fleet:**
When recent management measures (destruction of boats, temporary closures for trawlers) that may affect the overall effort are being enforced, an informative comment or note should be included in the description of the fishery within the stock assessment forms.

## DATE AND VENUE FOR THE NEXT MEETING:

32. As venue for next year meetings two countries were proposed, Morocco and Spain. After thanking the Spanish authorities for the proposal, the group decided to accept Morocco as it would represent a geographically more balanced choice after two consecutive years (2011-2012) in northern countries. Nevertheless Spain was retained for 2014 venue or as second option for 2013 in case that Morocco has some difficulty. The offer was kept open for the following two weeks, in case that another member state would intend to present its candidacy.

## ADOPTION OF THE REPORT/RECOMMENDATIONS

33. All Conclusions and Recommendations were adopted by the Working Group on the 9$^{th}$ of November 2012. The whole report was adopted after revisions and amendments by electronic correspondence within the following two weeks.

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**Appendix A**

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**Appendix B**

## Terms of Reference
## for the SCSA Working Groups on Stock Assessment
## for Demersal and Small Pelagic Species

One of the objectives of the Sub-Committee on Stock Assessment (SCSA) is to progress in the enhancement of joint practical stock assessment. "Joint" refers to the participation of scientists from different countries providing their data and sharing them with their colleagues, using a standard method and analyzing together the results and options for fisheries management.

The main objective of the annual meetings of the two Working Groups is to give advice on those stocks that are well assessed, "well" meaning agreed by the group on the type of data, on the parameters used and on the methodology applied. Specifically, the group will, on a stock by stock basis:

1. Analyze the data sets provided by the participants (Sampling frequency, time series, age structured, commercial vs. surveys data, etc.)
2. Check parameters used and methodology applied on the assessments already done "at home".
3. Resume the performance of the methods through sensitivity tests and residuals analysis.
4. Run stock assessments on the cases not previously done with the data sets available and with the agreed methodology on a practical session.
5. Get the actual values of the biological reference points (BRP) and compare with those agreed at the 13$^{th}$ SAC meeting, namely $F_{MSY}$ or its proxy $F_{0.1}$ as the Target Reference Point and $F_{max}$ as provisional Limit Reference Point.
6. In cases where BRP cannot be obtained use an empirical approach based on standing stock as stock status indicator, the harvest ratio (catch/biomass from survey) as fishing impact, and some indicators (SST, Chlorophyll, condition factor, etc.) of environmental stress.
7. Produce diagnoses on the status of the stocks.
8. Present and discuss assessment related works.
9. Complete the filling up of the SCSA stock assessment forms including, when available, those for direct methods.
10. Evaluate the new assessment forms provided this year, in relation to the recommendations provided by the 2011 Assessment Working Groups and the SAC.
11. Suggest management advice to the SAC considering different alternatives

**Appendix C**

## Agenda

### Monday 5 November 2012

*Morning Session, 9:00-13:00*

1. **Opening session (joint session for the two Working Groups on Demersal and Small Pelagic Species)**
   - Opening, arrangement of the meetings
   - Logistical aspects
   - Presentation of the new Stock Assessment forms
   - Structure of the report

2. **Introductory session**
   - Adoption of the agenda
   - Nomination of WG Coordinator and rapporteur(s)
   - Review of last year conclusions and recommendations

3. **Presentation and discussion of draft assessments** (presentations by national experts, about 15 min each, followed by 15 minutes of discussion)
   - 4 presentations: Hake in GSA 01, GSA 05, GSA 07 and GSA combined 12-16.

*Afternoon Session, 14:30-17:30*

**(*Cont'*) Presentation and discussion of draft assessments**
- 3 presentations: hake in GSA 18 and in GSA 06, sole in GSA 17

**(*Cont'*) Presentation and discussion of draft assessments**
- 2 presentations: common pandora in GSA combined 15-16 and blackspot seabream in GSA combined 1-3

### Tuesday 6 November 2012

*Morning Session, 9:00-13:00*

**(*Cont'*) Presentation and discussion of draft assessments**
- 4 presentations: stripped red mullet in GSAs 05, red mullet in GSA 07, in GSA combined 15-16 and in GSA 17

**(*Cont'*) Presentation and discussion of draft assessments**
- 4 presentations: red shrimp in GSA 05 (Catalonia), in GSA 05 (full area) and in GSA 06, deep water rose shrimp in GSA 06

*Afternoon Session, 14:30-17:30*

**(*Cont'*) Presentation and discussion of draft assessments**
- 4 presentations: deep water rose shrimp in GSA combined 01-04, in GSA combined 12-16, and in GSA 18, Norway lobster in GSA 05

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Lunch break: 13:00 – 14:30
Coffee breaks: 10:30-11:00 and 16:00-16:30

(*Cont'*) **Presentation and discussion of draft assessments**

- 4 presentations: mantis shrimp in GSA 17, lizard in GSA 26, blackbellied angler GSA combined 15-16 and in GSA 07

**Wednesday 7 November 2012**

*Morning Session, 9:00-13:00*

(*Cont'*) **Presentation and discussion of draft assessments**

- 3 presentations: spiny dogfish in GSA 29, whiting in GSA 29, turbot in GSA 29

4. **Presentation and discussion of assessment related works**
   - 1 presentations: hake in GSA 01-04.

*Afternoon Session, 14:30-17:30*

5. **Comments on the new Stock Assessment Forms, review and suggestions**

6. **Practical session to finalize individual reports and SAFs**

**Thursday 8 November 2012**

*Morning Session, 9:00-13:00*

(*Cont'*) **Practical session to finalize individual reports and SAFs**

*Afternoon Session, 14:30-17:30*

(*Cont'*) **Practical session to finalize individual reports and SAFs**

**Friday 9 November 2012**

*Morning Session, 9:00-13:00*

7. **Formulation of conclusions, recommendations and management advices to be transmitted for the consideration by the SCSA and SAC** (preparation of draft report)

*Afternoon Session, 14:30-17:30*

8. **Closing Session**
   - Any other matter
   - Adoption of the draft Report
   - Date and venue of the next meeting

Lunch break: 13:00 – 14:30
Coffee breaks: 10:30-11:00 and 16:00-16:30

**Appendix D**

## Summary Table of Stocks Assessed

| N° | GSA | Species | Yrs data | Methodology | Stock status | $F_{curr}/F_{0.1}$ |
|---|---|---|---|---|---|---|
| 1 | 01 | *Merluccius merluccius* | 2003-2011 | LCA, XSA, Y/R | In overfishing | 5.4 |
| 2 | 05 | *M. merluccius* | 2000-2011 | XSA, Y/R | In overfishing | 9.1 |
| 3 | 06 | *M. merluccius* | 1999-2011 | XSA, Y/R, FLR predictions | In overfishing | 10.0 |
| 4 | 07 | *M. merluccius* | 1998-2011 | XSA, Y/R | In overfishing | 11.2 |
| 5* | 12-16 | *M. merluccius* | 2010-2011 | LCA, Y/R | In overfishing | 3.6 |
| 6 | 18 | *M. merluccius* | 1996-2011 | SURBA, Y/R, LCA | In overfishing | 4.4 |
| 7 | 15-16 | *Pagellus erythrinus* | 2006-2011 | LCA, XSA | In overfishing | 2.4 |
| 8 | 17 | *Solea solea* | 2004-2011 | VPA, XSA, SURBA, Statistical Catch at Age using SS3 | In overfishing | 5.5 |
| 9 | 01, 03 | *Pagellus bogarveo* | 2009-2011 | LCA, Y/R, Depletion-Corrected Average Catch (DCAC) | In overfishing | 1.7 |
| 10 | 05 | *Mullus surmuletus* | 2000-2011 | XSA, Y/R | In overfishing | 3.1 |
| 11 | 07 | *M. barbatus* | 2004-2011 | XSA, Y/R | In overfishing | 2.5 |
| 12 | 15-16 | *M. barbatus* | 2006-2011 | XSA, SURBA | In overfishing | 2.9 |
| 13* | 07 | *Lophius budegassa* | 2009-2011 | LCA/XSA | In overfishing | 3.3 |

| Nº | GSA | Species | Yrs data | Methodology | Stock status | $F_{curr}/F_{0.1}$ |
|---|---|---|---|---|---|---|
| 14 | 15-16 | *L. budegassa* | 2002-2011 | VPA, Y/R, SURBA | In overfishing | 1.9 |
| 15 | 26 | *Saurida undosquamis* | 2002-2012 | LCA, Y/R | In overfishing | 2.0 |
| 16 | 05 | *Aristeus antennatus* | 1992-2011 | LCA, XSA, VPA, Y/R | In overfishing | 3.9 |
| 17 | 06 (partial) | *A. antennatus* | 2008-2010 | LCA, Y/R | In overfishing | 2.4 |
| 18 | 06 | *A. antennatus* | 1996-2011 | LCA, VPA, Y/R, XSA | In overfishing | 2.1 |
| 19* | 01, 03 and 04 | *Parapenaeus longirostris* | 2003-2011 | Dynamic Production Schaefer Model, LCA-VPA | In overfishing | 2.4 |
| 20 | 06 | *P. longirostris* | 2001-2011 | VPA, XSA | In overfishing | 3.2 |
| 21 | 12-16 | *P. longirostris* | 2007-2011 | VPA, XSA | In overfishing | 1.3 |
| 22 | 18 | *P. longirostris* | 2008-2011 | LCA, Y/R | In overfishing | 2.1 |
| 23 | 05 | *Nephrops norvegicus* | 2001-2011 | LCA, VPA, Y/R, XSA | In overfishing | 3.3 |
| 24 | 17 | *Squilla mantis* | 2007-2011 | VPA, Y/R | In overfishing | 1.9 |
| 25 | 29 | *Squalus acanthias* | 1989-2011 | YPR-LEN | In overfishing | 1.2 |
| 26 | 29 | *Merlangius merlangus euxinus* | 2000-2011 | YPR-LEN | In overfishing | 1.1 |
| 27 | 29 | *Psetta maxima* | 1970-2010 | XSA under FLR, Y/R | In overfishing | 3.5 |
| 28* | 17 | *M. barbatus* | 2006-2011 | LCA/XSA | In overfishing | 3.7 |

**Preliminary (not validated by the Working Group)*

**Appendix E**

# Stock Assessment Form (revised version)

# 1 Basic Identification Data

| Scientific name: | Common name: | ISCAAP Group: |
|---|---|---|
| Acipenser gueldenstaedtii | [Species Common Name] | [ISCAAP Group] |
| **1st Geographical sub-area:** | **2nd Geographical sub-area:** | **3rd Geographical sub-area:** |
| 1 - Northern Alboran Sea | [GSA_2] | [GSA_3] |
| **4th Geographical sub-area:** | **5th Geographical sub-area:** | **6th Geographical sub-area:** |
| | | |
| **1st Country** | **2nd Country** | **3rd Country** |
| [Country_1] | [Country_2] | [Country_3] |
| **4th Country** | **5th Country** | **6th Country** |
| | | |
| **Stock assessment method: (direct, indirect, combined, none)** | | |
| | | |
| **Authors:** | | |
| [Authors] | | |
| **Affiliation:** | | |
| | | |

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

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

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

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

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

# 2 Stock identification and biological information

Specify whether the assessment is considered to cover a complete stock unit. If the stock unit limits are more or less known, but for technical reasons the assessment only covers part of the stock (e.g. a GSA area but stock spreads to other GSAs), explain the state of the art of the stock unit knowledge. If there are doubts about the stock unit, state them here. If there is knowledge on migration rates between different stock units that affect the stock state them here.

## *2.1 Stock unit*

## *2.2 Growth and maturity*

Incorporate different tables if there are different maturity ogives (e.g. catch and survey). Also incorporate figures with the ogives if appropriate. Modify the table caption to identify the origin of the data (catches, survey). Incorporate maps of spawning and nursery areas if available.

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

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

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

| Size/Age | Natural mortality | Proportion of matures |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| … | … | … |

*Table 2-2.3: M vector and proportion of matures by size or age (Females)*

| Size/Age | Natural mortality | Proportion of matures |
|---|---|---|
| | | |
| | | |
| | | |
| … | … | … |

*Table 2-3: Growth and length weight model parameters*

| | | Sex | | | | |
|---|---|---|---|---|---|---|
| | | Units | female | male | Combined | Years |
| Growth model | $L_\infty$ | | | | | |
| | K | | | | | |
| | $t_0$ | | | | | |
| | Data source | | | | | |
| Length weight relationship | a | | | | | |
| | b | | | | | |
| | M (scalar) | | | | | |
| | sex ratio (% females/total) | | | | | |

# 3 Fisheries information

## *3.1 Description of the fleet*

This information should be consistent with the information provided in Task 1. In later versions of the stock assessment form, the tables will be pre-filled with the information from Task 1 and participants have to check for differences and report them. Also the SCSI recommends that fishing gears of the different operational units are described in detail (e.g. mesh size, etc.)

Same codes as in previous assessment forms should be used.

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

| | Country | GSA | Fleet Segment | Fishing Gear Class | Group of Target Species | Species |
|---|---|---|---|---|---|---|
| **Operational Unit 1*** | [Country1] | [GSA1] | [Fleet Segment1] | [Fishing Gear Class1] | [ISCAAP Group] | Acipenser gueldenstaedtii |
| **Operational Unit 2** | [Country2] | [GSA2] | [Fleet Segment2] | [Fishing Gear Class2] | [ISCAAP Group] | Acipenser gueldenstaedtii |
| **Operational Unit 3** | [Country3] | [GSA3] | [Fleet Segment3] | [Fishing Gear Class3] | [ISCAAP Group] | Acipenser gueldenstaedtii |
| **Operational Unit 4** | [Country4] | [GSA4] | [Fleet Segment4] | [Fishing Gear Class4] | [ISCAAP Group] | Acipenser gueldenstaedtii |
| **Operational Unit 5** | [Country5] | [GSA5] | [Fleet Segment5] | [Fishing Gear Class5] | [ISCAAP Group] | Acipenser gueldenstaedtii |
| **Operational Unit 6** | [Country6] | [GSA6] | [Fleet Segment6] | [Fishing Gear Class6] | [ISCAAP Group] | Acipenser gueldenstaedtii |

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

| Operational Units* | Fleet (n° of boats)* | Kilos or Tons | Catch (species assessed) | Other species caught | Discards (species assessed) | Discards (other species caught) | Effort (units) |
|---|---|---|---|---|---|---|---|
| [Operational Unit1] | | | | | | | |
| [Operational Unit2] | | | | | | | |
| [Operational Unit3] | | | | | | | |
| [Operational Unit4] | | | | | | | |
| [Operational Unit5] | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Total** | | | | | | | |

## *3.2 Historical trends*

Time series analysis with tables and figures showing the observed trends in catches, landings, fishing capacity or effort .

## *3.3 Management regulations*

List current and past (recent) management regulations that affect the different operational fleets and/or the whole fishery.

## *3.4 Reference points*

*Table 3.3-1: List of reference points and empirical reference values previously agreed (if any)*

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

# 4 Fisheries independent information

## *4.1 {Type OF SURVEY}*

Fill in one section for each of the direct methods used. The name of the section should be the name of the TYPE OF SURVEY.

### 4.1.1 Brief description of the direct method used

Description of the survey and method applied. One of several tables would have to be chosen: Egg Production Method, Acoustic survey, Trawl.

## *Direct methods: trawl based abundance indices*

*Table 4.1-1: Trawl survey basic information*

| | | | |
|---|---|---|---|
| **Survey** | | **Trawler/RV** | |
| **Sampling season** | | | |
| **Sampling design** | | | |
| **Sampler (gear used)** | | | |
| **Cod –end mesh size as opening in mm** | | | |
| **Investigated depth range (m)** | | | |

*Table 4.1-2: Trawl survey sampling area and number of hauls*

| **Stratum** | **Total surface ($km^2$)** | **Trawlable surface ($km^2$)** | **Swept area (km2)** | **Number of hauls** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| **Total (… – … m)** | | | | |

Map of hauls positions

*Table 4.1-3: Trawl survey abundance and biomass results*

| Stratum | Years | kg per $km^2$ | CV or other | N per $km^2$ | CV or other |
|---|---|---|---|---|---|
| | …… | | | | |
| | …… | | | | |
| | …… | | | | |
| | …… | | | | |
| | …… | | | | |
| **Total (… – … m)** | …… | | | | |

* with catchability coefficient assumed =1

Comments

- Specify the other index of variability of mean
- Specify sampling design (for example random stratified with number of haul by stratum proportional to stratum surface; or systematic on transect;…)

## Direct methods: trawl based length/age structure of population at sea

*Slicing method*

Report the maturity scale and age slicing method used

*Table 4.1-4: Trawl survey results by length or age class*

| N (Total or sex combined) by Length or age class | **Year** | | |
|---|---|---|---|
| | **….** | **….** | **…..** |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Total** | | | |

| Sex ratio by Length or age class | **Year** | | |
|---|---|---|---|
| | **….** | **….** | **…..** |
| | | | |
| | | | |
| | | | |
| | | | |
| **Total** | | | |

Comments

- Specify if numbers are per $km^2$ or raised to the area, assuming the same catchability .
- In case maturity ogive has not been estimated by year, report information for groups of years.
- Possibility to insert graphs and trends

## Direct methods: trawl based Recruitment analysis

*Table 4.1-5: Trawl surveys; recruitment analysis summary*

| **Survey** | | **Trawler/RV** | |
|---|---|---|---|
| **Survey season** | | | |
| **Cod –end mesh size as opening in mm** | | | |
| **Investigated depth range (m)** | | | |
| **Recruitment season and peak (months)** | | | |
| **Age at fishing-grounds recruitment** | | | |
| **Length at fishing-grounds recruitment** | | | |

*Table 4.1-6: Trawl surveys; recruitment analysis results*

| **Years** | **Area in $km^2$** | **N of recruit per $km^2$** | **CV or other** |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Comments

- Specify type of recruitment:
  - continuous and diffuse
  - discrete and diffuse
  - discrete and localised
  - continuous and localised.
- Specify the method used to estimate recruit indices

- Specify if the area is the total or the swept one
- Possibility to insert graphs and trends

## Direct methods: trawl based Spawner analysis

*Table 4.1-7: Trawl surveys; spawners analysis summary*

| | | | |
|---|---|---|---|
| **Survey** | | **Trawler/RV** | |
| **Survey season** | | | |
| **Investigated depth range (m)** | | | |
| **Spawning season and peak (months)** | | | |

*Table 4.1-8: Trawl surveys; spawners analysis results (Column removed)*

| **Surveys** | **Area in km$^2$** | **N (N of individuals) of spawners per km$^2$** | **CV or other** | **SSB per km$^2$** | **CV or other** |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Comments

- Specify type of spawner:
  - total spawner
  - sequential spawner
  - presence of spawner aggregations
- Specify if the area is the total or the swept one
- Possibility to insert graphs e trends

### 4.1.2 Spatial distribution of the resources

Include maps with distribution of total abundance, spawners and recruits (if available)

### 4.1.3 Historical trends

Time series analysis (if available) and graph of the observed trends in abundance, abundance by age class, etc. for each of the directed methods used.

# 5 Ecological information

## 5.1 Protected species potentially affected by the fisheries

A list of protected species that can be potentially affected by the fishery should be incorporated here. This should also be completed with the potential effect and if available an associated value (e.g. bycatch of these species in tn)

## 5.2 Environmental indexes

If any environmental index is used as i) a proxy for recruitment strength, ii) a proxy for carrying capacity, or any other index that is incorporated in the assessment, then it should be included here.

Other environmental indexes that are considered important for the fishery (e.g. that may affect catchability, etc.) can be reported here.

# 6 Stock Assessment

In this section there will be one subsection for each different model used, and also different model assumptions runs should be documented when all are presented as alternative assessment options.

## *6.1 {Name of the Model}*

### 6.1.1 Model assumptions

### 6.1.2 Scripts

If a script is available which incorporates the stock assessment run (e.g. if using FLR in R) it should be provided here in order to create a library of scripts.

### 6.1.3 Input data and Parameters

For analytical models: catch matrix in lengths or ages (see the example below for age). Specify if catch includes discards

| | **Catch-at-age (thousands)** | | | | | |
|---|---|---|---|---|---|---|
| Age class | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| 0 | 3341.40 | 4910.60 | 3802.40 | 5038.00 | 2259.70 | 1694.70 |
| 1 | 12424.30 | 22450.20 | 23198.00 | 12214.20 | 4095.70 | 5262.40 |
| 2 | 9114.20 | 9817.60 | 8351.40 | 7186.50 | 4849.10 | 4656.30 |
| 3 | 765.86 | 482.89 | 353.26 | 506.52 | 379.20 | 285.98 |
| 4 | 44.20 | 17.37 | 16.79 | 30.43 | 33.35 | 15.46 |
| 5+ | 0.05 | 0.26 | 0.23 | 0.04 | 0.02 | 0.01 |

Tuning data

| | **Catch-at-age (thousands)** | | | | | |
|---|---|---|---|---|---|---|
| Age class | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| 0 | | | | | | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5+ | | | | | | |

If it is the case add a table per gear (i.e. VIT)

Add a table with input parameters and model settings

### 6.1.4 Results

Tables and graphs of Total biomass, SSB, Recruitment, F or other outcomes of the stock assessment model with comments on trends in stock size, recruitment and exploitation.

### *6.1.5 Robustness analysis*

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

### *6.1.6 Assessment quality*

Stability of the assessment, evaluation of quality of the data and reliability of model assumptions.

# 7 Stock predictions

When an analytical assessment exists, predictions should be attempted. All scenarios tested (recruitment and/or fishing mortality) should be reported. The source of information/model used to predict recruitment should be documented.

## 7.1 Short term predictions

## 7.2 Medium term predictions

## 7.3 Long term predictions

# 8 Draft scientific advice

**(~~examples~~Examples in blue)**

| | Indicator | Analytic al reference point (name and ~~figure~~value) | Current value from the analysis (name and ~~figure~~value) | Empirical reference value (name and ~~figure~~value) | Trend (time period) | Status |
|---|---|---|---|---|---|---|
| **Fishery** | Fishing mortality | ($F_{0.1}$, = value, $F_{max}$= value) | | | N | |
| | Fishing effort | | | | D | $O_L$ |
| | Catch | | | | | |
| | | | | | | |
| **Stock** | Biomass | | | $33_{th}$ percentile | | O |
| | SSB | | | | | |
| Final Diagnosis | | In overfishing (~~unsustainable~~ level of fishing mortality higher than the value of the agreed target reference point) and overfished (~~very low~~ ~~r~~relative level of biomass below the value of the agreed ~~Limit~~ Reference Point) modulated by the three categories set for each.<br><br>Example: In intermediate level of overfishing and overexploited with low level of ~~b~~biomass | | | | |

State the rationale behind that diagnoses, explaining if it is based on analytical or on empirical references

## Trend category

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

## Stock Status

## Based on Fishery related indicators

1) **N - Not known or uncertain** – Not much information is available to make a judgment;

2) **U - undeveloped or new fishery** - Believed to have a significant potential for expansion in total production;
3) **S - Sustainable exploitation**- fishing mortality or effort below an agreed fishing mortality or effort based ~~Target~~ Reference Point;
4) **IO –~~–~~In Overfishing status**– fishing mortality or effort above the value of the ~~an~~ agreed fishing mortality or effort based ~~Limit (or target??)~~ Reference Point~~;~~ .An agreed range of overfishing levels is provided;
5) **C- Collapsed**- no or very few catches;

## Range of Overfishing levels

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

If Fc*/F0.1 is below or equal to 1.33 the stock is in **($O_L$): light overfishing**

If the Fc/F0.1 is between 1.33 and 1.66 the stock is in **($O_I$): intermediate overfishing**

If the Fc/F0.1 is equal or above to 1.66 the stock is in **($O_H$): high overfishing**

*Fc is current level of F

## Stock related indicators

1) **N - Not known or uncertain** – Not much information is available to make a judgment
2) **S–Sustainably exploited** - standing stock above a agreed biomass based Target Reference Point;
3) **O - Overexploited** -standing stock below the value of the agreed biomass based ~~Limit (or target??)~~Reference Point~~;~~.An agreed range of overexploited status is provided;
4) **D – Depleted** - Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering**- Biomass are again increasing after having been depleted from a previous;

## Empirical Reference framework for the relative level of stock biomass index

Values lower than or equal to 33$^{rd}$ percentile of biomass index in the time series –**relative low biomass**

Values falling within this limit and 66$^{th}$ percentile – **relative intermediate biomass**;

Values higher than the 66$^{th}$ percentile – **relative high biomass**

***Agreed definitions as per SAC Glossary***

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

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